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## Pattern of skin sensitivity to various aeroallergens in bronchial asthmatic patients in Lagos, Nigeria

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### Abstract

**Background:** Skin prick testing is an established way of investigating respiratory allergic diseases to determine the allergen or allergens responsible for clinical symptoms as well as degree of reactivity in the individual cases.

**Objective:** To study the skin sensitivity to various aeroallergens by skin prick test in selected asthmatic patients (with and without concurrent Allergic Rhinitis)

**Design:** A prospective case-control study.

**Setting:** Tertiary Health Institution.

**Subjects:** Cases were 160 adult patients with confirmed bronchial asthma and controls were 160 subjects without bronchial asthma.

**Methods:** Skin prick test was performed with a panel of allergens which included house dust mites, cockroach, cat, dog, moulds, and aspergillus fumigatus on all subjects.

**Results:** Amongst the asthmatic patients 148 (92%) had positive skin tests to the allergens, this is higher than findings from previous studies carried out on asthmatics in Lagos. The house dust mite (*Dermatophagoides pteronyssinus*) had the highest proportion of reactions among the study group. There is a higher incidence of severe reactions to other allergens (grass mix, dog skin, cat skin, aspergillus, cockroach) in the asthmatics than the control.

**Conclusion:** The skin test is a valuable diagnostic tool in detecting the presence and degree of allergy in asthmatics in our environment. However, the house dust mite was allergen that most of the subjects reacted to.

allergènes responsables des symptômes cliniques ainsi que le degré de réactivité dans les cas individuels.

**Objectif:** Pour étudier la sensibilité de la peau à divers allergènes-aéré par test de la piqure de la peau chez les patients asthmatiques sélectionnés (avec et sans concurrente Rhinite Allergique)

**Design:** Une étude prospective avec cas de repères. Cadre: Institution Tertiaire de santé.

**Sujets:** Les cas étaient 160 patients adultes souffrant d'asthme bronchique confirmé et 160 sujets étaient cas de repères sans asthme bronchique.

**Méthodes:** Le test de piqure de la peau a été réalisée avec un panel d'allergènes qui comprenait les acariens, blattes, chat, chien, moules, et l'*Aspergillus fumigatus* sur tous les sujets.

**Résultats:** Parmi les patients asthmatiques, 148 (92%) avaient des tests cutanés positifs aux allergènes, ceci est plus élevé que les résultats d'études antérieures effectuées sur les asthmatiques à Lagos. Les acariens (*Dermatophagoides pteronyssinus*) avaient la plus grande proportion de réactions au sein du groupe d'étude. Il ya une incidence plus élevée de réactions graves aux autres allergènes (mélange d'herbe, peau de chien, peau de chat, aspergillus, blattes) dans les asthmatiques que les cas de repères.

**Conclusion:** Le test de la peau est un outil précieux de diagnostic pour détecter la présence et le degré d'allergie chez les asthmatiques dans notre environnement. Cependant, l'acarien était allergène auquel la plupart des sujets ont réagi à.

**Mots Clés;** Allergènes-aéré, la rhinite allergique, l'asthme bronchique, test de la piqure de la peau

**Keywords;** Aeroallergens, allergic rhinitis, bronchial asthma, skin prick test

### Résumé

**Contexte:** Le test de piqure de la peau est une façon établie d'enquêter sur les maladies allergiques respiratoires pour déterminer l'allergène ou les

### Introduction

Asthma is a complex, environmentally-induced, allergic lung disease in genetically-predisposed individuals [1]. It is a major cause of chronic morbidity and mortality throughout the world that is characterized by paroxysmal spasmodic narrowing of the bronchial airway due to inflammation of the bronchial tree and contraction of the bronchial smooth muscle [2]. It is one of the most common chronic diseases in the world and is estimated that

around 300 million people in the world currently have asthma [3]. This condition has become more common in both children and adults around the world in recent decades. Its prevalence varies with geographical location. In Nigeria it has a prevalence of 29.4% [4] while the International Study of Asthma and Allergies in Childhood (ISAAC) in Nigeria revealed that cumulative prevalence rate for wheezing within the immediate 12 months has 10.7% [5].

Allergic rhinitis (AR) is a recognized risk factor for bronchial asthma, with 20%-50% of allergic rhinitis patients having bronchial asthma; conversely 30%- 90% of patients with bronchial asthma have co existing AR [6, 7]. Sensitization to aeroallergens is the most important factor in the pathogenesis of respiratory allergic diseases and identification of the aeroallergens to which the patients are sensitized has an important role in their diagnosis and treatment [8]. Nevertheless, studies have shown that the distribution and pattern of aeroallergens is significantly different from one country to another [9].

