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Mite sensitization among Latina women in New York, where dust mite allergen levels are typically low

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Abstract

In New York (NY), Latinos often have greater asthma morbidity than other ethnicities, and dust mite sensitization is common despite low allergen levels. We investigated mite allergen exposure and sensitization in atopic and/or asthmatic women, the majority being Puerto Rican. Women (n=274) recruited for a birth cohort study were visited postnatally. Dust from their homes was analyzed for mite allergens (Der f 1, Der p 1, and Blo t 5). Serum was analyzed for total and allergen-specific IgE. Thirty-seven percent were sensitized to *D. pteronyssinus*, 34% to *D. farinae*, and 21% to *B. tropicalis*. Only 5% of NY homes had levels of Der f 1 > 2 μg/g; none had Blo t 5 or Der p 1 above this level. Caribbean or Latin American birthplace (a proxy for childhood exposure) was not associated with mite sensitization. Sensitization to *D. pteronyssinus* and *D. farinae* was associated with a report of doctor-diagnosed asthma (Odds ratio (OR) = 3.27, p = 0.003; OR = 2.81, p = 0.010, respectively); sensitization to any mite was associated with asthma medication use in the past 12 months (OR=3.12, p=0.004). These associations held even after adjustment for cockroach, mouse, and cat sensitization.

Keywords

Allergy; Asthma; Dust mite; Hispanic; IgE; Puerto Rican

Introduction

The prevalence of asthma among Puerto Ricans in the United States (Puerto Rico and the mainland) has often been reported as high (18–35 %) compared with that of other ethnicities (African-American, Mexican, Dominican, Cuban, non-Hispanic white) (Beckett et al. 1996; Carter-Pokras et al., 1993; Crain et al., 1994; Findley et al., 2003; Lara et al., 2006; Rose et al., 2006; Dumanovsky et al., 2007), but still very few researchers have tried to understand this within the Puerto Rican community (Choudhry et al., 2006). Allergic sensitization is among the stronger risk factors for asthma (Platts-Mills et al., 1997), and among allergic asthmatics living in Puerto Rico, 75%, 76%, and 70% were allergic to *Dermatophagoides pteronyssinus*, *D. farinae*, and *Blomia tropicalis* mites, respectively (Montealegre et al., 2004). These mites are common in Puerto Rico (Montealegre et al., 1997), but *B. tropicalis* is not commonly recovered in more temperate climates (Arlian et al., 1992).

Most studies of allergy in the northeastern United States have focused primarily on allergy to *D. farinae* and *D. pteronyssinus*, as they are the predominant dust mites in this region (Chew et al., 1999; van Strien et al., 2004). Even within this region, differences in allergen concentrations have been observed such that drier multi-family apartment dwellings often have lower levels of dust mite allergens (Der f 1 and Der p 1) than do single-family houses

Practical implications: Despite the low concentrations of mite allergen in our community, many of the women in the atopically enriched cohort were sensitized to mites, even *Blomia tropicalis* which is typically found only in tropical environments.

(Chew et al., 1998). That said, a large multi-site asthma study has shown that asthmatic children in New York (living mainly in apartment buildings) have a high frequency of skin test reactivity to dust mite allergens (Gruchalla et al., 2005). This finding along with studies of allergy and asthma among immigrant populations living in Australia and Papua New Guinea suggest that that dust mite sensitization among some New York City (NYC) asthmatics could have occurred earlier in life before they moved to NYC (Dowse et al., 1985; Leung et al., 1994). We hypothesized that among Puerto Rican mothers of an ongoing NYC birth cohort enriched for atopy, sensitization to not only the *Dermataphagoides* dust mites, but also the tropical mite, *Blomia tropicalis*, would be associated with mite exposure as measured by current house dust measurements as well as surrogate measures, birthplace and travel patterns.

