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# Cockroach Allergy

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**ABSTRACT**

**Objective:** The aim of the study is to determine the frequency of Cockroach allergy, its percentage to other aeroallergens, to know the most common allergic disease caused by Cockroach aero allergen and to compare the result of this study with those of others.

**Material and Method:** This study included 484 patients who had positive aeroallergen skin test results, the Cockroach positive results were extracted from these 484 and study them, 81 patients were had Cockroach allergy, 43 (53%) male while 38 (46.9%) female, age range (5-65) years old. This study has been carried out in the Allergy and Asthma private clinic of Dr. Mohamed Abdal Satar Hamid in Wan global private hospital in Dohuk city in the period from January 2015- August 2018.

**Results:** Cockroach aeroallergen comes 3rd as a cause of respiratory allergy (16.7%) in multiple aeroallergen sensitive patients after 1st different types of pollen (36.7%) and 2nd mites (29.5%) but it is a first cause of respiratory allergy in single aeroallergen sensitive patients. It is more in urban areas and inner cities (60.4%) than rural areas (39.5%) and more in male (53%) than female (46.9%) and more in ages group from (26 - 35 ) than other age groups (38.2%) and the best time for its prevalence is the hot months (July- 16%, August- 12.3%). Allergic rhinitis (in this study) is the commonest respiratory allergic disease caused by Cockroach allergen (36.6%) followed by combined allergic rhinitis and asthma (27.8%) then followed by asthma alone (22.9%).

**Conclusion:** This study revealed that Cockroach aeroallergen is an important cause of upper and lower respiratory aeroallergen sensitivity and its effect is more prevalent than our estimation and there is big deficiency in the research for Cockroach allergy in our country and world.(key words: Cockroach, inner-city asthma, pests allergy, perennial asthma)

## INTRODUCTION

Insect inhalant allergy is a health problem worldwide due to cosmopolitan existence of those arthropods. Insect inhalant allergen are found indoor, outdoor, in homes and at work place. Sensitization can be due to airborne insect emanations in house dust or to occupational exposures encountered by professionals such as research entomologists [(1)]

Cockroach allergy is especially important for the development of asthma in inner cities among lower socioeconomic groups [(2)(3)]. Over 4000 species of Cockroach occur worldwide, the majority of which are not directly associated with human in their home and work environments. The two most common species associated with allergic disease are the:

1- American Cockroach (Periplanta Americana): is 34-53 mm long, reddish brown and capable of flight.
2- German cockroach (Blattella germanica): 16 mm long, brown, nocturnal, incapable of flight and strictly domestic.

**Public Health Importance of Cockroaches:**

Cockroach may adversely affect human health in several ways, include: Biting, Psychological stress, Contamination of food, Exposure to associated pathogen, Inhalant allergy.

Cockroach sensitization reported for 1st time by Brenton and Brown in the 1960s [(2)]. Sensitization and exposure to cockroach allergens and asthma has been confirmed by international studies. However, an association of exposure to cockroach protein with asthma is documented without evidence of allergy in other specific IgE .[(4)(5)]

Further convincing evidence was provided from a recent meta-analysis study summarizing research findings published from 2000 to 2013 0n indoor exposures, & exacerbation of asthma through PubMed suggests a causal relationship between cockroach allergens exposure & exacerbation of asthma, especially in adult who are sensitized to cockroach.[(6)] Cockroach allergy can result from initial sanitization to allergens mostly through inhalation, but also by ingestion or transdermal exposure due to abrasion or injection. Infestation by domiciliary cockroaches are largely dependent on housing conditions and

high-rise apartment have higher levels of cockroach allergens. [3][7][8] Potential sources of relevant cockroach allergens in the environment include: whole bodies, cast skins, egg casings and/ or fecal material.

