

Differences in Environmental Control and Asthma Outcomes Among Urban Latino, African American, and Non-Latino White Families

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Latino and African American children with asthma are at increased risk for asthma morbidity compared with non-Latino White children. Environmental control (ie, environmental exposures and family strategies to control them) may contribute to greater asthma morbidity for ethnic minority children living in urban environments. This study examined ethnic differences in a semi-structured assessment of environmental control, associations between environmental control and asthma outcomes (asthma control, functional limitation, and emergency department [ED] use), and ethnic differences in environmental triggers in a sample of urban Latino, African American, and non-Latino White families. One hundred thirty-three children (6–13 years of age) and their caregivers completed demographic questionnaires, measures of asthma control and morbidity, and a semi-structured interview assessing environmental control. Reported environmental control differed significantly by ethnicity ($P < 0.05$), with Latino families reporting higher levels of environmental control. Reported environmental control was significantly associated with asthma control ($P < 0.017$) and functional limitation ($P < 0.017$). Reported environmental control and ED use were significantly associated in Latino families ($P < 0.05$). Non-Latino White and African American families reported more secondhand smoke exposure than Latino families ($P < 0.001$). Latino families reported more optimal home environmental control than other ethnic groups. Substantial ethnic differences in asthma triggers suggest that observed ethnic disparities in asthma may be due, at least in part, to differences in the home environment.

Introduction

HEALTH DISPARITIES WITHIN pediatric asthma are well documented.^{1,2} Latino and African American children have greater morbidity and mortality from asthma.³ Puerto Rican children experience worse asthma outcomes than any other Latino or ethnic group.⁴ Converging evidence suggests that exposure to environmental factors within the child's home (eg, tobacco smoke, mold, and dust mites) may contribute to these disparities.^{5,6} Urban households as compared with suburban and rural homes contain higher levels of environmental allergens and irritants, including mice and cockroach exposure.^{7,8} Secondhand tobacco smoke is an irritant for all children with asthma and is commonly found among urban households.⁹ A disproportionate number of African American and Latino families live in urban settings, where exposure to poverty and substandard housing is common.^{10,11}

Current national guidelines on the treatment of asthma highlight the importance of decreasing the presence of triggers within the family's home and, especially, the child's

bedroom.⁹ Few studies have examined ethnic differences in exposure to asthma triggers. As improving control of exposures within the home can be burdensome, it is important to elucidate how exposures may differ for urban families from different ethnic backgrounds. This might allow for more effective targeting of asthma trigger control efforts.

The first aim of our study was to examine ethnic differences in reported environmental control in a sample of urban non-Latino White, African American, and Latino (Puerto Rican and Dominican) families. We incorporated a semi-structured interview, based on the Family Asthma Management System Scale (FAMSS),¹² to assess reported environmental control. We define reported environmental control as "a child's exposure to environmental triggers" and "family strategies to control these exposures." This assessment is unique in that it takes into account not only asthma triggers that a child is exposed to daily, but also what actions the family has taken to minimize child exposure to these triggers. A second aim of our study was to examine associations between reported environmental control and asthma outcomes (eg, child asthma control, functional

limitation due to asthma, and emergency department [ED] visits due to asthma) in children from this sample. Finally, we examined ethnic differences in asthma triggers in the home.

Materials and Methods

Design and procedures

This study was approved by the Institutional Review Board of Rhode Island Hospital in Providence, Rhode Island. Families were recruited through a hospital-based ambulatory pediatric clinic, community-based primary care pediatric clinics in the greater Providence area, hospital-based asthma educational programs, public schools, and other school-based community events (eg, school fairs). Thirty-five percent of families contacted ($n=375$) were interested and eligible to participate in this study. Inclusion criteria included child between the ages of 6 and 13 years, parent report of physician-diagnosed asthma (ie, a doctor told parent that child has asthma), parent-reported child breathing problems in the last 12 months, child currently receiving asthma treatment as reported by parent, a participating legal guardian of the child, family living in an urban setting (1 of 5 adjacent urban areas in the Providence, RI, area, as verified by zip code), and parent ethnicity self-identified as Latino, non-Latino White, or African American. Exclusion criteria included moderate to severe cognitive impairment as determined by school placement (eg, special education), asthma symptoms occurring only during exercise, and being in foster care (due to informed consent restrictions).

Interested families were contacted via telephone and those who enrolled completed 2 research visits occurring 2 weeks apart. The first visit was an interview in the participant's home or at the research clinic, according to family preference. Children and their caregivers completed demographic questionnaires and measures of asthma morbidity. The second visit occurred in the family's home. Families completed measures of asthma control and a semi-structured interview regarding family asthma management. Research sessions were conducted in English or Spanish according to participant preference.