Methods

Between November 2002 and December 2004, 274 women were recruited from NYC hospitals shortly after giving birth (Acosta et al., 2008). Informed consent was obtained in accordance with the Columbia University Medical Center institutional review board. Main inclusion criteria were: a) the mother (≥16 years old) reported ever having asthma, hay fever, or inhalant allergy; and b) the mother identified her newborn as being of Puerto Rican ethnicity. Home visits (usually within 1 month of birth) involved dust sampling and administration of a detailed questionnaire. House dust was vacuumed from mothers' beds and extracted for allergen analysis as described previously (Chew et al., 2003). Dust mite (Der p 1, Der f 1) allergens were measured by ELISA (Indoor Biotechnologies, Charlottesville, VA) as was another mite allergen (Blo t 5) (Yi et al., 2005). Brief questionnaires regarding recent travel to tropical locations were administered at 6 and 12 months. Two years after enrollment, the mothers donated blood and gave information about their current asthma/allergy symptoms and medication use. Total and mite-, cockroach-, cat-, and mouse-specific IgE antibodies (*D. pteronyssinus, D. farinae, B. tropicalis, Blatella germanica, Felis domesticus*, and *Mus musculus*) were assayed using the ImmunoCAP system (Pharmacia, Uppsala, Sweden).

Birthplace and travel to a tropical environment in the past 12 months were used as a surrogate measures for early-life dust mite and recent *B. tropicalis* mite exposure, respectively. Travel was dichotomized (Florida or the Caribbean vs. no travel to these locations). Allergen and IgE concentrations were ln transformed for analysis by linear regression. Women with total IgE ≥ 100 IU/ml were considered seroatopic (Lester et al., 2001) and those with allergen-specific IgE ≥ 0.35 IU/ml were sensitized to a given allergen. We also evaluated our data using the 0.7 IU/ml cutoff as it represents a stronger positive (i.e., CAP class 2) response. Categorical data were analyzed using a combination of Chi-square and logistic regression analyses.

Results

The demographic characteristics of the 274 women enrolled were not noticeably different from those with serum results (Table 1). Sixty-three percent of the women reported a previous clinical diagnosis of asthma, and 68% reported a previous clinical diagnosis of respiratory allergy.

For those women with serum results, 39% were allergic to at least one of the three mites tested: 37% had elevated IgE against *D. pteronyssinus*, 34% against *D. farinae*, and 21% against *B. tropicalis.* However, mite allergen levels in their NYC homes were low. Of all homes, only 5% had Der f 1 > 2 μg/g and none had Blo t 5 or Der p 1 above this level. Furthermore, of the measurements that were within the detection range of the ELISA, the

geometric means (GM) for Der p 1 (n=22), Der f 1 (n=77), and Blo t 5 (n=17) were 0.2 μg/g, 0.6 μg/g, and 0.2 μg/g, respectively. Dust mite allergen concentrations (Der p 1 or Der f 1) were not significantly different between homes of women who moved vs. did not move from birth to the time when their child reached age 2 years.

Birthplace in Puerto Rico, another Caribbean country or Latin America was not associated with increased odds of mite sensitization (using the 0.35 or the 0.70 IU/ml cutpoint for specific IgE titre). In fact, birth on the mainland seemed to be more of a risk factor, although this did not reach statistical significance (Table 2). Also, duration that Puerto Rican mothers lived in Puerto Rico (≥5 years) was not significantly associated with sensitization to *B. tropicalis* (OR=1.47, p=0.47), *D. pteronyssinus* (OR=0.48, p=0.18), and *D. farinae* (OR=0.41, p=0.13) or with seroatopy (OR=0.62, p=0.32).

In linear regression models, mite-specific IgE was not significantly associated with current Der f 1 levels in their beds (GM =0.075 μg/g for those sensitized to any mite,. vs. 0.065 μg/g for not sensitized). For Der p 1 and Blot 5, too many values were below limit of detection for an interpretable regression model. To date, we have analyzed the serum samples of the first 146 women in this ongoing cohort, of which 35 traveled to a tropical environment within the first year after recruitment. Sensitization to mite allergens was similar among those who traveled to a tropical destination vs. those who did not (37% vs. 37 %, 31% vs. 35%, and 20% vs. 21% for *D. pteronyssinus, D. farinae*, and *B. tropicalis*, respectively). Among only seroatopic women (i.e., total IgE ≥ 100 IU/ml), there was also no significant difference in prevalence of sensitization to any of the mites.

Sensitization to any of the mite allergens was significantly associated with the woman reporting ever having been diagnosed with asthma by a doctor (Odds ratio (OR) = 2.45, p = 0.017). Even after adjusting for sensitization to cockroaches, mice, and cats, the OR for mite sensitization was statistically significant (OR= 2.34, p = 0.046). When analysis was conducted for each specific mite, being sensitized to *D. pteronyssinus* or *D. farinae* were both significantly associated with the mother reporting ever having been diagnosed with asthma by a doctor (Odds ratio (OR) = 3.27, p = 0.003; OR = 2.81, p = 0.010, respectively). However, this association was not observed with *B. tropicalis* (OR = 1.88, p = 0.165).

