


# Allergic rhinitis facts from an Irish pediatric population

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## Abstract

**Objective:** Assessing the main allergens in the pediatric population from the largest urban area in the country.

**Methods:** Clinical letters of patients referred with possible allergic rhinitis (AR) were retrospectively reviewed over the past 5 years.

**Results:** Five hundred and fifty-five patients were included. Males suffer twice as often with AR than females and have high titers of allergens. House dust mites (44.7%) and grass pollen (29%) were the main allergens in our area, with 48% of patients sensitized to both allergens. Half of the patients had the diagnosis of AR confirmed with positive allergen-specific tests. For the other half, the diagnosis was based on a clinical assessment performed by a pediatric otolaryngologist.

**Conclusions:** Half of suspected AR children have environmental allergen sensitivity confirmed by testing, and a large number had a clinical diagnosis of AR after an otolaryngology consultation. Our findings can help clinicians to initiate AR treatment considering the most problematic allergens in the area.

## KEYWORDS

aeroallergens, allergic rhinitis, grass pollens, house dust mites, skin prick

## Key points

- Significant findings of the study: House dust mites followed by grass are the main allergens in our area. Half of our population is sensitized to both allergens.
- What this study adds: Allergen testing can be targeted, avoiding unnecessary costs and patient distress. Effective avoidance measurements can be started based on the most common allergens found in the area, considering sensitization to both allergens. Treatment should be initiated using nasal sprays, providing technical instructions, and escalated as per Allergic Rhinitis and its Impact on Asthma guidelines.

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## INTRODUCTION

Allergic rhinitis (AR) is poorly understood and underdiagnosed by clinicians worldwide despite its rising prevalence.<sup>1,2</sup> In the pediatric population, worldwide AR incidence has been reported to be as high as 40%.<sup>3,4</sup>

Besides the characteristic AR symptoms of nasal blockage, rhinorrhoea, nasal itching, and sneezing, in pediatric patients sleep disturbance, chronic cough, or epistaxis can also be present.<sup>5-13</sup> Children diagnosed with AR were found to have a 2.1 higher incidence rate of obstructive sleep apnea (OSA).<sup>8</sup> Kheirandish-Goza et al.<sup>9</sup> reported that 80.5% of children with AR and OSA had improvement their OSA symptoms if medical treatment for AR was started.

The patient's immune system response after allergen exposure is responsible for AR symptoms. This is a step-wise reaction, with a primary response within minutes (due to mast cell degranulation) and a late phase, after hours (due to the release of other inflammatory mediators).

If AR symptoms do not affect the patient's daily activities, they are considered mild. In moderate-severe symptoms, the patient's lifestyle is disturbed. AR can also be classified as persistent (secondary to indoor allergen sensitization) or intermittent (secondary to outdoor allergen sensitization).<sup>5</sup> House dust mites, molds, and animal dander represent indoor allergens, while grass, tree, and weed pollen are outdoor allergens. Symptom severity and timing depend on the geographic area, degree of urbanization, and pollination periods for specific plants.

Many risk factors have been associated with AR. These include being born during pollen season, male sex, parental smoking in the first year of life, early use of antibiotics, and early exposure to indoor allergens, such as house dust mites.<sup>14-16</sup> Personal or family history of atopy also increases the possibility of AR. Childhood AR was strongly associated with an increased risk of asthma in preadolescence, adolescence, and adult life.<sup>14</sup> House dust mites AR was specifically found to correlate with an increased risk of asthma.<sup>17</sup> A high index of AR suspicion is needed when dealing with an atopic child.

AR diagnosis is a clinical one, based on a focused history and nasal examination. Seasonal symptoms should point the clinician to an outdoor allergen, while constant or nighttime/morning time symptoms have an indoor culprit. The triggering allergen is easy to identify if symptoms are present in certain conditions. Clinicians should be aware of the possibility of mixed AR, with the patient being polysensitized.