Measures

Background questionnaire (visit 1). Caregivers completed questions regarding child age and gender, family income, and parent and child ethnicity.¹³ Poverty was determined by dividing the family's annual income by the poverty threshold for a family of that size.¹⁴ This ratio was converted to a percentage such that those families at the poverty line had a score of 100%; scores above 100% reflected less poverty and scores below 100% indicated greater poverty.

Environmental control. The environmental control subscale from a semi-structured interview, the FAMSS,¹² was used to assess reported child exposure to environmental triggers and reported family efforts to control those exposures. The FAMSS interview consists of open-ended questions related to 8 areas of family asthma management (eg, adherence to medications and family knowledge of asthma) over the last year. Interviews are conducted by trained research assistants with the child and parent, audiotaped, and coded across each dimension according to a standardized coding system.¹² Scores range from 1 to 9, with higher scores indicating better family management. In the original validation study, overall summary scores and individual subscale scores demonstrated

convergent validity with self-report measures of parent asthma knowledge, child self-efficacy, and an objective measure of medication adherence.¹²

The key subscale of interest in this study, the FAMSS environmental control subscale, assesses child exposure to relevant triggers such as secondhand tobacco smoke, pets, and pests (eg, cockroaches), as well as family knowledge and implementation of trigger controls (eg, no pets and no smoking in home).¹² The interviewer begins this section of the FAMSS by stating, "There are several changes you can make in your home to help your child have fewer problems with wheezing, coughing, or shortness of breath. Please list for me what your doctor(s) have told you to change. What have you tried?" Families are also asked to describe the child's exposure to smoke in the home, family pets and whether they come inside or go in the child's bedroom, problems with pests in the home and how they have been addressed, and about the presence of carpeting in the child's room and in common living areas. Lower environmental control scores are indicative of higher levels of exposure to triggers in the home, as well as fewer reported family efforts to control trigger exposure.¹² The FAMSS environmental subscale has been validated with objective markers of environmental exposures, including cotinine, cat dander, and dog dander.¹⁵

Asthma control. Parents and children completed the Asthma Control Test (ACT).¹⁶ For children 6–11 years of age, the ACT was used with 4 items child completed and 3 items parent completed. Children 12–13 years old completed the 5 items of the ACT independently.¹⁶ Higher scores represent better asthma control. The ACT has been found to differentiate between groups of children based on lung function and asthma control as determined by a specialist.¹⁷ Using established clinical cut-off scores,^{18,19} children with a score of 19 or lower were classified as having "poor control," whereas scores above 19 were classified as "good control."

Asthma morbidity. Two indicators of asthma morbidity were utilized in this study, functional limitation due to asthma and ED visits over the last 12 months, and were determined from parent report of the Asthma Functional Severity Scale (AFSS).²⁰ Functional limitation is based on frequency of asthma episodes, frequency of symptoms between asthma episodes, intensity of limitation during an episode, and intensity of limitation between episodes over the past year. Scores range from 1 to 7, with higher scores indicating more functional limitation. If a parent indicated that the child had not been to the ED in the last 12 months, the response was coded as "0." A score of "1" was assigned if the child had had one or more visits to the ED over the last year. As a part of the AFSS, parents also reported whether the child was prescribed or not prescribed a controller medication.¹³

Statistical analysis

All analyses were performed using SPSS version 13.0 software (Statistical Product and Service Solutions 13.0; SPSS Inc., Chicago, IL). Analyses of variance assessed for differences in poverty level and environmental control across ethnic group. Correlational analyses, simple *t*-tests, and chi-square analyses were used to evaluate child age, poverty, recruitment site, and reported controller use (prescribed vs. not prescribed) as covariates in associations with environ-

mental control and asthma outcomes (control, functional limitation, and ED visits). Regression analyses were used to examine associations between environmental control and asthma outcomes, adjusting for covariates as appropriate. Chi-square analyses were used to assess for ethnic differences in the presence of asthma triggers. Pairwise chi-square analyses were utilized to determine where significant differences existed for any significant overall effects. To account for the possibility that significant associations between environmental control and asthma outcomes may be driven by differences on certain environmental exposures (eg, secondhand smoke), we explored associations between individual environmental exposures and outcome measures using chi-square and *t*-test analyses as appropriate. These follow-up analyses were performed on associations between reported environmental control and asthma outcomes that were significant in our original analyses. A *P* value of 0.05 was used to determine significance in all analyses except those examining associations between environmental control and our 3 outcome variables in the full sample. In these analyses, we adjusted our significant *P* value to 0.017 to account for multiple comparisons.

