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# Prevalence of common inhaled allergies in Erbil province, Kurdistan Region of Iraq

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**ABSTRACT:** Nowadays, inhaled allergens are the main causes of allergic diseases, which are derived from different sources such as animal dander, grasses, tree, insects and fungi/molds. Identification and detection of allergens play a critical role in the diagnosis and treatment of many allergic diseases. Aims were to determine the prevalence of most common inhaled allergens in Erbil province and determination the intensity of allergic response among allergic patients against 35 identified inhaled allergens items. A total number of 170 patients suffering from suspected inhalant allergy were checked in the present study. The study was carried out for patients who visited the private clinical sectors between 2018-2020 in Erbil province, Kurdistan Region of Iraq. Determination of specific IgE (sIgE) antibodies was examined for suspected patients. The country-specific inhaled allergy profile "Euroline inhaled Iraq 1" (Catalog no: DP 313816011 E, IVD approved, and CE certified EUROLINE immunoblot), containing strip for 35 different inhalant allergens, has been used in this study. Positive specific IgE to inhaled allergens was detected in 22.35% of our suspected patients. Orchard grass (21.05%) was the most inhaled allergen in our 38 allergic patients, followed by the Meadow foxtail (15.78%), Cockroach German and Sweet vernal grass (13.15%). Based on the present study results, we conclude that the prevalence of inhaled allergy differed between men and women in different age groups. Our study reached that there were no associations between inhaled allergens and sex or age.

**Keywords:** Allergic diseases; Inhalant allergens; IgE; Erbil and Euroline inhaled Iraq 1.

## 1. INTRODUCTION

The prevalence of allergic diseases, such as allergic rhinitis, bronchial asthma, and atopic dermatitis, has risen steadily over the last decades [1]. Allergic sensitization to the inhaled antigens is normal but incomprehensible. While lung epithelial cells were initially considered merely as a passive barrier impeding the penetration of allergens [2]. Aeroallergens trigger eosinophilic inflammation and hyper-responsiveness of the airways through various immunological cells, orchestrated by T helper 2 (Th2) cells and their released cytokines [3]. There are several possible etiological causes, in addition to host and environmental causes, viruses, bacteria and fungi have all been implicated with the possibility of a number of underlying endotypes [4].

Aeroallergens (airborne allergens) play an important role in the initiating and pathogenesis of allergic respiratory diseases. Dust mites, pollens, molds, fungal spores, feces of insects and animal dandruff are the most important allergens involved in causing allergic reactions, but the distribution of different aeroallergenic compounds varies widely from country to country [5, 6]. A recent practice update from American allergy organizations suggested that immunotherapy for allergens could be considered in selected patients with atopic dermatitis with aeroallergen sensitivity [7]. Allergic reactions may result from different antigen-bearing agents such as foods, insect stings, soaps, feathers, cosmetic fibers, etc. [8].

Total Serum Immunoglobulin E or IgE was the initial allergy screening study, and increased total serum IgE may be in support of allergy diagnosis because some physicians find it the first laboratory test. However, the elevated total IgE level is non-specific, like skin reactivity and it is not only strict with allergies but also with other diseases such as helminthic infections, alcoholism, some malignancies, etc. [9]. Elevated rates of total serum immunoglobulin E (IgE) and sensitization to different inhalant allergens were observed in patients suffering from allergic diseases such as (atopic dermatitis, allergic rhinitis), which are associated with the development of chronic childhood asthma. A high level of serum immunoglobulin IgE and sensitization to various inhalants, foods and microbial allergens noticed in lower respiratory tract infections, peripheral blood eosinophilia, and patients exposed to ambient tobacco smoke (ETS) [10].

## 2. MATERIAL AND METHODS

### 2.1. Sample collection

All 170 blood samples were collected from patients suspected of inhalation allergy at private clinical sectors in Erbil province, Kurdistan Region of Iraq between 2018 to 2020. All blood samples were collected inside the (10 ml) gel tubes containing clotting activators; after clotting, they were centrifuged for 15 minutes at 5000 rounds per minute (RPM). Serum samples were subjected to determine varieties of inhalant allergens by using country-specific inhalation allergy kits, regarding the manufactures instructions for test performance. Blood samples were sorted in the different aged groups (13-30 and 31-52 years) and also classifying them regarding the genders (males and females).