Further investigations to detect the responsible allergen are beneficial to inform avoidance measures but are not routinely performed. If symptoms persist after a trial of properly administered topical medication, then allergen testing should be carried out. Allergen-specific testing is also indicated in severe cases when immunotherapy is recommended. Allergen-specific tests include the skin prick allergen test (SPAT) and serum allergen-specific IgE test (SASIgET). Both methods are highly reliable, but accessibility varies. SPAT testing is preferred as children tolerate it better, it is

sensitive, multiple allergens can be tested, and it produces results in approximately 20 min which can be explained to patients/parents at the same clinic appointment. SASIgET is a blood test and so is less well tolerated by children, results can take many weeks, and it is more expensive than SPAT. However, eczema or antihistamines do not preclude SASIgET testing. Both tests show the same results when compared.<sup>18-20</sup> The European Academy of Allergy and Clinical Immunology recommends testing with the most relevant local allergens in perennial AR cases, but only for treatment-resistant seasonal AR.<sup>21</sup>

Allergen avoidance measures and medical therapy directed at preventing and controlling the symptoms are the main AR treatment methods. Patients with mild symptoms should be treated with intranasal corticosteroid sprays or oral/intranasal H1-antihistamine medication in monotherapy. In moderate-to-severe symptoms, an intranasal corticosteroid spray in combination with an antihistamine should be prescribed. Leukotriene-receptor antagonists and allergen immunotherapy are advised in recalcitrant disease.<sup>5</sup> Surgical treatment, such as inferior turbinate procedures, has a limited role in poorly controlled patients who have failed immunotherapy.

The economic impact of AR, on the patient and society, is high.<sup>5,22-24</sup> The avoidable indirect costs per untreated patient with AR per year were €2405 as per the European Union analysis from 2014.<sup>22</sup> An understanding of AR in the pediatric population is needed, especially in the context of atopic diseases and their increasing prevalence. Our objective was to study the main allergens and demographic data in an Irish pediatric population from a large urban area.

## MATERIAL AND METHODS

We retrospectively reviewed dictated clinic letters for 5 consecutive years (2015-2019). These letters are stored on a password-protected encrypted network on the hospital intranet. We searched these letters to identify patients sent to our department with a suspicion of AR or associated symptoms. We used the search term "allergic rhinitis." Our tertiary pediatric otorhinolaryngology (ORL) department is within the largest urban area in the Republic of Ireland.

We included new patients referred with AR-associated symptoms and also reviewed patients that have been diagnosed with AR after being evaluated in our clinic. The diagnosis of AR was made if symptoms of rhinorrhoea, nasal obstruction, nasal itching, and sneezing were present, associated with a positive allergen-specific test.<sup>6</sup> In cases without an allergen-specific test, clinical findings of inferior turbinates hypertrophy, when observed by an ORL specialist, associated with a history of atopy was used to make the diagnosis. Patients with a known diagnosis of AR but with well-controlled symptoms have been excluded. We also excluded patients for whom we did not have complete information.

A single blood sample taken in our outpatient's department was used for the SASIgET testing via enzyme-linked immunosorbent assay for individual aeroallergens. SPAT was performed outside of

our institution, with only the results available to us, not the kit used nor the spectrum of substances used for testing. Ethical approval for our research was granted by the hospital Ethics and Research Committee (decision number 20.007). The data were processed using Minitab 17 (Minitab LLC).

We analyzed the data for demographics, identified allergens, and performed a correlation between the birth month and intermittent allergic status. A house dust mite immunoglobulin E (IgE) titer over 300 kU/L and over 100 kU/L for grass pollen were considered high and recorded separately for further analysis. We have also compared SASIgET and SPAT results when available, as well as repeated allergen testing results.

## RESULTS

### Demographics

Five hundred and fifty-five patients were diagnosed with AR in our clinic over the 5 years of our study. Sixty-three percent of our population (350 patients) were male, and 37% (205 patients) were female. At presentation, the median age was 9 years, with a minimum of 1 year and a maximum of 19 years. The most tested group of patients was 5–9 years of age, accounting for almost half of our population. Table 1 shows the patients' age group distribution.

The number of AR referrals has increased with time. In the last year of our study (2019), we reviewed 258 patients as opposed to an average of 74 patients per year for the preceding 4 years. This means that 46.5% of our study patients were seen in the last year of the study.