Results

Participants included 133 urban, low-income children with asthma between the ages of 6 and 13 years [mean (SD)=9.83 (1.61)] and their primary caregivers. Of the families enrolled, 52 self-identified as Latino, 47 self-identified as non-Latino White, and 34 self-identified as African American. Forty-seven percent of the sample reported being below poverty threshold, 67% of the sample reported being on a controller medication, and 32% of children reported at least one ED visit over the last year. (See Table 1 for demographic information by ethnicity.) Of the possible covariates, only poverty was significantly associated with reported environ-

mental control ($r=0.23$, $P<0.01$) and functional limitation ($r=-0.24$, $P<0.01$). Poverty was significantly related to ethnicity ($P<0.001$); Latino families were more likely to report higher levels of poverty.

Ethnic differences in reported environmental control

Reported environmental control scores significantly differed by ethnicity ($R^2=0.02$; $P<0.05$), with Latino families reporting the highest level of environmental control (see Table 2 for mean scale scores by ethnicity). *Post hoc* comparisons using Tukey's Honestly Significant Difference test indicated that the mean score for Latinos was significantly different from that for non-Latino Whites ($d=0.50$; $P<0.05$). African American scores on the FAMSS subscale did not significantly differ from Latino or non-Latino White scores. After adjusting for the effects of poverty, the association between ethnicity and environmental control approached statistical significance ($R^2=0.08$; $P=0.055$).

Associations between reported environmental control and asthma outcomes

Scores on the environmental control subscale of the FAMSS ranged from 1 to 8, with a mean score of 3.05 ($SD=2.53$) reported for the sample. Reported environmental control was significantly associated with asthma control ($d=0.66$, $P<0.017$) and functional limitation ($r=-0.21$, $P<0.017$). In both cases, more optimal environmental control was associated with more positive asthma control and lower levels of functional limitation. Controlling for poverty, reported environmental control and asthma control were still significantly associated ($R^2=0.08$; $P<0.017$). Reported environmental control and functional limitation were associated at a trend level ($R^2=0.09$; $P=0.06$).

TABLE 1. CHILD AND CAREGIVER DEMOGRAPHIC CHARACTERISTICS BY ETHNIC GROUP

	Latino (n=52)	Non-Latino White (n=47)	African American (n=34)
Child			
Age, mean year (SD)	10.10 (1.58)	9.62 (1.69)	9.73 (1.53)
Gender, female, <i>n</i> (%)	20 (39%)	22 (47%)	15 (44%)
Prescribed a controller med, <i>n</i> (%)	35 (67%)	34 (72%)	20 (59%)
ED visits in last year, <i>n</i> (%)			
None	35 (67%)	36 (76%)	19 (56%)
1 or more	17 (33%)	11 (24%)	15 (44%)
Caregiver			
Education (highest year completed), mean (SD)	11.54 (2.69)	13.59 (2.59)	12.28 (1.97)
Marital status, <i>n</i> (%)			
Married	24 (47%)	24 (51%)	13 (38%)
Separated	6 (11%)	3 (6%)	3 (9%)
Divorced	6 (11%)	9 (19%)	2 (6%)
Widowed	1 (2%)	1 (2%)	0 (0%)
Never married	15 (29%)	10 (21%)	16 (47%)
Below poverty threshold, <i>n</i> (%)	30 (60%)	13 (28%)	19 (56%)
Recruitment site, <i>n</i> (%)			
Hospital-based ambulatory clinic	5 (11%)	6 (13%)	4 (13%)
Community-based primary care clinic	11 (23%)	3 (7%)	1 (3%)
Hospital-based asthma education program	13 (28%)	18 (39%)	9 (29%)
Public schools	5 (11%)	2 (4%)	4 (13%)
School-based community events	13 (11%)	17 (37%)	13 (42%)

SD, standard deviation; ED, emergency department.

TABLE 2. MEAN SCALE SCORES BY ETHNICITY

	Latino	Non-Latino White	African American
Environmental control subscale, mean (SD)	3.67 (2.61)	2.43 (2.38)	2.97 (2.43)
Functional limitation (from AFSS), mean (SD)	1.41 (.82)	1.23 (.66)	1.61 (.79)
Asthma control (from ACT), <i>n</i> (%)			
Poor control (scores ≤ 19)	11 (28%)	8 (23%)	8 (30%)

ACT, Asthma Control Test; AFSS, Asthma Functional Severity Scale.

The association between reported environmental control and ED use was significant for Latino families only ($d=0.76$; $P<0.05$). This effect remained significant after controlling for poverty ($OR=0.72$; $P<0.05$). Associations between reported environmental control and functional limitation were significant only among non-Latino Whites ($r=-0.32$, $P<0.05$). When controlling for poverty, this association remained at $P=0.05$ ($r=-0.30$).