### 2.2. Detection of specific IgE for inhaled allergens

Clarifications of inhaled allergies can carry out by using various inhaled allergy profiles. Human IgE antibodies against the most frequent inhaled allergens in serum, can determine semi-quantitatively or qualitatively based on the test system. Country-specific inhaled allergy profiles vary in their allergen composition and are optimized concerning the regional conditions. The EUROLINE test kit provides semi-quantitative in vitro determination of allergen-specific (sIgE) in serum, contributing to the diagnosis of allergies. The test is a multiparameter assay containing optimized combinations of relevant allergens, enabling the analysis of sIgE against these different allergens in one test. In this study, we used the country-specific inhalation allergy profile “Euroline inhaled Iraq 1” (Catalog no: DP 3138-1601-1E, IVD-approved CE-certified EUROLINE immunoblot) test kit contains a strip with 35 different allergens. All serum samples have been subjected to determinations of inhalation allergies according to the manufacturer's instructions. Briefly, test strips were coated with 35 inhaled allergens: Cat (e1), Dog (e2), Horse (e3), Cow (e4), Sheep (e81), Feather mix 1 (es2), Cage bird mix 2 (es172), *Anthoxanthum odoratum* (g1), *Dactylis glomerata* (g3), *Secale cereale* (g12), *Avena sativa* (g14), *Alopecurus pratensis* (g16), *Artemisia vulgaris* (w6), *Plantago lanceolata* (w9), *Chenopodium album* (w10), *Salsola kali* (w11), *Amaranthus retroflexus* (w14), *Bassia*

*scoparia* (w17), Rose (w28), *Rumex acetosella* (w100), *Acer negundo* (t1), *Fraxinus acuminata* (t15), *Pinus strobus* (t16), *Morus* sp. (t70), Tree mix 4 (ts22), Tree mix 6 (ts26), Honey bee venom (i1), Cockroach, German (i6), House dust (h1), *Dermatophagoides pteronyssinus* (d1), *Dermatophagoides farinae* (d2), *Penicillium notatum* (m1), *Cladosporium herbarum* (m2), *Aspergillus fumigatus* (m3), *Alternaria alternata* (m6). In addition to inhalant allergens, strip coated with a cross-reactive carbohydrate determinant (CCD) and an indicator band. Test strips are first moistened with 1.0 ml of working strength universal buffer for (5) minutes, then aspirate off all liquid. Directly incubated with 400 µl of undiluted patient serum to bind s-IgE antibodies if present. If samples contain specific class IgE antibodies, they will bind to the allergens coated on the strip. Subsequently, the bound s-IgE antibodies were detected using an enzyme-linked anti-human IgE catalyzing a color reaction. After stopping the reaction using deionized or distilled water, place the incubated test strip onto the adhesive foil of the green work protocol (created in the EUROLINE scan program) using a pair of tweezers. The position of the test strips can be corrected while they are wet. As soon as all test strips have been placed onto the protocol, they should be pressed hard using filter paper and left to air dry. The drying process should take place without any direct light in a room as dark as possible. After they have dried, the test strip will be stuck to the adhesive foil. Incubated strips that are still moist show a background coloring that disappears when they are completely dry. Therefore the evaluation of the strips only takes place after strips have completely dried. Class of antibodies can be classified into the following types depending on the concentration range and their explanation (Table 1).

Patients' rights and ethics approval statement explaining: Ethical approval for this research has not been obtained from the institutional review board or committee because all blood samples have been collected from a private clinical diagnostic laboratory, which officially has been recognized by the Ministry of Health Kurdistan Regional government of Iraq. Ministry of Health instructions for Ethical criteria and patient's rights mandatory should consider all diagnostic laboratories in the Kurdistan Region of Iraq. Contentment for blood drawing orally earned from all patients after proceeding with all ethical instructions. Patients' and clients' information (name, age, and gender) electronically submitted to the lab database.

