

Allergen Sensitivity (Mites, Insects, and Pets) in a Puerto Rican Population

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Objective: The people of Puerto Rico have one of the highest asthma prevalence and morbidity rates in the USA. Limited information is available on the most common allergy sensitivities among island residents. The aims of the study were to determine the most common inhalant allergen sensitivities among a convenience sample in Puerto Rico and determine as well their relationship to an asthma or a rhinitis diagnosis.

Methods: In August of 2008, we evaluated a cohort of subjects visiting ambulatory clinics offering health screening; the clinics were located in two of the island's biggest cities: Guaynabo in the north and Ponce in the south. Subjects over three years of age (or their parents) visiting the clinics answered a survey on asthma and rhinitis and were skin tested for reactivity to common aeroallergens.

Results: The survey included 395 subjects with a mean age of 29 years. Thirty-six percent reported a history of asthma, of whom 83% (30% of the total participants) reported still having asthma, and 76% reported having rhinitis. Sixty-five percent of the subjects were sensitive to at least one antigen. Subjects sensitive to mites were 53% more likely to have suffered from asthma than were non-mite-sensitized subjects (OR = 1.53, $p < 0.05$) Sensitivity to mosquitoes (OR = 2.25, $p < 0.02$), mites (OR = 2.53, $p < 0.00001$), feathers (OR = 2.72, $p < 0.03$), dogs (OR = 3.02, $p < 0.01$), or cats (OR = 3.42, $p < 0.001$) increased an individual's likelihood of suffering from rhinitis.

Conclusion: The most common sensitivities identified were to mites and insects. Mite sensitivity was associated with rhinitis and asthma. Sensitivity to animal dander as well as to mosquitoes was associated to with rhinitis. Further studies are warranted to explore the relevance of allergen sensitivity in terms of asthma and rhinitis prevalence and morbidity among residents of Puerto Rico. [*P R Health Sci J* 2012;31:24-28]

Key words: Asthma, Puerto Rico, Skin test

The people of Puerto Rico have one of the highest asthma prevalence rates among Hispanics and other ethnic groups in the United States (1). The rate of asthma diagnosis in this population was 17%, according to recent US National Health Interview Surveys (2); asthma morbidity was also elevated, with a greater number of emergency room visits and higher hospitalization rates than were found in other ethnic groups (1).

Limited published data on atopy among the people of Puerto Rico are available. Montealegre and colleagues (3) compared skin sensitivity in 576 asthmatics and 144 healthy controls and reported that 86% of the asthmatics had had at least one positive skin test. They also reported that among 1496 atopic asthmatics living in southern Puerto Rico, 94.3% were sensitized to mites, 41.5% to cockroaches, 31.5% to pets, 31.1% to plants, and 19.4% to fungal spores (4).

Chew and colleagues (5) reported that 35% of the Puerto Rican children living in New York were sensitive to at least one

allergen. Mite (19%), cockroach (16%), cat (23%), and mouse (3%) were the predominant antigens. Acosta et al (6) reported 62% sensitization among allergic asthmatics from East Harlem, in whom cockroach sensitization was the most common (60%), followed by sensitization to dust mites (43%), cats (41%), and molds (21%). Among asthmatics of Puerto Rican descent living in Connecticut, the most common sensitivities were to dust mites (44.9%), cockroaches (29.5%), cats (33.7%), and grass (17.6%) (7).

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No published study has included mosquito sensitivity in its assessment of atopy among the people of Puerto Rico. Mosquito hypersensitivity manifestations may include asthma, rhinitis, large cutaneous reactions, or anaphylaxis (8). Positive serology and skin tests for mosquitoes have been reported among asthmatics in India (9) and Mexico (10). Srivastava and colleagues (11) published the results of their having used antigen-specific immunotherapy on 40 mosquito-allergic subjects with asthma and/or rhinitis and reported significant improvements in skin reactions, rhinitis symptom scores, asthma symptom scores, and FEV1 among those receiving immunotherapy for one year when compared to baseline and those receiving placebo.

The aims of the study were to determine the most common inhalant allergen sensitivities among a convenience sample in Puerto Rico and determine as well their relationship to asthma or rhinitis.

Methods

Subjects

This is a cross-sectional, descriptive, hypothesis-generating study. The Puerto Rican Allergist Association (APMA [Asociación Puertorriqueña de Médicos Alergistas, in Spanish]) conducted 4 health fair clinics during August 2008 in Ponce (in southern PR) and Guaynabo (in northern PR), Puerto Rico. These clinics were advertised on local television and radio stations. The study population was composed of subjects 3 years of age and older who were willing to participate.