Ethnic differences in specific exposures

Ethnic differences in exposure to triggers can be found in Table 3. Non-Latino White families were significantly more likely than Latino families to report a cat in the home. Both African American and Latino families were significantly more likely than non-Latino White families to report cockroaches in the home. African American and non-Latino White families were more likely to report secondhand smoke exposure than Latino families (70% of non-Latino White, 66% of African American, and 31% of Latino families; $P<0.001$).

Associations between environmental triggers and asthma outcomes

In the full sample, child functional limitation differed by the presence of carpeting in the family room ($d=0.44$; $P<0.017$); more functional limitation was reported in homes with family room carpeting. In Latino families, ED use was associated with secondhand smoke ($OR=4.34$; $P<0.05$) and carpeting in the family room ($OR=3.43$; $P=0.05$). In non-Latino White families, functional limitation differed by secondhand smoke ($d=0.98$; $P<0.05$) and by the presence of a pet in the home ($d=0.78$; $P<0.05$); higher levels of functional

limitation were found in homes with reported secondhand smoke exposure or the presence of a pet.

Discussion

We found that Latino families demonstrated higher levels of reported environmental control than non-Latino White families (even after controlling for poverty). This suggests that children in Latino families in this urban sample reported less exposure to triggers, as well as greater family efforts to control trigger exposure. It is important to recognize, however, that more optimal reported environmental control scores can be influenced, in part, by lack of exposure to secondhand smoke (in our sample, 31% of Latino children versus 70% of non-Latino White children were exposed to secondhand smoke). Latino families may have had higher reported environmental control scores because fewer Latino families endorsed this trigger. Despite this possibility, our findings suggest that Latino families perform consistently well in restricting other domains of exposure aside from secondhand smoke, which contributes to more optimal reported environmental control.

We also found that higher levels of reported environmental control (suggesting less trigger exposure and more optimal family efforts to control exposures) were associated with more positive asthma control and lower levels of functional limitation in the entire sample. We found ethnic differences in associations between reported environmental control and asthma outcomes. Lower levels of reported environmental control were associated with higher levels of functional limitation in non-Latino White children. On the other hand, greater ED use was found among Latino children in homes with lower levels of reported environmental control, a finding that is consistent with previous research examining health disparities.^{21,22}

We found substantial ethnic differences in reported exposure to asthma triggers in the home. Non-Latino White and African American children reported higher levels of secondhand smoke exposure than Latino families. Non-Latino White families were more likely to report pet exposure compared with Latino families. Our findings suggest that interventions to improve the in-home environment among children with asthma should account for ethnic specific differences in exposures. As associations existed between other in-home asthma triggers and asthma outcomes, it was difficult to determine an independent effect of secondhand smoke exposure.

Limitations

This is a convenience sample drawn from the greater Providence, RI, area. As research subjects, families in our

TABLE 3. REPORTED ENVIRONMENTAL TRIGGERS IN FULL SAMPLE AND BY ETHNIC GROUP

	Full sample	Latino	Non-Latino White	African American	Chi-square results (P)
Pets in home	45%	31% ^{a*}	62% ^a	41%	<0.05
Cat**	22%	19% ^a	69% ^a	39%	<0.05
Pests in home	40%	55% ^a	23% ^a	41%	<0.05
Cockroaches**	17%	50% ^a	9% ^{a,b}	54% ^b	<0.05
Carpeting in child's room	44%	29% ^{a,b}	53% ^a	53% ^b	<0.05
Carpeting in family room	48%	29% ^{a,b}	63% ^a	59% ^b	<0.05
Secondhand smoke	54%	31% ^{a,b}	70% ^a	66% ^b	<0.001

*Corresponding letters designate significant differences between groups.

**Data on triggers collected for those families that reported a pet or pest in the home.

study were likely more motivated than the general population. The demographic composition of our sample is reflective of Providence, RI, and although similar to other urban areas in the United States, further research is needed to demonstrate broad generalizability of our findings. More Latino families in our sample were recruited from community-based clinics and had greater poverty levels than other ethnic groups in our sample. Exposure assessment, asthma control, and health care utilization were via parent report and as such may be subject to self-report bias.

Conclusion

We documented ethnic differences in environmental control scores by ethnic group, and that environmental control scores are associated with differences in asthma outcome measures. We also found substantial ethnic differences in in-home asthma triggers, suggesting that a portion of observed ethnic disparities in asthma may be due to differences in the home environment. It also suggests that interventions to improve the home environment should take into account ethnic differences in exposures within a community, as well as family efforts to control home exposures.

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Author Disclosure Statement

No competing financial interests exist for any authors.

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