**Table 1.** Classes of antibodies with concentration range and explanations.

| Class | Concentration [Ku/I] | Explanation |
|---|---|---|
| 0 | < 0.35 | No specific antibodies detected |
| 1 | 0.35 ≤ sIgE < 0.7 | Very weak antibody detection |
| 2 | 0.7 ≤ SIgE < 3.5 | Weak antibody detection |
| 3 | 3.5 ≤ sIgE < 17.5 | Definite antibody detection |
| 4 | 17.5 ≤ sIgE < 50 | Strong antibody detection |
| 5 | 50 ≤ sIgE < 100 | Very high antibody titer |
| 6 | ≥ 100 | Very high antibody titer |

### 2.3. Statistical analysis

The chi-square was applied to examine the relationship between the prevalence of inhaled allergens and the types of antibody detection in allergic patients from different sexes and aged groups. P-values < 0.05 were considered to be statistically significant.

## 3. RESULTS

The present study illustrated that the prevalence of inhalation allergy (measured by specific IgE concentration) in men is 10% and 12.35% in women. The inhalation allergy rate in 13-30 years was 12.35% and in 31-52 years was 10%. Table 2 clarifies the prevalence of inhaled allergy between different aged groups, with males and females. Prevalence of positive results for 35 inhaled allergens items in all 170 screened samples illustrated in Table 3, regarding aged groups and genders.

**Table 2.** Distribution of positive and negative inhaled allergy according to ages and gender.

| **Age groups (Years)** | **N (%) positive** | **N (%) negative** |
|---|---|---|
| 13-30 | 21 (12.35) | 55 (32.35) |
| 31-52 | 17 (10) | 77 (45.29) |
| Total | 38 (22.35) | 132 (77.64) |
| **Gender** | **N (%) positive** | **N (%) negative** |
| Male | 17 (10) | 77 (45.29) |
| Female | 21 (12.35) | 55 (32.35) |
| Total | 38 (22.35) | 132 (77.64) |

**Table 3.** Prevalence of positive inhaled allergy in all 170 screened samples according to gender and aged groups.

| **Inhaled allergy** | **Number of screened** | | **Positive inhaled allergy** | | **Number of screened** | | **Positive inhaled allergy** | |
|---|---|---|---|---|---|---|---|---|
| | **Sex N (%)** | | | | **Age N (%)** | | | |
| | **Male** | **Female** | **Male** | **Female** | **13-30** | **31-52** | **13-30** | **31-52** |
| Cat | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| Dog | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |
| Horse | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |
| Cow | 76 | 94 | 1 (1.31) | 1 (1.06) | 76 | 94 | 1 (1.31) | 1 (1.06) |
| Sheep | 76 | 94 | 2 (2.63) | 1 (1.06) | 76 | 94 | 2 (2.63) | 1 (1.06) |
| Feather mix 1 | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |
| Cage bird mix 2 | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |
| Sweet vernal grass | 76 | 94 | 3 (3.94) | 2 (2.12) | 76 | 94 | 3 (3.94 | 2 (2.12) |
| Orchard grass | 76 | 94 | 5 (6.57) | 3 (3.19) | 76 | 94 | 6 (7.89) | 2 (2.12) |
| Cultivated rye | 76 | 94 | 2 (2.63) | 2 (2.12) | 76 | 94 | 3 (3.94 | 1 (1.06) |
| Cultivated oat | 76 | 94 | 4 (5.26) | 1 (1.06) | 76 | 94 | 3 (3.94 | 2 (2.12) |
| Meadow foxtail | 76 | 94 | 5 (6.57) | 1 (1.06) | 76 | 94 | 4 (5.26) | 2 (2.12) |
| Mugwort | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| English plantain | 76 | 94 | 1(1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 1 (1.06) |
| Goosefoot | 76 | 94 | 2 (2.63) | 0(0) | 76 | 94 | 2 (2.63) | 0 (0) |
| Russian thistle | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| Rough pigweed | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| Firebush (Kochia) | 76 | 94 | 2 (2.63) | 0 (0) | 76 | 94 | 1 (1.31) | 1 (1.06) |
| Sorrel | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| Rose | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |
| Box elder | 76 | 94 | 3 (3.94) | 1 (1.06) | 76 | 94 | 3 (3.94 | 1 (1.06) |
| White ash | 76 | 94 | 2 (2.63) | 0 (0) | 76 | 94 | 1 (1.31) | 1 (1.06) |
| White pine | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |

| Inhaled allergy | Number of screened | | Positive inhaled allergy | | Number of screened | | Positive inhaled allergy | |
|---|---|---|---|---|---|---|---|---|
| | Sex N (%) | | | | Age N (%) | | | |
| | **Male** | **Female** | **Male** | **Female** | **13-30** | **31-52** | **13-30** | **31-52** |
| Mulberry tree | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| Tree mix 4 | 76 | 94 | 2 (2.63) | 0 (0) | 76 | 94 | 2 (2.63) | 0 (0) |
| Tree mix 6 | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| Honey bee venom | 76 | 94 | 2 (2.63) | 2 (2.12) | 76 | 94 | 2 (2.63) | 2 (2.12) |
| Cockroach, German | 76 | 94 | 3 (3.94) | 2 (2.12) | 76 | 94 | 2 (2.63) | 3 (3.19) |
| House dust | 76 | 94 | 0 (0) | 2 (2.12) | 76 | 94 | 2 (2.63) | 0 (0) |
| *Dermatophagoides farina* | 76 | 94 | 2 (2.63) | 2 (2.12) | 76 | 94 | 1 (1.31) | 3 (3.19) |
| *Dermatophagoides pteronyssinus* | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 0 (0) | 1 (1.06) |
| *Penicillium notatum* | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |
| *Cladosporium herbarum* | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |
| *Aspergillus fumigatus* | 76 | 94 | 1 (1.31) | 0 (0) | 76 | 94 | 1 (1.31) | 0 (0) |
| *Alternaria alternata* | 76 | 94 | 0 (0) | 0 (0) | 76 | 94 | 0 (0) | 0 (0) |

Out of 170 samples, 38 of them were given positive results for different inhaled allergens items. Table 4 shows the prevalence percentage for different allergen items among the 38 allergenic patients.

**Table 4.** Prevalence [number and (%)] of inhaled allergens in all 38 allergic patients.

| Animal dander | Grasses | Tree | Insects | Fungi/ Molds |
|---|---|---|---|---|
| Cat<br>1 (2.63) | Sweet vernal grass<br>5 (13.15) | Rose<br>0 (0) | Honey bee venom<br>4 (10.52) | *Penicillium notatum*<br>0 (0) |
| Doge<br>0 (0) | Orchard grass<br>8 (21.05) | Box elder<br>4 (10.52) | Cockroach, German<br>5 (13.15) | *Cladosporium herbarum*<br>0 (0) |
| Horse<br>0 (0) | Cultivated rye<br>4 (10.52) | White ash<br>2 (5.26) | House dust<br>3 (7.89) | *Aspergillus fumigatus*<br>1 (2.63) |
| Cow<br>2 (5.26) | Cultivated oat<br>5 (13.15) | White pine<br>1 (2.63) | *Dermatophagoides farina*<br>4 (10.52) | *Alternaria alternata*<br>0 (0) |
| Sheep<br>3 (7.89) | Meadow foxtail<br>6 (15.78) | Mulberry tree<br>1 (2.63) | *Dermatophagoides pteronyssinus*<br>1 (2.63) | |
| Feather mix 1<br>0 (0) | Mugwort<br>1 (2.63) | Tree mix 4<br>2 (5.26) | | |
| Cage bird mix 2<br>0 (0) | English plantain<br>2 (5.26) | Tree mix 6<br>1 (2.63) | | |
| | Goosefoot<br>2 (5.26) | | | |
| | Russian thistle<br>1 (2.63) | | | |
| | Rough pigweed<br>1 (2.63) | | | |
| | Firebush (Kochia)<br>2 (5.26) | | | |
| | Sorrel<br>1 (2.63) | | | |

Prevalence percentage for all allergen items has been checked in all positive cases regarding age groups and gender (Table 5).