A Spanish-language survey on self-reported allergic conditions was distributed among participants. The specific questions were as follows: 1) "Do you have nasal allergies?" 2) "Do you have hives?" 3) "Has a physician ever told you that you have asthma?" 4) "If so, do you still have asthma?" Subjects answered the survey by themselves, except for children younger than 15 years of age, whose parents answered the survey.

Skin test

Subjects underwent skin tests against a panel of inhalant allergens (GREER®) including dust mite (*Dermatophagoides pteronyssinus* and *D. farinae*), cat, dog, feather, insect mix (American and German cockroaches and fire ants), mosquito (*Aedes taeniorhynchus*), mixed grass (Bermuda, Johnson, Bahia, Salt, and Rye), tree (mix 1: Mulberry, Elm, Acacia, Cypress; mix 2: box elder, beefwood, bayberry, oak, palm, melaleuca, hackberry, sweet gum, and maple), interior and exterior mold (*Rhizopus*, *Mucor*, *Pullularia*, *Penicillium*, *Aspergillus*, *Curvularia*, *Fusarium*, *Alternaria*, *Hormodendrum*, *Helminthosporium*), and weed (mix 1: English Plantain, Pigweed, Ragweed; mix 2: marsh elder, cocklebur, lamb quarter); in addition, a histamine skin test was performed and a diluent control was included for each series. The skin tests were applied on the forearms using a multitest device (Lincoln Diagnostics, Inc.®). Sensitivity to outdoor and indoor

molds was added and, in the event that a positive reading resulted, reported as mold sensitization. The skin tests were conducted by experienced allergists who measured the induration and erythema across the largest diameter surrounding each allergen. Adhesive tape was applied over the surface where the skin test had been applied to confirm readings, maintain a permanent record, and validate the allergists' measurements. Atopy was defined as an induration 3 mm larger than the negative control on one or more of the allergens tested within 15 minutes of application. Subjects who did not respond to histamine were excluded from the analysis. Subjects who had uncontrolled asthma, who reported a recent use of antihistamines, or who were on beta-blockers were not skin tested.

Approval was obtained from the University of Puerto Rico Medical Sciences Campus Institutional Review Board and written informed consent obtained from all research subjects before enrollment.

Statistical analysis

Data were collected and transferred to a Microsoft Excel table. Data were analyzed using IBM's SPSS. Descriptive statistics were calculated. The subject report of rhinitis or asthma and individual allergen sensitivity were compared using a Chi square test. A p-value less than or equal to .05 was considered statistically significant. The odds ratios (ORs) were estimated directly from the 2-by-2 tables with standard deviation for the log OR used to compute the 95% confidence interval (CI).

Results

We examined a total of 411 subjects (139 males and 272 females) with a mean age (\pm standard deviation) of 29 ± 20 years (range 3-85 years). Almost half of the participants (50.7%) had private health insurance, 39.8% had government-sponsored insurance (HMO type), 5% had Medicare, and 4.5% were uninsured. Subjects' responses indicate that 76.6% suffered from rhinitis and 35.1% from urticaria; 36.2% had a history of asthma and 29.9% had asthma at the time of the survey. There were no sex differences in reported rhinitis or asthma.

A total of 395 subjects were evaluated by skin test. Of these, 250 (65.1%) had at least one positive skin test, with 109 having one or two sensitivities (28%), and 141 (36.7%) having three or more positive skin tests. Most subjects were sensitized to mites (50.5%), followed by 32.5% being sensitized to insects, 23.2% to cats, and 22% to mosquitoes. Relatively fewer subjects were sensitized to plants, molds, or pets, as shown in Figure 1.

Sensitized subjects were 84% more likely to suffer from nasal allergies than were non-sensitized subjects ($p = 0.01$). There was a higher risk of allergic rhinitis as the number of positive skin tests increased (67% for non-sensitized, 78% for those sensitized to one or two antigens, and 83% for those sensitized to three or more antigens). No statistically significant association was found

between overall sensitization and current asthma ($p = 0.24$) or having a history of asthma ($p = 0.12$).