Mild to moderate symptoms and induced by cockroach allergen inhalation include: sneezing and rhinorrhea, skin reaction, mild dermatitis and eye irritation with difficulty in breathing and possible anaphylactic episodes occurring in more severely allergic individuals. [9]

**Cockroach allergen cross reactivity:**

An analysis of 45 antigens in P. Americana and 29 antigens in B. germanica by cross immunoelectrophoresis and immunoblots identified per a 1(American cockroach allergen) and Bla g 1 (German cockroach allergen) as cross- reactive homologous allergens. [10] A70% - 72% amino acid identify between both allergens reveal the molecular basis of the allergic cross- reactivity. [11][12][13][14]

**Mechanism of cockroach allergen sensitization:**

Cockroach proteases increase Il – 8 expression in human bronchial epithelial cells via extracellular- signal- regulated kinase and activation of protease-activated receptor- 2 which are up regulated in respiratory epithelium from asthmatic patients. [15][16]

**- Diagnosis:**

Skin testing using crude whole- body extract is the gold standard to diagnosis cockroach allergy.
RAST, basophile histamine release and distal IgE are poor predictor of subsequent bronchial provocation results.
The aim of the study is to determine the frequency of Cockroach allergy, its percentage to other aeroallergens, to know the most common allergic disease caused by Cockroach aero allergen and to compare the result of this study with those of others.

## MATERIAL AND METHOD

The study was conducted in respiratory allergic patients (Asthma and Allergic Rhinitis) in Wan global Private Hospital in the period from January 2015-August 2018, (which is the period of opening the clinic & case collection till beginning the study writing & result obtaining).

After patent attendance, full history (a detailed history : the approach is similar to the standard medical history : history of presenting complaint, past medical history, drug history, social history, family history & review of system)[17], then physical examination and needed investigations (include complete pulmonary function testing & selected evaluation to reach the diagnosis of asthma and rhino laryngoscopy in needed cases to diagnose nasal polyp[17] in case of allergic rhinitis. . . etc.) had been done to reach the diagnosis[17].

Then stop all anti allergic medications and gave the patient an appointment after 10 days at least for skin prick testing (SPT) for allergy.
In the next visit, Skin Prick Test had been done; introduce a very small amount of the antigen into the dermis through the surface of the stratum corneum by prick method: a drop of antigen is placed on the skin & a sharp instrument (lancet) is passed through the drop, penetrating the skin at approximately a 45 degree angle. The device is then lifted, creating a small break in the epidermis. It is estimated that only 0.3 microliters of fluid is introduced into the skin. The mast cells are located in the dermis & on specific interaction of the antigen with the specific IgE, the mediators will be released to cause the wheal & flare reaction [17], then read the result after 20 minutes, & negative results were excluded from the study.

All positive skin spick test results are registered and they were 484 patients that had positive skin prick test for different aeroallergen, statistical analysis had been done to show the sequence of cockroach +ve skin prick test results in relation to other aeroallergen. Then cockroach positive skin prick test results were extracted and complete the study.

**Skin prick test (SPT) aeroallergens:**

The aeroallergens of SPT were obtained from 2 companions: (Immunoteck Spain and Allergopharma companies)

The aeroallergens included were: Dermatophagoid pternysinnus, D.Faraine, Blomia Tropicalis, Storage mites, Cockroach (American), Cockroach (German), House dust, Alternaria Alternata, Cladosporium, Penicillium, Aspergillus, 6 Grass mix, 4 cereals mix, Olive tree grass, Bermuda grass, Chenopodium album, Salsoli kale, Plantain, Mugwort, Cat dander, Dog dander, Ash tree pollen, - ve control, Positive (histamine) control.

Two + , three + and 4 + were labeled as positive skin test reaction.

**Criteria for exclusion:**

There are several causes for exclusion from this study which were: Negative SPT, Extremities of age (below 5 yr and above 65), Pregnant and lactating women, Diabetic patients and severely ill patents.