Skin allergy testing via skin prick test (SPT) is a useful method to demonstrate hypersensitivity to a specific antigen [9, 10]. Skin prick testing has been found to be more sensitive and specific than radioallergosorbent test (RAST) [10]. Skin sensitization patterns against allergens differ significantly by age, gender, environmental factors, and the presence of respiratory diseases such as allergic rhinitis and asthma [11]. This study therefore aimed to determine the pattern of skin prick test reactivity to various aeroallergens among adult bronchial asthmatic patients (with or without) concurrent AR in a tertiary hospital in Nigeria.

## Materials and methods

This was a case control study of adults in Lagos, Nigeria involving consecutive asthmatic patients and non-asthmatics studied between October 2011 and November 2012. The cases were adults diagnosed and being managed for bronchial asthma at the medical out-patient (MOP) clinic in LUTH. The controls were adults matched age and sex with the cases from MOP without cardio-respiratory diseases, and no self or family history of asthma or allergy. Exclusion criteria included acute severe attack or exacerbation of bronchial asthma, current steroids and/or antihistamines ingestion and presence of skin dermatographism. The study was approved by the Research & Ethical Review Committee Lagos University Teaching Hospital (LUTH), Lagos, Nigeria and informed consent was obtained from each participant.

## Data collection procedures and interventions

### Questionnaire

Questionnaire was applied on each subject to obtain socio-demographic data, clinical history (presence of allergic rhinitis, eczema), family history of atopy, and medication history. Social stratification of the patients was based on occupational strata as devised by Famuyiwa *et al* [12].

### Peak expiratory flow rate test

The Peak Expiratory Flow rate was measured. Test was performed in accordance to the Statement on Technical Standards for Peak Flow Meters and the mean peak expiratory flow rate was then calculated

### Skin prick test

This was performed with the Diagenics allergy kit manufactured by Diagenics Limited, South House 3 Bond Avenue, Milton Keynes, United Kingdom. The test confirms the presence of allergy, determined its severity and identified the responsible inhalant allergen. Procedure was carried out according to the prick technique as recommended by Diagenics limited. The inhalant allergens in the kit were *Dermatophagoides pteronyssinus*, Grass mix, Cockroach, Dog skin, Cat skin, *Aspergillus fumigatus*. The positive and negative controls were histamine and saline solution respectively from the same manufacturer. The diameter of the wheal  $\pm$  erythema that developed at the site of prick was suggestive of a positive or negative skin prick reaction. It was graded normal or no reaction if the diameter of the wheal  $\pm$  erythema was  $<5\text{mm}$ , mild (+1) if wheal  $\pm$  erythema was 5mm diameter, moderate (2+) if wheal  $\pm$  erythema between degree 5-8mm and severe if wheal  $\pm$  erythema was more than 8mm. There is positive skin prick test if the diameter of the produced wheal is about or more than that caused by histamine.

### Definition of allergic rhinitis

Participants were classified as having allergic rhinitis if they had had 2 or more recurrent nasal symptoms such as excessive sneezing, nasal itching, nasal discharge, or nasal congestion or obstruction that were reversible either spontaneously or with treatment in the preceding 12 months [13,14].

### Definition of asthma using peak expiratory flow rate

Asthma was diagnosed in individuals with either 2 or more recurrent asthma symptoms (current asthma) or physician diagnosed asthma in addition to a PEF variability of  $\geq 10\%$ . It is important to mention that in diagnosing asthma, reversible and variable airflow

limitations can be measured with either a spirometer (FEV1) or a peak flow meter [15].

#### Data analysis

Statistical analyses were performed using the SPSS program for Windows version 17.0 (Statistical Package for the Social Sciences, Inc., Chicago, IL). For all analyses, a  $p$  value of  $< 0.05$  was accepted as significant. Differences in sensitization rates between the variables were determined using chi-square tests

In this study, the mean peak expiratory flow rate in asthmatic patients with a concomitant allergic rhinitis was 228.5L/min while that of subjects without allergic rhinitis was 245.2L/min, even though the differences was not statistically significant, it is evident that the peak flow rate of asthmatics without allergic rhinitis is better than that of their counterpart with concurrent allergic rhinitis (table 2)

Eighty three percent of the asthmatic patients had concomitant allergic rhinitis. The mean age of