Sensitivities to cats, mites, dogs, feathers, and mosquitoes were statistically associated with rhinitis, as shown in Table 1. Individuals who were sensitive to mites, mosquitoes, or pets (or any combination) had an increased risk of suffering from rhinitis compared to those individuals who were not so sensitive. No significant association was found between grass, tree, weed, mold, or cockroach/fire ant sensitivity and rhinitis.

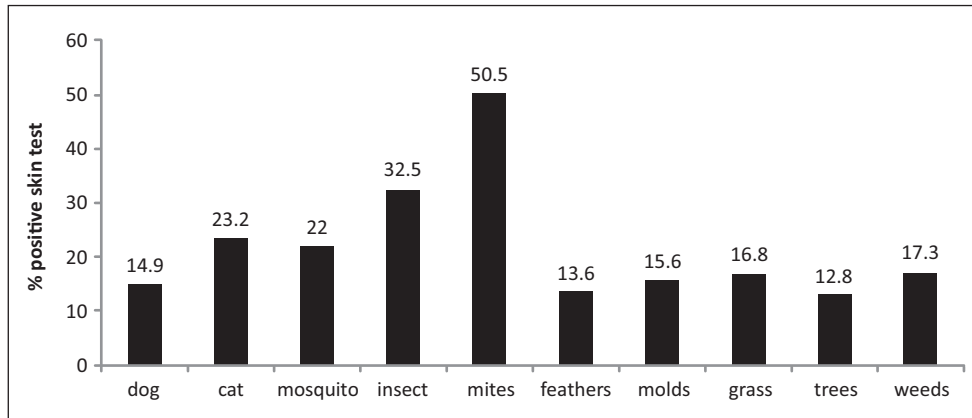


Figure 1. Percent of subjects sensitized to aeroallergens as determined by skin test in a convenience cohort in Puerto Rico.

Table 1. Association between allergen sensitivity and rhinitis, history of asthma, and current asthma

Allergen	Association with rhinitis			Association with asthma history			Association with current asthma		
	OR	95% CI	p-value	OR	95% CI	p-value	OR	95% CI	p-value
Trees 1	0.78	0.34-1.71	.51	0.76	0.35-1.74	.53	0.98	0.39-2.43	.97
Trees 2	0.94	0.41-2.19	.89	0.88	0.4-1.92	.74	1.09	0.46-2.57	.85
Grass	1.06	0.54-2.09	.86	1.43	0.8-2.57	.23	1.53	0.79-2.94	.19
Weeds 1	0.76	0.38-1.52	.44	1.61	0.85-3.02	.14	2.19	1.08-4.41	.02
Weeds 2	0.86	0.35-2.11	.74	1.22	0.54-2.77	.63	1.01	0.35-2.91	.98
Indoor Mold	1.4	0.46-2.45	.56	0.58	0.21-1.62	.3	0.86	0.27-2.73	.80
Outdoor Molds	1.6	0.59-4.33	.36	0.87	0.38-1.96	.73	0.56	0.18-1.7	.31
Mosquito	2.25	1.16-4.37	.02	0.99	0.6-1.63	.97	1.33	0.77-2.3	.31
Insects	1.61	0.95-2.74	.08	1.09	0.7-1.7	.71	1.36	0.83-2.23	.22
Mites	2.53	1.55-4.14	<0.01	1.53	1.01-2.33	0.05	1.35	0.84-2.16	.22
Feathers	2.72	1.12-6.58	.03	0.81	0.43-1.49	.49	0.89	0.44-1.83	.77
Cat	3.42	1.64-7.14	<0.01	1.22	0.75-1.99	.43	1.19	0.68-2.08	.54
Dog	3.02	1.25-7.31	.01	1.26	0.71-2.26	.43	2.2	1.16-4.17	.02

Statistically significant p-values are denoted in bold. OR: Odds ratio; CI: Confidence interval

There was a statistically significant relationship between mite sensitization and asthma history. Mite-sensitive subjects were 53% more likely to have history of asthma than were those who were not mite-sensitized (OR = 1.53; CI: 1.01-2.33; $p = 0.046$). No other antigen sensitivity was statistically associated with a past history of asthma. There was a significant association between weed and dog sensitivity and current asthma sufferers (OR 2.19; $p = 0.02$ and OR = 2.2; $p = 0.02$, respectively). No other significant association was found between sensitization to other antigens and a given individual's current status as an asthma sufferer.