Sensitization to any of the mite allergens was significantly associated with asthma medication use in the past 12 months (OR=3.12, p=0.004). After adjusting for sensitization to cockroach and cat allergens, mite sensitization was still associated with current asthma medication use (OR=2.30, p=0.048, and OR=2.40, p=0.042, respectively); however, adjustment for mouse sensitization decreased the association (OR= 1.90, p=0.15).

Discussion

Atopically predisposed individuals tend to develop allergy toward agents in their environment (Gruchalla et al., 2005). However, capturing the biologically relevant time period for allergic sensitization is difficult with changing migration patterns and global travel. In a Boston cohort of women that was also enriched for atopy, Latinas had higher levels of total IgE compared with those of white (non-Latina) and black ethnicity (Litonjua et al., 2005). Thirty-nine percent of the women in our cohort were allergic to allergens from one or more of three major domestic mites, *D. pteronyssinus, D. farinae, and B. tropicalis.* This prevalence of mite sensitization was similar to that of the Boston cohort; 36 % were allergic to the pyroglyphid mites (Lewis et al., 2001). Among our study participants, allergy to mites in general was expected, but the presence of *B. tropicalis* allergy (21% of the women) was surprising, given the cold dry climate of NYC during the winter. Some of the dust mites have cross-reactive epitopes with *B. tropicalis* (Simpson et al., 2003) and this

could also explain why some of the women in our study were allergic to *B. tropicalis.* Other studies have also shown that dust-mite sensitized individuals can have specific IgE against tropomyosins from other sources including shrimp and cockroaches (Purohit et al., 2007; Adalsteinsdottir et al., 2007). An alternate explanation for the relatively high sensitization, given the low exposures indicated by the antigen levels in dust, is that sensitization may occur at lower than the expected threshold level of 2 μg/g, an example of which previously was reported in the German Multicenter Atopy Study (Wahn et al., 1997).

In contrast to a British study of adults, we did not find that current dust mite antigen exposure was significantly associated with mite sensitization (Custovic et al., 2003). In addition, travel to a tropical environment in the past year was not associated with mite sensitization. In lieu of the women's past mite allergen exposure, we considered place of birth as a proxy for early life mite exposure. An Australian study reported that more Asian immigrants were allergic to *D. pteronyssinus* than were Australian-born non Asians (57% vs 40%) (Leung et al., 1994). However, birthplace was not associated with mite specific-IgE (using a cutpoint of 0.35 IU/ml or 0.70 IU/ml) in our study. In fact, birth off the mainland seemed to be protective, but this did not reach statistical significance. This finding would be supported bya study of Mexican-American children in Chicago which found US-born children had a higher prevalence of dust mite sensitization than those born in Mexico (24.5% vs. 14.6%) (Eldeirawi et al. 2005).

We also examined the possibility that mite sensitization might be related to duration that the women lived in Puerto Rico. Leung et al. also reported that the Asian immigrants had a greater prevalence of hayfever with greater length of stay in Australia (< 5years = 35%, 6–10 years = 66%, >10 years = 65%), p = 0.001) (Leung et al., 1994). Duration of residence in Puerto Rico was not related to mite-specific IgE. Our mothers could have traveled in childhood to other areas (such as Florida) with abundant mite allergens; however, this information was not collected. In addition, mite allergen could have been passively transferred from mite-endemic areas to NYC homes where the women lived prior to enrolling in our study (Dowse et al., 1985; Hallas et al., 2004; Walliser et al., 1994)