**Table 5.** Prevalence (%) of inhaled allergens in all 38 allergic patients according to aged groups and gender.

| Item number | Inhaled allergens | Aged groups | | Gender | |
|---|---|---|---|---|---|
| | | 13-30 | 31-52 | Male | Female |
| 1. | Cat | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 2. | Dog | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 3. | Horse | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 4. | Cow | 1 (4.76) | 1 (5.88) | 1 (5.88) | 1 (4.76) |
| 5. | Sheep | 2 (9.52) | 1 (5.88) | 2 (11.76) | 1 (4.76) |
| 6. | Feather mix 1 | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 7. | Cage bird mix 2 | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 8. | Sweet vernal grass | 3 (14.28) | 2 (11.76) | 3 (17.64) | 2 (9.52) |
| 9. | Orchard grass | 6 (28.57) | 2 (11.76) | 5 (30) | 3 (14.28) |
| 10. | Cultivated rye | 3 (14.28) | 1 (5.88) | 2 (11.76) | 2 (9.52) |
| 11. | Cultivated oat | 3 (14.28) | 2 (11.76) | 4 (23.52) | 1 (4.76) |
| 12. | Meadow foxtail | 4 (19.04) | 2 (11.76) | 5 (30) | 1 (4.76) |
| 13. | Mugwort | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 14. | English plantain | 1 (4.76) | 1 (5.88) | 1 (5.88) | 0 (0) |
| 15. | Goosefoot | 2 (9.52) | 0 (0) | 2 (11.76) | 0 (0) |
| 16. | Russian thistle | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 17. | Rough pigweed | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 18. | Firebush (Kochia) | 1 (4.76) | 1 (5.88) | 2 (11.76) | 0 (0) |
| 19. | Sorrel | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 20. | Rose | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 21. | Box elder | 3 (14.28) | 1 (5.88) | 3 (17.4) | 1 (4.76) |
| 22. | White ash | 1 (4.76) | 1 (5.88) | 2 (11.76) | 0 (0) |
| 23. | White pine | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 24. | Mulberry tree | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 25. | Tree mix 4 | 2 (9.52) | 0 (0) | 2 (9.52) | 0 (0) |
| 26. | Tree mix 6 | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 27. | Honey bee venom | 2 (9.52) | 2 (11.76) | 2 (17.4) | 2 (9.52) |
| 28. | Cockroach, German | 2 (9.52) | 3 (14.28) | 3 (17.4) | 2 (9.52) |
| 29. | House dust | 2 (9.52) | 0 (0) | 0 (0) | 2 (9.52) |
| 30. | *Dermatophagoides farina* | 1 (4.76) | 3 (14.28) | 2 (11.7) | 2 (9.52) |
| 31. | *Dermatophagoides pteronyssinus* | 0 (4.76) | 1 (5.88) | 1 (5.88) | 0 (0) |
| 32. | *Penicillium notatum* | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 33. | *Cladosporium herbarum* | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| 34. | *Aspergillus fumigatus* | 1 (4.76) | 0 (0) | 1 (5.88) | 0 (0) |
| 35. | *Alternaria alternata* | 0 (0) | 0 (0) | 0 (0) | 0 (0) |
| | P value | 0.11 | 0.13 | 0.13 | 0.07 |

Class of allergic response and the intensity of the response to all inhaled allergen items have been checked in all positive cases. Table 6 illustrates the prevalence percentage of inhaled allergen items with class and intensity of allergic response.

**Table 6.** Prevalence (%) of inhaled allergens with class and intensity of antibody detection in all 38 allergic patients.