A history of atopic disease was common in our study group. Twenty-six percent of patients had a concurrent diagnosis of asthma. Nineteen percent of our population reported other atopies with allergic conjunctivitis present in 32% of these cases, followed by eczema in 28.7% of cases and food allergy in 9.5% of cases.

### Allergen testing

Three hundred and thirty-seven patients (60.7%) had an allergen-specific test done. Sixty-seven tests (12%) were performed before attending our clinic. SPAT was performed for 13 patients, with 12 positive results. SASIgET testing was done for 54 patients, 43 of

them being positive. Eighty-two percent of these preclinic tests were positive for at least one aeroallergen.

Two hundred and seventy allergen-specific tests were performed at our request, and these were almost exclusively SASIgET. We referred only 1% of patients to our respiratory colleagues for SPAT. Out of these serum-testing patients, 74% were positive for an aeroallergen, while 80% of SPAT patients tested positive for an aeroallergen.

Out of the tested patients, 73.3% tested positive for an aeroallergen (247 cases). They represent 44.5% of all our population studied. We will refer to these patients as ARWIA (allergic rhinitis with an identifiable allergen) patients.

### ARWIA patients

Males (175 cases) have ARWIA 2.3 times more often than females (75 cases). The ages of these patients varied between 2 and 19 years, with a median of 9 years. The 5–9 year age group had the most ARWIA cases. Fifty-five patients had ARWIA before attending our clinic, while 200 were confirmed after our testing. The year 2016 had the most ARWIA patients (51%), while 2017 had the lowest ARWIA incidence of 32%. Despite the large number of patients assessed for AR in 2019, just 45% of cases were confirmed to be allergic. It was noted that 30% of patients who presented with recurrent epistaxis and were suspected of having concomitant AR, tested positive for an aeroallergen. A history of atopy was present in 26.7% of ARWIA patients, with eczema being the most prevalent (32%), followed by allergic conjunctivitis (28.8%) and food allergy (15%). Thirty-one percent of ARWIA cases have had a concomitant diagnosis of asthma.

### Common allergens

Overall, house dust mites were the most common aeroallergen identified (44.7%), followed by grass pollen (29%), dog dander (16%), cat dander (8.5%), and aspergillus/molds (2%). When food allergies were tested (38 patients), 7.5% were positive, mostly for cow's milk protein, egg, and nuts. Concomitant allergy to house dust mites and grass pollen was present in 48% of ARWIA patients. We found no statistical significance for any of the allergens individually tested before and after ORL assessment to be more likely to have a positive result (Table 2). Next, we compared the patients who had high titers of allergens and total IgE, and found no statistical significance between pre- and post-ORL assessment (Table 3). The IgE and allergen titers were three times higher in male patients. Eleven patients have had repeated allergen testing over the years. All repeat testing was done via SASIgET, with only two patients having SPAT previously performed. There was a 100% correlation in the results, with nine patients testing positive for aeroallergens and two patients testing negative for aeroallergens.

**TABLE 1** Age group distribution of our patients in percentages.

Age group (years)	Percentage (%)
0–4	10.2
5–9	48.5
10–14	33
15–19	8.3

**TABLE 2** Common allergen results in percentages for pre-ORL and post-ORL assessment with differences in proportions evaluated using  $\chi^2$  test.

Allergen tested	Pre-ORL assessment (n = 67, %)	Post-ORL assessment (n = 270, %)	Difference [% (P value)]
Dust mites	28 (45.2)	100 (44.7)	0.5 (0.94)
Grass pollen	24 (27.3)	136 (29.0)	1.7 (0.78)
Dog	12 (12.6)	75 (16.3)	3.7 (0.46)
Cat	10 (10.5)	40 (8.8)	1.7 (0.67)
Aspergillus/molds	2 (4.2)	9 (1.0)	3.2 (0.07)
Food	29 (27.3)	18 (11.3)	11.1% (0.001)
Dust and grass	20 (36.3)	98 (48.0)	11.7 (0.09)
Grass and dog	6 (11.0)	51 (25.0)	14 (0.01)

Abbreviation: ORL, otorhinolaryngology.