The prevalence of domestic mites varies with geographic area and climate. To date, this is the first study to show any *Blomia* allergens in NYC, albeit the levels were low when detected. One study of 252 homes in 7 states across the United States found no *Blomia tropicalis* mites in a city with a similar latitude to NYC, but did find them in 19–25% of homes in two cities with warmer and more humid climates (Arlian et al., 1992). In a study in Puerto Rico, *B. tropicalis* was found in 32% of the 57 homes examined (Montealegre et al., 1997). In the same study *D. pteronyssinus* and to a lesser extent, *D. farinae* were common (46% and 18%, respectively). Montealegre et al. (2004) later reported a geometric mean of combined *D. pteronyssinus and D. farinae* allergen of 4.3 μg/g dust (Montealegre et al., 2004). This contrasts with the low levels in NYC homes of our study; only 5% had Der f 1 > 2 μg/g. In the Inner-City Asthma Study (ICAS), 6.7% and 14.1% of the New York and Bronx homes, respectively, had levels of Der f 1 > 2 μg/g (Gruchalla et al., 2005). Differences between the concentrations observed in our NYC homes and those of ICAS could be due to differences in sample collection, extraction procedures, and analytical methods. Nonetheless, mite allergen levels in NYC sites of ICAS were lower than those of warm humid climates which belies the fact that a large percentage of study participants in ICAS (55–60% of asthmatic children) and in our study were allergic to dust mites.

In our cohort, mite-sensitized women had greater odds of ever reporting doctor-diagnosed asthma compared with those who were not sensitized to mites. The odds ratios for sensitization and asthma were similar and statistically significant in the adjusted (OR = 2.34) and unadjusted models (OR = 2.45), suggesting that mite sensitization is associated with

report of doctor-diagnosed asthma independent of cockroach, mouse, and cat sensitization. The mite-sensitized women also reported greater asthma medication use in the past 12 months (e.g., inhaled and oral steroids). While mite allergen in their NYC homes was rare, substantial mite allergen has been measured in Puerto Rico (Montealegre et al., 2004). Therefore, given the known association between allergen exposure and asthma exacerbation among sensitized individuals, this could represent an important exposure for these women and others with similar disease and travel habits in the community.

A limitation of our study is the use of self-reported ever having asthma which could have included women that had experienced early childhood wheezing episodes that did not have an allergic component. Also, the cross-sectional examination of current allergy/asthma status with proxy measures for early life allergen exposures is problematic. Therefore, we are further testing the association between longitudinal measures of mite allergen exposure in NYC and in Puerto Rico with the development of sensitization by prospectively following the children of the mothers in this study.

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Table 1

Demographics and symptoms of entire cohort and those with serum results

Characteristic	Entire Cohort (n=274)	Subset with serum results (n=146)
Age: mean ± std. dev	27 ± 6.0 years	28 ± 6.4 years
Place of birth		
-Mainland United States	203 (74%)	108 (74%)
-Puerto Rico	55 (20%)	26 (18%)
-Other	16 (6%)	12 (8%)
Main language spoken at home		
-English	208 (76%)	107 (73%)
-Spanish	66 (24%)	39 (27%)
Doctor diagnosed Asthma* n (%)	173 (63%)	92 (63%)
Doctor diagnosed Allergy * n (%)	187 (68%)	96 (66%)

* The exact wording of the questions were, “Has a doctor ever said that you had asthma?” and “Has a doctor ever said that you had allergy?”

Table 2

Allergic sensitization and associations with birthplace

	Mainland United States (n=108)		Puerto Rico (n=26)		Latin America or Caribbean (including Puerto Rico) (n=38)	
Allergen-specific IgE	**Prevalence**	**Odds Ratio**	**Prevalence**	**Odds Ratio**	**Prevalence**	**Odds Ratio**
D. farinae	38 %	reference	19 %	0.39 (p = 0.08)	24 %*	0.51 (p = 0.11)
D. pteronyssinus	41 %	--	23 %	0.44 (p = 0.10)	27 %*	0.54 (p = 0.14)
B. tropicalis	22 %	--	23 %	1.10 (p = 0.93)	18 %	0.79 (p = 0.62)
F. domesticus	44 %	--	31 %	0.58 (p = 0.24)	24 %	0.42 (p = 0.04)
B. germanica	47 %	--	38 %	0.70 (p = 0.42)	37 %	0.65 (p = 0.27)
M. musculus	18 %	--	15 %	0.85 (p = 0.79)	11 %	0.55 (p = 0.31)
Any domestic mite	41 %	--	31 %	0.65 (p = 0.35)	34 %	0.76 (p =0.48)
Any of the above	65 %	--	50 %	0.54 (p = 0.17)	58 %	0.75 (p = 0.45)

* n = 37 because of missing sample for two of the tested allergens

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