Discussion

The current study assessed allergen sensitivity in a convenience sample of subjects living in Puerto Rico. The data show the preponderance of mite, insect (cockroach/fire ant), and animal dander sensitivity in the population studied (Figure 1). However, not all of these sensitivities were associated with self-reported asthma or rhinitis. Discrepancies between reported rhinitis, asthma, and skin sensitivity have been described (12). In

a cross-sectional study of 616 Costa Rican asthmatic children, Bunyavanich et al (13) reported variability in the association of allergens with rhinitis, which variability depended on the criteria used to define rhinitis. The higher proportion of subjects reporting rhinitis over those reporting asthma in our sample might explain the identified stronger association with allergens in the former.

Our results are generally consistent with previous studies in Puerto Rico, but they are unique in several important aspects: 1) they emphasize the relevance of mite sensitivity in association with rhinitis and asthma history; 2) they identify an association between rhinitis and mosquito sensitivity; 3) and they highlight an association between animal dander sensitivity and rhinitis. In addition, our study enjoys the distinction of being

the only published study in which skin sensitivity was measured by experienced allergist-immunologists in Puerto Rico.

Mite sensitivity predominates in our cohort. Since mites grow well in hot, humid weather, the preponderant sensitivity to this antigen is not surprising. Mite sensitivity was significantly associated with both asthma history and rhinitis. The relevance of mite sensitivity has been described extensively in the literature, particularly in terms of how such sensitivity is affected by tropical weather (14). Crisafulli et al (15) reported a study in the city of Sidney that described a seasonal variation in dust-

mite concentration in beds. This variation was partly determined by relative humidity, with minimal levels occurring during the summer and two- to threefold higher levels being found during late autumn. Chew and colleagues (16) examined a cohort of Latino (mostly Puerto Rican) women in New York and reported an association between asthma diagnosis or treatment and mite sensitization, even in the absence of exposure at their current homes and after controlling for other allergens, strengthening the relevance of mite sensitivity to asthma development.

Insect sensitivity was the second most common in our cohort, but was not associated with either rhinitis or asthma. Since the insect mix included both cockroaches and ants, we cannot separate the effects of these allergens in our sample, and, in fact, ant sensitivity may have diluted the importance of cockroach allergy in terms of the manifestations of asthma or rhinitis suffered by the pertinent members of our study population. Cockroach sensitization has been reported to increase asthma severity and morbidity in inner cities in the United States (7). Furthermore, longitudinal studies have determined that cockroach exposure increases the risk of wheezing among children of atopic adults, even among non-sensitized subjects (17). Socioeconomic and housing characteristics may also account for the lack of association between insect sensitivity and asthma in our cohort.

The 22% sensitivity to mosquitoes and its association with rhinitis are remarkable, but the clinical significance of mosquito sensitivity cannot be established with these data. In Mexico, González and colleagues (10) reported allergy skin-test sensitivities in a convenience sample of 482 subjects. They reported that 16% of the subjects were sensitized to mosquitoes. Most of their subjects (84.4%) reported only local reactions, 2.4% reported large local reactions (only 0.6% had a positive skin test), and 0.2% reported a systemic reaction. The sensitivity to mosquitoes demonstrated among our subjects may correspond to skin reactions (urticaria, local reactions) or inhalant allergies (rhinitis, asthma), or it may be secondary to cross-reactive antigens such as tropomyosin (18). Challenge studies may help to clarify the relevance of skin sensitivity.

Animal dander was an important allergen in our sample. Dog sensitivity increased the likelihood of rhinitis and asthma in our cohort, in spite of the fact that more subjects were sensitized to cats than to dogs. This is an unexpected finding since 80% of the allergenic material from dogs (Can f 1) is found on non-respirable particles that are greater than 5 μ m, whereas the majority of allergenic material from cats (Fel d 1) is found on particles that are less than 5 μ m (19). A recent meta-analysis reported a slightly increased relative risk of asthma among dog owners, although birth cohort studies failed to identify an association (17). The association between dog sensitivity and rhinitis in our cohort could be due to the fact that dogs are the most popular pets in Puerto Rico. Since dogs tend to remain closer to home than do cats, dog owners would have increased exposure and, therefore,

an increased likelihood of developing clinical symptoms compared to cat owners. Alternatively, reverse causation may explain the association with rhinitis (i.e. cat-allergic subjects may tend to avoid cats more than dog-sensitive subjects avoid dogs). No report on the prevalence of feathered pets among Puerto Ricans that could account for the role of exposure to these animals on allergy sensitization was found.