## RESULTS

From 484 positive different type aeroallergen prick test, 81 patients were positive skin prick test of cockroach aeroallergen, 43 (53%) were male and 38

(46.9%) were female, with age ranging from 5- 65 years old, and the detailed results as the following :
I – Allergens distribution:

**Table 1: (complete study aeroallergen distribution):**

| Type of Allergen | Mites | Molds | Cockroach | Pollen | Others |
|---|---|---|---|---|---|
| No. of Patients | 143 | 37 | 81 | 178 | 45 |
| % | 29.5 | 7.6 | 16.7 | 36.7 | 9.2 % |

**Table 2: (Single allergen patient's sensitive patients)**

| Type of allergen | DP | DF | Alternaria | Aspegillus | Cockroach | Pollen | Others |
|---|---|---|---|---|---|---|---|
| Vo. Of Patients | 6 | 1 | 7 | 1 | 20 | 12 | 3 |
| % from single allergen | 12 | 2 | 14 | 2 | 40 | 24 | 6 |
| % from all | 1.2 | 0.2 | 1.4 | 0.2 | 4.1 | 2.4 | 0.6 |

**Table 3: (Multiple allergen sensitive patient distribution)**

| Type of aero allergen | Mite | Mold | Cockroach | Pollen | Others |
|---|---|---|---|---|---|
| No. of Patients | 136 | 29 | 61 | 166 | 42 |
| % from multiple allergen group | 31.3 | 6.6 | 14 | 38.2 | 9.6 |
| % of all patients | 28 | 5.9 | 12.3 | 34.2 | 8.6 |

II - Cockroach Allergy:
Sexual distribution of cockroach allergy:
Male: 43 (53%)
Female: 38 (46.9%)
Age & sexual distribution of cockroach allergic patients :

**Table 4 :( age & sexual distribution)**

| 5-15 yr | | 26-35 yr | | 36-45 yr | | 46-55 yr | | 56-65 yr | |
|---|---|---|---|---|---|---|---|---|---|
| Male | Female | M | F | M | F | M | F | M | F |
| 1 | 4 | 16 | 15 | 8 | 12 | 3 | 2 | 3 | — |
| 1.2% | 4.9 | 19.7 | 18.5 | 9.8 | 14.8 | 3.7% | 2.4 | 3.7 | zero |
| % from all 6.1% | | 38.2 % | | 24.6 % | | 6.1 % | | 3.7 % | |

Residence distribution of cockroach allergy:
Urban areas: 49 patients (60.4%)
Rural areas: 32 (39.5%)

Monthly distribution of positive Cockroach skin test result:

**Table 5: (Monthly distribution of positive Cockroach skin test result)**

| Month | January | February | March | April | May | June | July | August | September | October | November | December |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| No. of patients | 9 | 5 | 6 | 3 | 9 | 1 | 13 | 10 | 2 | 7 | 9 | 7 |
| % | 11.1 | 6.1 | 7.4 | 3.7 | 11.1 | 1.2 | 16 | 12.3 | 2.4 | 8.6 | 11.1 | 8.6 |

Cockroach allergy distribution according to no. of aeroallergen sensitivity in cockroach sensitive patients are of 2 types:

1- Single aeroallergen (cockroach) sensitive patients = 20 patients (24.6%) as in table 6.
2- Multiple aeroallergen sensitive patients (cockroach with one or more from other aeroallergen group) = 61 patients (75.3%) as in table 7.

Distribution according to the type of clinical allergy:

1- Single aeroallergen sensitive patients:

**Table 6: (single aeroallergen distribution)**

| Type of allergic disease | Allergic rhinitis | Asthma | Throat allergy | Allergic rhinihs asthma | AR + skin allergy | AR + throat allergy |
|---|---|---|---|---|---|---|
| No. of patients | 5 | 3 | 4 | 4 | 3 | 1 |
| % from single type | 25 | 15 | 20 | 20 | 15 | 5 |
| % from all cock. sensitivity | 6.1 | 3.7 | 4.9 | 4.9 | 3.7 | 1.2 |

2- Multiple aeroallergen sensitive patients:

Table 7: (multiple aeroallergen distribution)

| Type of allergic disease | Allergic rhinitis | Asthma | Throat allergy | Skin | AR + asthma | AR + throat | AR + skin |
|---|---|---|---|---|---|---|---|
| No. of patients | 22 | 14 | 3 | 1 | 17 | 1 | 3 |
| % from multiple type | 36 | 22.9 | 4.9 | 1.6 | 27.8 | 1.6 | 4.9 |
| % from all cock. Sensitivity | 27.1 | 17.2 | 3.7 | 1.2 | 20.9 | 1.2 | 3.7 |