| Number | Inhaled allergens | No specific antibody detected (class 0) | | Very weak antibody detection (class 1) | | Weak antibody detection (class 2) | | Definite antibody detection (class 3) | | Strong antibody detection (class 4) | | Very high antibody titer (class 5) | | Total | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | N | % | N | % | N | % | N | % | N | % | N | % | N | % |
| 1. | Cat | 37 | 97.36 | 0 | 0 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 2. | Dog | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 3. | Horse | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 4. | Cow | 36 | 94.73 | 1 | 2.63 | 1 | 2.63 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 5. | Sheep | 35 | 92.10 | 2 | 5.26 | 1 | 2.63 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 6. | Feather mix 1 | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 7. | Cage bird mix 2 | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 8. | Sweet vernal grass | 33 | 86.84 | 2 | 5.26 | 0 | 0 | 2 | 5.26 | 1 | 2.63 | 0 | 0 | 38 | 100 |
| 9. | Orchard grass | 30 | 78.94 | 4 | 10.52 | 1 | 2.63 | 0 | 0 | 3 | 7.89 | 0 | 0 | 38 | 100 |
| 10. | Cultivated rye | 34 | 89.47 | 0 | 0 | 1 | 2.63 | 3 | 7.89 | 0 | 0 | 0 | 0 | 38 | 100 |
| 11. | Cultivated oat | 33 | 86.84 | 1 | 2.63 | 1 | 2.63 | 0 | 0 | 3 | 7.89 | 0 | 0 | 38 | 100 |
| 12. | Meadow foxtail | 32 | 84.21 | 1 | 2.63 | 2 | 5.26 | 0 | 0 | 1 | 2.63 | 2 | 5.26 | 38 | 100 |
| 13. | Mugwort | 37 | 97.36 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 14. | English plantain | 36 | 94.73 | 1 | 2.63 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 15. | Goosefoot | 36 | 94.73 | 1 | 2.63 | 0 | 0 | 0 | 0 | 1 | 2.63 | 0 | 0 | 38 | 100 |
| 16. | Russian thistle | 37 | 97.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.63 | 38 | 100 |
| 17. | Rough pigweed | 37 | 97.36 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 2.63 | 38 | 100 |
| 18. | Firebush (Kochia) | 36 | 94.73 | 1 | 2.63 | 0 | 0 | 0 | 0 | 1 | 2.63 | 0 | 0 | 38 | 100 |
| 19. | Sorrel | 37 | 97.36 | 0 | 0 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 20. | Rose | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 21. | Boxelder | 34 | 89.47 | 3 | 7.89 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 22. | White ash | 36 | 94.73 | 1 | 2.3 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 23. | White pine | 37 | 97.36 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 24. | Mulberry tree | 37 | 97.36 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 25. | Tree mix 4 | 36 | 89.47 | 1 | 2.63 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 26. | Tree mix 6 | 37 | 97.36 | 0 | 0 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 27. | Honey bee venom | 34 | 89.47 | 1 | 2.63 | 1 | 2.63 | 1 | 2.63 | 1 | 2.63 | 0 | 0 | 38 | 100 |
| 28. | Cockroach, German | 33 | 86.84 | 1 | 2.63 | 3 | 7.89 | 2 | 5.26 | 1 | 2.63 | 0 | 0 | 38 | 100 |
| 29. | House dust | 36 | 86.47 | 2 | 5.26 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 30. | *Dermatophagoides farina* | 34 | 89.47 | 3 | 7.8 | 0 | 0 | 1 | 2.63 | 0 | 0 | 0 | 0 | 38 | 100 |
| 31. | *Dermatophagoides pteronyssinus* | 37 | 97.36 | 1 | 2.63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 32. | *Penicillium notatum* | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 33. | *Cladosporium herbarum* | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 34. | *Aspergillus fumigatus* | 38 | 100 | 1 | 2.63 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| 35. | *Alternaria alternata* | 38 | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 100 |
| P value | | 0.99 | | 0.1 | | 0.19 | | 0.19 | | 0.006 | | 0.05 | | | |

## 4. DISCUSSION

This research was conducted to determine the prevalence of inhaled allergens in the Kurdistan Region of Iraq, Erbil province. We were unable to find any reported data on the prevalence of inhalation allergy in Erbil. A total of 94 men (55.29%) and 76 women (44.71%) were studied and their ages were between 13 and 52 years and the average age was 32.57±1.36 years. They split into two age classes, the first ranging from 13 to 30 years 76 (44.71%), and the second ranging from 31 -52 years 94 (55.29%). We will also assess the prevalence of inhaled allergens and their relation to gender and aged groups for more detail (Table 1).

Totally 38% of the patients with suspected allergy were positively sensitized and give the positive result for specific IgE to at least one of the 35 inhaled allergen items. This percentage goes with various studies conducted worldwide for instance: the sensitization to aeroallergens was 26.7% in the Northern Sweden population [11], 23.1% in Turkey [12], 46.77% in India [13], 42.8% in sub-Saharan Africa, 34% in Tunisia [14] and 30.7% in Uganda [15].