Table 1: Socio-demographic characteristics of the study group

Variable	Case n=160(%)	Control n=160(%)	Test of Significance
<b>Sex</b>			
Male	46(28.7%)	62(38.7%)	$\chi^2 = 3.5779$ , df = 1 $p = 0.059$
Female	114(71.3%)	98 (61.3%)	
<b>Age (years)</b>			
<20	30(18.8%)	21(13.1%)	$\chi^2 = 2.1546$ df = 3 $p = 0.541$
20-34	45(28.1%)	40(25.0%)	
35-49	49(30.6%)	57(35.6%)	
$\geq 50$	36(22.5%)	42(26.3%)	
Mean age (SD)	36.3 (14.2)	38.1 (13.2)	$t = 1.1653$ df = 318, $p = 0.2448$
<b>Occupation</b>			
Class 1	25(15.6%)	42(26.3%)	$\chi^2 = 6.2541$ df = 4 $p = 0.181$
Class 2	25(15.6%)	21(13.1%)	
Class 3	6(3.8%)	8(5.0%)	
Class 4	37(23.1%)	34(21.2%)	
Class 5	67(41.9%)	55(34.4%)	
<b>Educational background</b>			
None	12 (7.5%)	10(6.3%)	$\chi^2 = 4.781$ df = 2 $p = 0.221$
Primary	37(23.1%)	28(17.5%)	
Secondary	39(24.4%)	35 (21.8%)	
Tertiary	72 (45.0%)	87(54.4%)	

#### Result

One hundred and sixty asthmatic adult patients comprising 46(28.7%) males and 114(71.3%) females and 160 non-asthmatic controls comprising 62 (38.7%) males and 98 (61.3%) females were investigated. The age of the cases ranged from 18 to 64 years, mean of  $36.3 \text{ years} \pm 14.2$ . The asthmatic and the controls were similar in sex and age ( $p = 0.244$  and  $0.059$  respectively). Meanwhile most of the subjects belong to the class 5 occupational level (unemployed, retired or students) 67 (41.9%) and 55 (34.4%) for the cases and control respectively  $p = 0.18$ . Ninety eight (61.3%) of the cases had a positive family history of allergy while 32 (20.0%) of the control group had a similar history. The difference was statistically significant as  $\chi^2 = 39.14$ ,  $p < 0.001$ . (table 1).

Table 2: Association of allergic rhinitis with the mean peak flow rate of the cases

	AR+ve	AR-ve
Peak flow rate	228±77.0	245± 74.7
L/min		
t (student test) = 0.9995		
p = 0.3191		

the first asthma diagnosis in Asthmatics with allergic rhinitis is  $27.3 \pm 16.4$  years while the mean age of the first asthma diagnosis of those without allergic rhinitis is  $35.8 \pm 19.6$  years. This was statistically significant  $t$  (student test) = 2.2098,  $p = 0.0287$ .

Comparison of skin prick test reaction between case and control groups shows that the overall number of cases with positive skin prick test

to allergens is one hundred and forty two (92%) while only thirty seven persons among the control group had positive skin prick test. It is noteworthy that most of the asthmatics in the study group showed sensitivity to multiple allergens. The house dust mite had the highest proportion of reaction. Ninety five (59.4%) asthmatics had a severe reaction to *Dermatophagoides pteronyssinus* (house dust mite) allergen while 4 (2.5%) of the control had severe reaction. This is followed by cockroach, with 81 (50.6%) of the asthmatics having severe reaction and next is the dog skin, grass mix, *Aspergillus fumigatus* (table 3).

without AR. It was observed that asthmatics with concomitant AR had more severe reactions to multiple allergens. The highest reaction was observed in *Dermatophagoides pteronyssinus* (house dust mite) with severe skin prick reaction in 77 (57.9%) asthmatics with allergic rhinitis and 2 (22.2%) of those without allergic rhinitis. The difference was statistically significant as  $\chi^2 = 162.45$ ,  $p < 0.001$ . Similarly, there was more severe skin reactions to cockroach allergens in the asthmatics with AR as compared with those without AR ( $p < 0.001$ ).