## DISCUSSION

In this study, allergic rhinitis is the commonest allergic disease caused by cockroach allergy followed by asthma (in adult and children), and cockroach allergy comes 3rd after pollen and mite (as a collective results). But the national cooperative inner- city asthma study found that exposure and sensitization to cockroach aeroallergen were associated with asthma morbidity in the children from 8 major inner- city areas in the United States. Of 476 children with asthma (age 4-7 years), (36.8%) were allergic to cockroach followed by dust mite (34.9%) than cat (22.7%). [18]

Kang and Eolleagues showed that 60% of patients with asthma in the Chicago are had positive skin test, serum IgE Ab or positive bronchial challenge test to B. germanica allergen. [19]

The relationship between cockroach allergy and asthma associated morbidity was confirmed in the late 1999s by Rosenstreich and colleagues.
Most importantly, however, was the finding that of the allergen sensitivities evaluated, only one (which is cockroach allergy) was related to asthma associated morbidity.
In addition, and as importantly, was the finding that sensitivity alone was not sufficient, but both cockroach- allergic and exposed to high levels of cockroach allergen (great than 8 U/gram of dust). Those patients unlike patients who were not cockroach- allergic or who were cockroach allergic but not exposed, had significantly greater unscheduled visit for asthma, days of wheezing, nights of disrupted sleep and school days missed.
Thus the results of this study confirmed that cockroach allergy plays a central role in asthma, especially asthma in inner- city residents. [20]

So, for cockroach allergy, the prevalence of sensitization is associated with the level of exposure and cockroach infestation is a strong factor for cockroach sensitization especially in inner- city population.

In this research, the result showed that urban area (inner- city) had more allergic patients than rural area, more exposures since the people spend more times indoor (in house, school, office or worker place) while in urban area, there are many people and workers outdoor as in the agricultural fields and so on.
Sensitization to indoor inhalant allergen is strongly associated with development of respiratory allergy and asthma.

In urban and inner city areas up to 80% of children with asthma may have IgE Ab to cockroach allergy. Infestation of domiciliary cockroach are largely dependent on housing condition. The average American spends approximately 95% of the time indoor in controlled environment that lead to continued low dose allergen exposure which may lead to sensitization in predisposed individuals. Amorphous cockroach particles containing allergens are recognized as an important source of indoor allergen together with dust mite particles.[9] Male more allergic to cockroach than female in this study, may be

due to that in our society most women are house wife and exposed only to indoor cockroach allergen while males are exposed to outdoor and indoor cockroach aeroallergen because of their work places.

Both mites and cockroach prefer the worm environment [20] and in this study, we found that the highest positive skin test result for cockroach allergen is in the hot months (July and August).

This cockroach allergy –as in other aeroallergen allergy- can be reduced by 2 methods after treat the patients with suitable needed pharmacotherapy:

1- Cockroach control measures :
Physical measures (reduce access to food & water& improve ventilation & eliminate hiding places& access points.

Chemical measures: (aerosol sprays of organophosphates like chlorpyrifos: pyrethrum or pyrethroids, boric acid powder &baits, organo guard (D-limonene). [9]

2- Cockroach Immunotherapy :

Cockroach immunotherapy for cockroach allergy holds promise as a treatment strategy with immunomodulatory & clinical effects in a limited number of trails [21]

But lack of standardized cockroach extract limits their potential to provide optimal clinical efficacy to patients. Thus further works are needed to identify major allergenic components in cockroach & clone immunodominant cockroach allergen products with enhanced clinical efficacy. [22]

## CONCLUSION

**The study revealed that:**

1- Cockroach aeroallergen is an important cause of upper and lower respiratory allergies.
2- Cockroach allergy is more prevalent than our expectations, so it is underestimated in our country and the world.
3- Inner cities are more prone to cockroach allergy.

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