The present study demonstrated that the prevalence percentage of Cultivated rye and Meadow foxtail 6.57%, Cultivated oat 5.26%, Boxelder, Sweet vernal grass, and Cockroach, German 3.94%, were the most common inhaled allergens in male respectively. On the other hand, Orchard grass 3.19% followed by Sweet vernal grass, Cultivated rye, Honey bee venom, Cockroach, German, House dust and Dermatophagoides farina 2.12% were identified as the most common inhaled allergens in females respectively. Skin prick test positivity to any of the measured allergens varied within Europe from 31.4% to 52.9%. These findings showed prevalence lower than findings of a study conducted in china 84.4% for house dust mites (HDMs), 23.4% for pet allergens, 21.1% for cockroaches, 9.1% for mold allergens, 7.7% for tree pollen, and 6.0% for weed pollen [16]. The prevalence of sensitization to single allergens also varied. Variation in serum total IgE was less marked [17]. The researcher found that 26.5% were sensitized, including dogs (15.5%) and cats (9.2%). Additionally, tree sensitization was demonstrated in the youngest age group (7.8% at 0-2 years; 17.1% at 2-4 years) [18]. The most common four allergens in male patients with allergic rhinitis were *Dermatophagoides farina* (Der f), *Dermatophagoides pteronyssinus* (Der p), Mugwort, and *Blatella germanica*. In contrast, Der f, Der p, Mugwort, and *Chenopodium album* were the most common in female patients [19].

The prevalence of positive inhaled allergens in the aged 13-30 years was higher than in the second aged group 31-52 years. Our results showed that Cultivated rye has the highest prevalence percentage among other allergens, which was 7.89%, and followed by Meadow foxtail 5.26%, cultivated oat, Boxelder was 3.94% in 13-30 years. However, in the second aged group 31-52 years, House dust and *Dermatophagoides farina* were noticed as the most common allergens 3.19%. Based on data reported by Sakashita et al., which suggest that the prevalence of inhalation allergy in patients whose ages were between 20 and 49 years has increased by nearly 10% during the last 10 years [20]. On the other hand, in the study conducted among the top ten allergens, the top three positive ones in all groups, was *Dermatophagoides pteronyssinus*, *D. farina*, and house dust. Also, there were significant differences between the 4-17-year-olds group and the other age groups [21].

In this study, 35 common aeroallergens were sorted into 5 groups (animal dander, grasses, tree mix, insects and fungi/molds), they were studied in all 38 allergic patients. The results illustrated that sheep dander 7.89%, Orchard grass 21.05%, Meadow foxtail 15.78%, Boxelder 10.52%, Tree mix 4 contains (elm, plane

tree, willow, poplar, cypress) 5.25% and Tree mix 6 contains (alder, birch, hazel, oak, olive tree, plane tree) 2.63%, cockroach German 13.15% in insects and *Aspergillus fumigatus* among fungi and molds 2.63% showed that they have the highest prevalence respectively. Also, we have no detected some of the inhaled allergens from 3 out of 5 groups such as in Feather mix 1 (contains chicken feathers, duck feathers, and goose feathers), Cage bird mix 2 (contains budgerigar feathers, canary bird feathers, parrot feathers, rose-ringed parakeet feathers, and finch feathers), dog and horse in animal dander groups, Rose from tree groups, *Penicillium notatum*, *Cladosporium herbarum* and *Alternaria alternata* from fungi/molds groups (Table 3). The prevalence of allergy to furry animals has been increasing, and allergy to cats, dogs, or both is considered a major risk factor for developing asthma and rhinitis [22]. The Shanghai study concluded that mites, cockroaches, and dog dander are the most common inhaled allergens [23]. Sensitization to mites had the first rank in Tetouan then followed by grass pollen and olive in sensitized patients [24, 25] reported that the most common offending allergen was *Dermatophagoides pteronyssinus* (19.5%), then followed by *D. farinae* (17.2%), *Tyrophagus putrescentiae* (10.1%), *Trichophyton* (9.5%), rabbit fur (7.8%), mugwort (7.4%), cockroach (6.5%) and orchard grass respectively (4.9%).

