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PART I. DISEASES AND PROBLEMS DISTINGUISHED BY WHO AND FAO
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THE INCIDENCE OF ALLERGY TO COMMON ALLERGENS BASED ON A RETROSPECTIVE ANALYSIS

CZĘSTOŚĆ WYSTĘPOWANIA ALERGII NA POSPOLITE ALERGENY NA PODSTAWIE ANALIZY RETROSPEKTYWNEJ

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B. Data collection/entry
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C. Data analysis/statistics
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D. Data interpretation
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Summary

Background. The aim of this work was to find out which of the aeroallergens most often cause positive skin prick tests in the population with allergic diseases. Depending on the type of allergens, exposure to them can aggravate asthma symptoms and cause allergic conjunctivitis and allergic rhinitis.
Material and methods. A group of 100 people between 18 and 78 years of age were included in the study. The average age was 45.8 years. There were 34 men and 66 women in the group. All patients were allergy clinic patients. The results of point skin tests for the basic aeroallergen panel were analyzed in this study and summarized using descriptive statistics.
Results. Sixty subjects had positive tests for dust mites. Most subjects were allergic to two allergens. Monovalent allergy was found in 10 subjects. Multivalent allergy was predominant, but tended to involve relatively few allergens.
Conclusions. The results obtained may be due to year-round exposure to the house dust mite allergen. Prolonged allergen exposure translates into more frequent immune responses and greater clinical response of patients, which is manifested by allergic rhinitis and/or bronchial asthma or allergic conjunctivitis. Due to the small patient population studied, this subject requires further analysis.

Keywords: allergy, skin prick test, allergen

Streszczenie

Wprowadzenie. Celem pracy była ocena, który z aeroalergenów najczęściej wywołuje dodatnie punktowe testy skórne w badanej populacji osób z chorobami alergicznymi. W zależności od rodzaju alergenów, narażenie na nie może powodować nasilanie objawów astmy, wywoływać alergiczne zapalenie spojówek, alergiczny nieżyt nosa.
Materiał i metody. Badaniem objęto grupę 100 osób w wieku od 18 do 78 lat. Średnia wieku wynosiła 45,8 lat. W badanej grupie było 34 mężczyzn i 66 kobiet. Wszyscy byli pacjentami poradni alergologicznych. Analizowano wyniki punktowych testów skórnych dla podstawowego panelu aeroalergenów. Wyniki podsumowano z zastosowaniem statystyki opisowej.
Wyniki. Spośród badanych u 60 chorych stwierdzono dodatnie testy punktowe na roztocza kurzu domowego. Większość ankietowanych osób była uczulona na dwa alergeny. Alergię monowalentną stwierdzono u 10 osób. Dominowała alergia wielowartościowa, zwykle obejmowała jednak stosunkowo niewiele alergenów.
Wnioski. Otrzymany wynik może być skutkiem całorocznego narażenia na alergen roztoczy kurzu domowego. Ponieważ długotrwała ekspozycja przekłada się na częstsze odpowiedzi immunologiczne i większą odpowiedź kliniczną pacjentów, objawiającą się alergicznym nieżytem nosa i/lub astmą oskrzelową lub alergicznym zapaleniem spojówek. Ze względu na niewielką populację badanych pacjentów kwestia ta wymaga dalszej analizy.

Słowa kluczowe: alergia, punktowy test skórny, alergen

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Introduction

Allergy is an immunology-based hypersensitivity. According to Gell and Coombs, there are four major types of allergic reactions. In everyday clinical practice, two types of reactions are typically diagnosed: type I (immediate-type hypersensitivity) and type IV (cellular hypersensitivity). The first type is characterized by specific IgE antibodies whose presence can be tested for in the skin by a skin prick tests or in the blood using an ELISA. The Type IV reaction is mainly mediated by T lymphocytes, which is a delayed cell response. The main diagnostic method is the patch test. In our research, we analyzed the results of skin prick tests for the basic aeroallergenic panel, and also included testing for molds. The results have been summarized using descriptive statistics [1-6].

Allergic rhinitis (AR) is the most common allergic disease, affecting more than 500 million individuals. In people with a genetic predisposition, AR is caused by the IgE-dependent response to various allergens. These include both respiratory allergens of the external and internal environment, whereas food allergens are rarely the cause of isolated AR. In the course of this disease, inflammatory infiltration of the nasal mucosa occurs through various cells [7-10].

Allergic conjunctivitis is an allergic reaction of the conjunctiva, mainly IgE-dependent, which typically co-occurs with the AR. The symptoms of this disease include itching, tearing, eye congestion, and it may also be accompanied by conjunctival and eyelid edema [11-14].