**TABLE 3** Numbers, percentages, and P values of patients with high titers of allergens and IgE tested pre- and post-ORL assessment.

High titers of allergens	Pre-ORL clinic test (n = 57, %)	Post-ORL clinic test (n = 61, %)	Fishers exact (P value)
House dust mites	15 (8.6)	9 (14.8)	0.17
grass pollen	3 (5.3)	1 (1.6)	0.35
IgE	17 (29.8)	29 (47.5)	0.06
Multiple allergens	12 (21.1)	22 (36.1)	0.10

Abbreviations: IgE, immunoglobulin E; ORL, otorhinolaryngology.

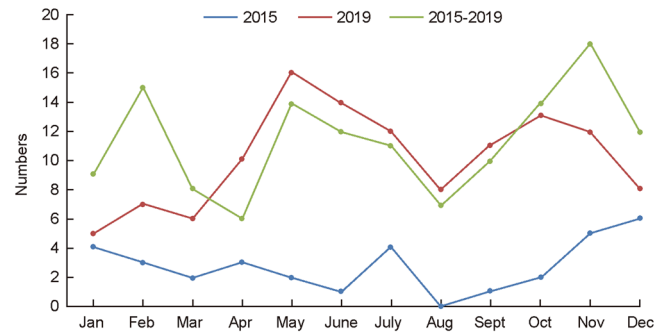
## Birth months and allergens

Patients born in November had the highest grass pollen allergen titers. Patients born in the winter months were more likely to have ARWIA with a second peak in summer. We have compared the birth months of ARWIA patients from the year 2015 to the year 2019. A definite change in the pattern from the winter/spring months of 2015 to the spring/summer of 2019 was observed. These changes along with the overall distribution of allergens assigned to the patient's month of birth can be followed in Figure 1.

## DISCUSSION

### Original research

To the authors' knowledge, this is the first study in our country to objectively investigate AR in a pediatric population with confirmation of AR after allergen testing. Our study is based on specialist



**FIGURE 1** Overall birth months of grass pollen allergy patients, birth months of 2015 and 2019 ARWIA patients in numbers. ARWIA, allergic rhinitis with an identifiable allergen.

evaluation and diagnosis. Previous studies were either subjective (questionnaires based on patient's reported symptoms),<sup>2,25</sup> or the studied population contained both adults and children.<sup>18</sup> A previous author's study did not discuss the allergens and patients' demographics in the pediatric population in detail.<sup>19</sup>

In the current study, for almost half of the patients, the clinical diagnosis of AR was supplemented with positive allergen-specific tests. For the other half, the diagnosis was based on a clinical assessment performed by an experienced pediatric otolaryngologist. This clinical diagnosis of AR was confirmed when there was a positive response to standard AR treatment.

## Demographics

There was a male prevalence in AR and ARWIA patients. Male sex was also associated with higher allergen and IgE titers. Males were found to have a more severe reaction to SPAT testing in a study performed in the west of Ireland.<sup>18</sup>

The median age in both groups (AR and ARWIA) was 9 years, with a higher incidence in the age group of 5–9 years. These results support previous literature findings that in the pediatric population, sensitization for at least two pollen seasons is needed to initiate AR symptoms.<sup>26</sup> Also, older children may be more aware of their symptoms and report them to their parents.

An apparent increase in AR cases was seen in the last year of our study. A similar trend was noted in a study conducted in the west of Ireland in 2018.<sup>18</sup> This might represent a true increased prevalence of AR and climate change or there may be local contributory factors but clearly has put a burden on our service. Further studies are needed to explore other Irish counties and neighboring countries for answers. An apparent reduction in cases in 2017 was noted. This observation could be related to the fact that the revised Allergic Rhinitis and its Impact on Asthma (ARIA) guidelines were published in 2016, making clinicians more aware of the disease and its stepwise medical treatment.<sup>27</sup> As demonstrated in the main author's previous paper, increased AR awareness among general practitioners (GPs) is needed. This would facilitate better patient triaging for specialist review.<sup>19</sup>

## Birth month and allergens

We have not found a correlation between the birth months of children with confirmed grass allergies. Our grass allergy population shows a winter/spring pattern. Probably this is because almost half of our patients were sensitized to both house dust mites and grass pollen.