**Table 3:** Distribution of skin prick reaction among the case and control groups

Variable	Cases n=160(%)	Control n=160(%)	Test of significance
<i>Dermatophagoides pteronyssinus</i>			
No reaction	16(10.0%)	80 (50.0%)	X <sup>2</sup> = 162.451 df = 3 p < 0.001
Mild	18(11.2%)	65 (40.6%)	
Moderate	31(19.4%)	11(6.9%)	
Severe	95(59.4%)	4(2.5%)	
<i>Grass mix</i>			
No reaction	14(8.8%)	83(51.8%)	X <sup>2</sup> = 150.620 df = 3 p < 0.001
Mild	23(14.3%)	60(37.6%)	
Moderate	42(26.3%)	13(8.1%)	
Severe	26(16.3%)	4(2.5%)	
<i>Dog skin</i>			
No reaction	27 (16.9%)	98(61.3%)	X <sup>2</sup> =127.35 df = 3 p<0.001
Mild	35(21.9%)	49(30.6%)	
Moderate	69(43.1%)	13(8.1%)	
Severe	29(18.1%)	0(0.0%)	
<i>Cat skin</i>			
No reaction	27(16.9%)	101(63.1%)	X <sup>2</sup> =89.28, df = 3, p<0.001
Mild	44(27.5%)	39(24.4%)	
Moderate	73(45.6%)	20(12.5%)	
Severe	16(10.0%)	0(0.0%)	
<i>Cockroach</i>			
No reaction	26(16.3%)	104(65.0%)	X <sup>2</sup> = 97.75 df = 3 p < 0.001
Mild	53 (33.1%)	43(26.8%)	
Moderate	55(34.3%)	11(6.9%)	
Severe	81(50.6%)	2(1.3%)	
<i>Aspergillus fumigatus</i>			
No reaction	28(17.5%)	107(66.9%)	X <sup>2</sup> = 86.7130 df = 3, p < 0.001
Mild	54(33.7%)	33(20.6%)	
Moderate	60(37.6%)	18(11.2%)	
Severe	18(11.2%)	2(1.3 %)	

Comparison of skin prick test reaction between asthmatics with and without allergic rhinitis shows that of the one hundred and sixty asthmatics, 133 patients had concomitant AR and these groups had more severe reactions to the allergens than those

For grass mix allergen, 22 (16.5%) asthmatics with allergic rhinitis had severe skin reactions to the allergen as compared with 2 (7.4%) of those without allergic rhinitis who had severe reaction. This was statistically significant  $\chi^2 = 97.75$ ,

$p < 0.001$ . In this study, none of the asthmatics without AR had severe skin reaction to *Aspergillus fumigatus*, cat skin and dog skin while there was significant reaction observed amongst asthmatics with AR (table 4).

similar study. There is an increase in the prevalence of allergic reaction in asthmatics in this study when compared with previous local studies. This may be due to a progressive increase in urbanization and

**Table 4:** Distribution of skin prick reaction among the asthmatic patients

Variable	Cases (asthmatic) AR+ve n=133(%)	AR-ve n=27(%)	Test of significance
<i>Dermatophagoides pteronyssinus</i>			
No reaction	12(9.0%)	20(74.0%)	$X^2 = 162.451$ $df = 3$ $p < 0.001$
Mild	17(12.8%)	0(0.00%)	
Moderate	27(20.3%)	2(7.4%)	
Severe	77(57.9%)	6(22.2%)	
<i>Grass mix</i>			
No reaction	10(7.5%)	22(66.7%)	$X^2 = 66.203$ $df = 3$ $p < 0.001$
Mild	14(10.5%)	4(14.8%)	
Moderate	36(27.1%)	2(7.4%)	
Severe	22(16.5%)	2(7.4%)	
<i>Dog skin</i>			
No reaction	14(10.5%)	23(85.2%)	$X^2 = 56.58$ , $df = 3$ $p < 0.001$
Mild	58(43.6%)	3(11.1%)	
Moderate	31(23.3%)	3(11.1%)	
Severe	29(21.8%)	0(0.0%)	
<i>Cat skin</i>			
No reaction	61 (45.9%)	21(77.7%)	$X^2 = 52.50$ , $df = 3$ $p < 0.001$
Mild	39(29.3%)	5(18.5%)	
Moderate	17(12.8%)	2(7.4%)	
Severe	16(12.0%)	0(0.0%)	
<i>Cockroach</i>			
No reaction	15(11.3%)	20(74.1%)	$X^2 = 49.58$ $df = 3$ $p < 0.001$
Mild	50(37.6%)	4(14.8%)	
Moderate	46(34.6%)	2(7.4%)	
Severe	73(54.9%)	2(7.4%)	
<i>Aspergillus fumigatus</i>			
No reaction	22(16.5%)	22(81.5%)	$X^2 = 48.59$ , $df = 3$ $p < 0.001$
Mild	45(33.8%)	4(14.8%)	
Moderate	12(9.0%)	2(7.4%)	
Severe	54(40.6%)	0(0.0%)	