There are differences among allergic patients for types of inhaled allergens, according to genders and aged groups. The highest percentage of inhaled allergens were in Orchard grass and Meadow foxtail 5 (30%), Meadow foxtail 4 (23.52%) in the male group, while in the female group, the most inhaled allergens were observed in cultivated rye, Orchard grass, cultivated oat, Honey bee venom, German cockroach, House dust, and *Dermatophagoides farina*. Statistically, there was no significant relationship between inhaled allergens in men and women, and the p-value were 0.07 and 0.13, respectively. Based on our results, in the female group, no positive results observed for these items English plantain, Goosefoot, Russian thistle, Rough pigweed, Firebush (Kochia), Sorrel, White ash, White pine, Mulberry tree, Tree mix 4, Tree mix 6, *Dermatophagoides pteronyssinus* and *Aspergillus fumigatus*, but these inhaled allergens were detected in different percentage in male groups. In contrast, some inhaled allergens such as dog and horse dander, Feather mix 1, Cage bird mix 2, rose and *Alternaria alternata* were not detected in both groups (male and female). There are many differences in the prevalence of inhaled allergens in allergic patients based on the aged groups. For instance, in allergic patients in both aged groups (13-30 and 31-52 years), no allergic responses have been detected against these items dog and horse dander, Feather mix 1, Cage bird mix 2, Rose, *Penicillium notatum*, *Cladosporium herbarum*, and *Alternaria alternata*. There are no statically differences between these two groups, and the p-value was 0.11 in 13-30 years, statically not significant. However, the p-value was 0.13 in 31-52 years (Table 4).

Immunoglobulin E (IgE) is a critical component of allergic diseases [26, 27]. The local IgE induced by common aeroallergens may mediate mast cell activation [28]. Increased serum IgE levels are characteristic but not specific for allergic diseases [29]. Eosinophilic asthma exhibits higher total serum IgE and animal dander sensitization rate, although clinical severity was not preferentially associated with any form of common aeroallergens, although it was also associated with higher total IgE [30].

The classes of antibody detection vary among 35 different inhaled allergens. Classes of antibodies expressed as: No specific antibodies detected, Very weak antibody detection, Weak antibody detection, Definite antibody detection, Strong antibody detection, and Very high antibody titer. The highest frequency of Very high antibody titer was detected only in Meadow foxtail 5.26%, Russian thistle, and Rough pigweed 2.63%. Also, the p-value was 0.05 and statistically was significant. Out of 35 inhaled allergens, only in 8 of them, Strong antibody has been detected. The highest rate of Strong antibody has been found in Orchard grass

and Cultivated oat (7.89%) rather than 5 remained inhaled allergens. Statistically, a strong and significant relationship was observed between inhaled allergens and antibody detection classes, and the p-value was 0.006. Very weak antibody detection was observed in the most inhaled allergen. No allergic reactions recorded for these allergens in different groups: cat, dog, horse, Feather mix 1, Cage bird mix 2, Cultivated rye, Mugwort, Russian thistle, Rough pigweed, Sorrel, rose, White pine, Mulberry tree, Tree mix 6, *Penicillium notatum*, *Cladosporium herbarum* and *Alternaria alternata.* Orchard grass was showed the highest frequency of very weak antibodies, 10.52% and statistically not significant, the p-value was 0.1. Also, for most of the inhaled allergens, weak antibodies were seen and the highest prevalence of weak antibodies was seen in the German cockroach, 7.89%, and there was no relationship between inhaled allergens and antibodies detection in class 2 and the value was 0.19. Definite antibodies were detected in certain inhaled allergens and the p-value was (0.19) and the association between allergic patients was not statistically significant with the inhaled allergens. Among the 35 allergic inhalants, many antibodies were found in the Meadow foxtail (Table 5).

## 5. CONCLUSIONS

Our work represents the first prevalence and detection study for the 35 inhaled allergens in different genders and aged groups in Erbil province, among allergic patients. The highest prevalence of inhalation allergy was observed in females than the males and the highest frequency of inhalation allergy seen among the (13-30 years) allergic patients compared with (31-52 years).

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