Very interestingly, a change in the pattern from the year 2015 winter/spring AR prevalence to spring/summer of 2019 was observed for ARWIA patients. Duggan et al.<sup>25</sup> previously reported the same pattern for AR patients in the years 2002 and 2007. Climate change and pollution could be responsible for this shift from an indoor to an outdoor cause of AR.

## Atopy

In our study, AR and asthma were associated in 26% of cases, with 30.7% of ARWIA patients being diagnosed with both, similar to previous literature reports of 30%.<sup>28,29</sup> Ireland has the fourth highest prevalence of asthma in the world; therefore, local AR facts are useful to the Irish population.<sup>30</sup> An increased risk of asthma in pre-adolescence, adolescence, and adult life was strongly correlated with childhood AR in some studies. Atopic diseases and their association are quite common in children. Clinicians need to be aware of the possibility of AR in a child with a personal or family history of atopy.

## Main allergens

In our area, house dust mites followed by grass pollen and dog dander were the main sensitizing allergens. This is in keeping with national and international literature results.<sup>2,18,25</sup> Grass allergy was mainly tested for grass pollen and less often with a grass mix kit.

Overall, persistent AR was present in 71% of cases and intermittent AR in 29% of cases. Extensive studies have found that persistent AR accounts for 23%–40% of cases and intermittent AR for 60%–77% of AR cases.<sup>23,31,32</sup> Why the trends are reversed in our study compared to the literature needs to be investigated further with local studies. A possible cause could be that half of our patients are allergic to both house dust mites and grass pollen, but this would explain it if the percentages were more even, not inverted.

Half of our patients tested positive for house dust mites and grass pollen. These findings are of high importance, suggesting that symptom control and compliance are more challenging to achieve in these patients. There is a massive economic and social impact on these patients and the health system if their AR is challenging to treat. There are a large number of patients suffering from non-AR, making control of their symptoms even more difficult.<sup>33,34</sup> We found no statistical significance when comparing pre- and post-ORL assessment in terms of allergens and their high titers.

A 100% correlation was found when allergen-specific tests were repeated, making test repetition unnecessary. If a new sensitizing

allergen is suspected, testing can be carried out only for the predicted one, limiting expense.

AR was found in a third of pediatric patients complaining of recurrent epistaxis. In these patients, topical nasal medication as per ARIA guidelines, along with allergen avoidance measures,<sup>3,8,12</sup>

## Study limitations

We excluded AR patients whose symptoms were under control. We have focused on the diagnosis and management process. More information could have been gathered by including these cases, although only 10 cases, in our study. These patients can help us understand better the AR management strategies and could represent a separate study group.

Almost half of the patients diagnosed with AR neither had allergen testing done nor had allergens identified on testing. The diagnosis of AR was provided by ORL specialists based on a typical history, characteristic nasal findings, and symptom improvement with AR local treatment.

The retrospective-type study has its disadvantages with regard to data collection, accuracy, and data availability. We do acknowledge all these limitations and consider our results characteristic to the population seen in our practice.

## CONCLUSIONS

Almost half (44.5%) of the pediatric population seen in our clinic for suspicion of AR were found to have aeroallergen sensitivities on testing. Seventy-three percent of tested patients were positive for at least one aeroallergen. Males tested positive for aeroallergens more often and had higher allergen titers than females. House dust mites and grass pollen are the primary allergens present in the east of Ireland, with 48% of our patients testing positive for both allergens. No correlation between birth month and grass allergy in ARWIA patients was noted. We emphasize the importance of high suspicion of AR in atopic children. Retesting patients with a known allergy test result should be discouraged. Our study has drawn a unique allergen map in the east of Ireland. This is aimed at guiding local GPs and clinicians with testing and treatment, along with informing allergen avoidance measures.

## AUTHOR CONTRIBUTIONS

All authors listed contributed equally to the study conception, data analysis, draft review, and approval of the final paper.

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## CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest.

## DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

## ETHICS STATEMENT

Ethical approval for our research was granted by the hospital Ethics and Research Committee (decision number 20.007).

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