Bronchial asthma is a chronic inflammatory disease of the respiratory tract that affects between 1 and 18% of the population, depending on country. Etiological factors of bronchial asthma can be divided into asthma-causing (individual factors) and those triggering clinical symptoms of the disease (environmental factors). The environmental factors mainly include allergens. The pathomechanism of asthma involves numerous cells and mediators. It is known that the majority of asthmatic patients experience rhinitis, and that lower respiratory tract inflammation is accompanied by upper respiratory tract inflammation. In bronchial asthma, subclinical inflammation of the gastrointestinal mucosa was also observed, whereas food allergy demonstrated variable bronchial hyperreactivity. The above findings suggest that the whole mucosal system is involved in allergic diseases. Hence, in bronchial asthma coexisting with AR, antihistamines are used alongside asthma-controlling drugs in order to combat the symptoms of rhinitis [15-19].

Skin prick testing is a method that enables in vivo detection of the presence of specific IgE antibodies associated with the mast cells of the skin within a short period time (15 minutes). Thus, in combination with a medical interview, it enables the diagnosis of allergic disease. The tests involve the introduction of a standardized allergen solution by puncturing the skin (typically in the area of forearms), which then triggers an itchy bump (wheal) if specific IgEs are present in the skin. In Europe, when the blister is greater than or equal to 3 mm (always in comparison with the positive control) the test result is considered to be positive [20-22].

Purpose of the study

The aim of the study was to evaluate which aeroallergens most frequently induce positive skin prick tests in the studied population of people with allergic diseases.

Material and methods

The study was conducted on a group of 100 people between 18 and 78 years of age, with an average age of 45.8 years. There were 34 men and 66 women from Świętokrzyskie Voivodeship, Poland. All were patients of allergology clinics. Each patient was diagnosed with one or more of the following three allergic diseases: AR, allergic conjunctivitis or allergic bronchial asthma. The diagnosis was made on the basis of clinical symptoms and additional examinations including spirometry and skin prick tests.

These studies were carried out as part of the patients' routine examinations during their clinic visits. Prick tests consisted of injecting a standardized allergen solution by puncturing the skin, most often of the forearms. Two controls were included: a histamine positive control, and a negative control, usually consisting of a physiological saline solution or other solution that is used for dissolving the allergens. A standardized lancet was used for punctures, using a new one for each subsequent puncture, with its blade introduced into the skin through a drop of allergen. The allergens were applied to maintain at least a 2 cm distance between one another as they cause an erythematous and ablative reaction when specific IgEs are present in the skin. If allergens are applied too closely together, the reactions they cause may merge, making them harder to interpret. In Europe, a test with a blister greater than or equal to 3 mm and bigger than the negative control is considered positive.

Also, it is always compared to the positive control [1]. This method allows detection of specific IgE antibodies in the skin in a very short time (even 15 minutes). Thanks to its simplicity and short waiting time, it is a primary tool in allergology [23].

The study was conducted using a spot skin test kit (Table 1) [24]. The results of the skin tests for basic aeroallergens and two additional mold allergens were then analyzed retrospectively on the basis of patients' medical history. The outcomes were summarized using descriptive statistics.

Table 1. A set of basic respiratory allergens

Allergen screening kit for the spot skin test
Dermatophagoides pteronyssinus
Dermatophagoides farinae
Animal allergens: cat, dog
Trees: alders birches, hazels
Grasses and cereals
Weeds
Rye
Plantago lanceolata
Artemisia
Household dust mites
Molds
Cladosporium herbarium
Alternaria tenuis

Results

Of all the examined patients, 60 demonstrated positive prick test result to house dust mites (*Dermatophagoides pteronyssinus* and *Dermatophagoides farinae*), and were the most frequently identified allergens in the examined population. The second most frequent was the allergic reaction to grasses/cereals, with 56 people having positive skin tests, and to rye, also seen in 56 patients. We found the same number of specific IgE in the skin for hazel and *artemisia* pollens (35), while positive tests for birch occurred in 31 persons. In terms of animal allergens, cat proteins proved to be more frequent for our population, with 19 sensitized people, than dog protein reactions, which were seen in 15 people. For molds, positive tests for *Cladosporium herbarium* occurred in 13 patients, while 16 patients displayed positivity for *Alternaria tenuis*. Additional tests were performed for other molds, *Penicillium notatum* (7 sensitized patients) and *Aspergillus fumigatus* (6 patients), thus extending the panel of allergens tested. In our study, only two patients demonstrated positive reactions for *Plantago lanceolata*, making it the least sensitizing allergen in our study. Table 2 shows the number of patients allergic to the allergens listed after the tests.