Weeds are not identified as significant allergens in air samples (20), making the association between sensitization and asthma unexpected. The mechanism of this association is not clear.

Sensitivity to grass, trees, and mold could not be definitively associated with asthma or rhinitis in our cohort. Grass is an important seasonal allergen in the USA and in Europe but not in our cohort. Grass is a perennial allergen in Puerto Rico. Grass pollen levels in air samples throughout the year are undetectable or at low levels except for a few days each month when the levels reach moderate values (20). The lack of association between grass sensitivity and asthma or rhinitis is not surprising. Trees pollinate during different months throughout the year in Puerto Rico. Pollen can be identified as being at high levels during May, June, September, and October (20). The lack of association between tree sensitization and atopy could be due to a dilution effect as well as to the absence of extracts for some indigenous species of trees.

Mold spores can be identified at high levels throughout the year in Puerto Rico and reach very high levels during the rainy months of May, September, and October (20). However, no association with asthma or rhinitis could be identified in our study. Possible explanations for our finding include decreased mold allergenicity (when compared to standardized extracts), the dilution of the relevant allergens in the mixture used, the unavailability of FDA-approved extracts against basidiospores (which are the most prevalent mold spores in air samples) (21), and the possibility that the high levels of exposure to mold have led to tolerance instead of sensitization (22).

In recent decades, the population of Puerto Rico has gone from living a primarily rural existence to enjoying a more urban one. This shift from an agricultural lifestyle (i.e. one relying on intense physical labor) to a sedentary one may have contributed to the increased role of mite, insect, and animal-dander sensitization in atopy compared to that once played by such outdoor allergens as grass and trees.

This study has several limitations. First, the data described are based on self-reports. We did not include questions on symptoms, medication use, or exposure information to validate the reported diagnosis of any given case. Second, symptomatic subjects were more likely to participate in the study than were asymptomatic controls, which may bias the study in favor of allergic subjects. Third, the process of determining sensitivity was accomplished using a limited panel of mixed allergens. The relevance of certain allergens may have been lessened because of the mixture. Fourth, the study population consisted of a convenience sample that was

not restricted to asthmatics, which lack of restriction may have resulted in different patterns of sensitivity.

The successful management of either asthma or rhinitis includes the proper diagnosis of allergies through allergy testing. Further research must be conducted to determine skin sensitivities in a population-based cohort of island-living Puerto Ricans and to determine as well the relevance of allergen sensitivity to asthma and rhinitis.

Resumen

Objetivo: Las personas de Puerto Rico tienen una de las tasas de prevalencia y morbilidad de asma más altas. Existe información limitada sobre las sensibilidades a aero-alergenos entre los individuos que habitan en la isla. Determinar las sensibilidades a aero-alergenos en una muestra de conveniencia en Puerto Rico y sus relaciones con el diagnóstico de asma o rinitis. **Métodos:** Se evaluó una cohorte de sujetos que participaron en una clínica ambulatoria de salud en dos ciudades al norte y sur de la isla durante agosto del 2008. Los sujetos mayores de 3 años que participaron en la clínica, o sus padres, contestaron una encuesta sobre asma y rinitis y se llevaron a cabo pruebas de piel contra aero-alergenos. **Resultados:** La encuesta incluyó 395 sujetos con una edad promedio de 29 años. Treinta y seis por ciento reportó un historial de asma, de los cuales 83% (30% de los participantes totales) reportó aun padecer de asma y 76% reportó padecer de rinitis. Sesenta y cinco por ciento de los sujetos estaban sensibilizados a un antígeno o más. Los sujetos sensibilizados contra ácaros tenían 53% más probabilidad de haber sufrido de asma que los sujetos que no estaban sensibilizados a ácaros (OR = 1.53, p<0.05). La sensibilidad a mosquitos (OR = 2.25, p<0.02), ácaros (OR = 2.53, p<0.00001), plumas (OR = 2.72, p<0.03), perros (OR = 3.02, p<0.01) o gatos (OR = 3.42, p<0.001) aumentaba la probabilidad de sufrir de rinitis. **Conclusión:** Las sensibilidades más comunes identificadas fueron a ácaros e insectos. La sensibilidad a ácaros se asoció a sufrir de rinitis y de asma. Rinitis se asoció a sensibilidad a animales y mosquitos. Se necesitan estudios adicionales para explorar la relevancia de sensibilidad a estos alérgenos en la prevalencia y morbilidad de asma y rinitis en los puertorriqueños.

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