## Discussion

Different types of environmental aeroallergens are known to play a role in triggering or exacerbating asthma. The skin test is immunologically the most consistent and quantitatively reproducible test in vivo [10]. The overall proportion of positive skin prick test to allergens found in this study group was 92% (n=148) in contrasts with the 37% (n=43) found in the control group (most of the subjects in the study group showed sensitivity to multiple allergens). This finding is higher than the observations of researchers like Ogunlade *et al* (65%) [11], Bandele (76%) [12], Kumar *et al* (71.5%) [13] who have carried out

industrialization in Lagos leading to more environmental pollutants that can exacerbate allergy.

A significant proportion of the asthmatics in this study had more positive skin reactions to the allergens than the controls. The house dust mite (*Dermatophagoides pteronyssinus*) was the most prevalent positive skin reaction (57%) among the asthmatics. This finding is similar to the observations of researchers in previous studies done; Onadeko and Sofowora (43%) [14], Awotodu *et al*. (58%) [15], Ogunlade *et al* (45%) [11], Potter *et al* (73%) [16], Ngahane (95.6%) [23]. House dust mite is abundant on the surface of mattresses, highly allergenic and

common in Nigeria and Nigeria being a tropical country with high humidity encourages the growth of mould and mite hence house dust mite is one of the commonest allergen in this environment. Celedon *et al* in a study done in China demonstrated that sensitization to dust mite predictive of asthma in families of asthmatic subjects [24]. Zureik *et al* demonstrated that sensitivity to airborne house dust mite increased with the severity of a person's asthma in a coordinated a large scale multi country cross-sectional survey carried out in United Kingdom, northern and southern Europe, the United States, New Zealand and Australia [25].

There is a higher incidence of severe reactions among the asthmatics to other tested allergens (grass mix, dog skin, cat skin, aspergillus, and cockroach) than the control. Cockroach allergen was the second most commonly recognized allergen in this study, because 50% of the asthmatic patients had positive reaction. Adanijo and Bandele reported a prevalence of 44% in Lagos [26]. The higher prevalence of cockroach allergen sensitivity obtained in Lagos may be due to dense population and cockroach infestation. Cockroach sensitisation was noted to be 40% in Western Cape, which is similar to the prevalence of 30-70% worldwide [27]. Dog dander was the third commonest allergen in this study.

A prevalence of 18% was observed in this study. This was similar to the finding reported by Ogunlade *et al* (11.3%) [17], Onadeko and Sofowora (14%) [20], Awotodu *et al*. (12.9%) [21] and Aderele *et al*. (7%) [28]. In this study, 11% of the asthmatics had severe reaction to *Aspergillus fumigatus*, this is similar to the observations of Bandele (5%) [18] in a similar study done in Lagos in 1980. In the present study, 16% of the asthmatics had severe reaction to grass mix allergen, this is lower to the previous findings of Bandele *et al* (21%) [18] and Warrell *et al* (30%) [29]. This implies that both indoor and outdoor allergens are responsible for allergic disorders in this environment. This finding is in agreement with the previous studies done both locally and internationally.

This study showed that asthmatics with concurrent allergic rhinitis were sensitive to multiple allergens (polysensitisation) and they also had higher proportion, more severe skin reactions to each of the allergen than asthmatics without allergic rhinitis. Several studies have reported that patients with both asthma and rhinitis have increased numbers and intensity of sensitization [30]. A cross sectional study in Italy reported polysensitization as a significant risk factor for asthma in AR patients [23].

Hence, the identification of causative allergen or allergens by skin testing is of great value which will enable patients to know the allergen that they are sensitive to. They can thus be educated about avoidance measures and may be considered for desensitization (immunotherapy). Our study has some limitations: limitation in the range of allergens used for the skin prick test and use of imported allergen kit, this is due to the fact that locally produced allergens are not readily available in Nigeria. Spirometry was not done in these patients due to logistics reasons hence this should be borne in mind for subsequent studies.

## Conclusion

Our study revealed 92% of asthmatics had positive skin prick test. Majority of them were sensitive to house dust mite. Intense skin reactivity and multiple sensitizations were markedly increased in patients with both allergic rhinitis and asthma. Physical measures and changing lifestyle to reduce dust mite allergen levels may improve respiratory symptoms in our patients with respiratory allergies.

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