Table 2. Number of patients sensitized to specific allergens

Allergens	No. of patients
Dermatophagoides pteronyssinus	60
Dermatophagoides farinae	60
Cladosporium herbarium	13
Alternaria tenuis	16
Aspergillus fumigatus	6
Penicillium notatum	8
Alder	12
Hazel	35
Birch	32
Grasses and cereals	56
Rye	56
Artemisia	35
Plantago lanceolata	2
Cat	19
Dog	15

Statistically, women were more frequently sensitized to house dust mites, with 40 out of 66 women showing positive reactions to these allergens (about 61% of female patients), while men most often reacted positively to grasses/cereals and rye, with 21 out of 34 men reacting, which is about 62% of the men surveyed. This was followed by household dust mites, with 20 out of 34 men demonstrating positive test results. In women, the second most frequent allergens were grasses/cereals with 35 out of 66 surveyed females (53%) being positive. None of the male patients displayed allergy to *Plantago lanceolata*, and it was also the least frequent allergen in women, with only two patients who tested positive (about 3%). The number of patients sensitized to each allergen by gender is shown in Table 3.

Table 3. Number of patients sensitized to specific allergens, divided by gender

Allergens	Men	Women
Dermatophagoides pteronyssinus	20	40
Dermatophagoides farinae	20	40
Cladosporium herbarium	3	10
Alternaria tenuis	2	14
Aspergillus fumigatus	1	5
Penicillium notatum	2	6
Alder	5	7
Hazel	14	21
Birch	11	21
Grasses, cereals	21	35
Rye	21	35
Artemisia	8	27
Plantago lanceolata	0	2
Cat	7	12
Dog	4	11

Out of the patients examined, 60 had isolated AR. Of the remaining patients, 29 had rhinitis coexisting with bronchial asthma, and 9 had AR with allergic conjunctivitis. Only two patients experienced all allergic conditions (AR, bronchial asthma and allergic conjunctivitis). Table 4 shows the distribution of incidence in the study group.

Table 4. Distribution of diseases in the examined group

Disease	AR	AR + asthma	AR + conjunctivitis	AR + asthma + conjunctivitis
No. of patients	60	29	9	2

Both patients with coexistence of the three allergic diseases had an allergy to hazel and *Cladosporium herbarium*. Only one patient had a positive skin prick tests for grass/cereal, rye and birch. Notably, in both patients there was a prevalence of reactivity to seasonal allergens over the year-round ones.

The distribution of allergies in two patients with three coexisting allergic diseases is shown in Table 5. Table 6 shows the distribution of allergies in patients with one or two coexisting allergic diseases.

Table 5. Distribution of allergies in two patients with coexisting three allergic diseases

Cladosporium herbarium	Hazel	Grass/cereal	Rye	Birch
2	2	1	1	1

Table 6. Allergy distribution in patients with one or two coexisting allergic diseases

Allergens	AR + asthma	AR + conjunctivitis	AR
Dermatophagoides pteronyssinus	19	7	34
Dermatophagoides farinae	19	7	34
Cladosporium herbarium	4	3	4
Alternaria tenuis	2	2	12
Aspergillus fumigatus	1	2	3
Penicillium notatum	4	2	2

Alder	1	1	10
Hazel	9	2	22
Birch	7	3	21
Grass/ cereal	9	7	39
Rye	9	7	39
Artemisia	7	3	25
Plantago lanceolata	0	0	2
Cat	3	1	15
Dog	0	0	15

Of all the examined patients, the majority (22 individuals, 22%) was allergic to two agents, followed by the patients displaying sensitivity to five allergens (19 individuals, 19%). Only one patient was sensitized to nine allergens, and two patients displayed sensitivity to ten allergens. Monovalent allergy, i.e. being sensitive to only one allergen, was found in ten people. Even though polyvalent allergy dominated, it was usually with relatively few allergens. The breakdown of the number of patients sensitized to different numbers of allergens is shown in Table 7.

Table 7. Patients allergic to a specific number of allergens

No. of allergens	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
No. of patients sensitized to a given number of allergens	10	22	9	15	19	6	10	6	1	2

It should be noted that it was not possible to establish real differences in the prevalence of allergies to individual allergens between men and women, as it was not possible to equalize the size of both populations.

Discussion

According to the data found in specialist literature, the pollens from grasses, cereals, weeds (e.g. *artemisia*, *Plantago lanceolata*) and trees (e.g. birch, hazel, alder) are the most common allergens in Poland [25,26]. In our study, dust mites proved to be the most common sensitizing agent. Dust mites are widely recognized to be a very strong in-home, year-round allergen [27-29]. It is also undeniably one of the most important allergens causing clinical symptoms in children; in particular, it is associated with the development of bronchial asthma [30,31]. Numerous publications report that the risk of developing asthma and allergy in children sensitive to in-home allergens is several times higher [32-35]. It is also an important allergenic factor in adults, especially in the development of chronic AR or asthma. As revealed by epidemiological data, about 20% of adults in Europe are sensitive to this allergen [36-39]. Therefore, it is hardly surprising that out of 29 AR cases co-occurring with bronchial asthma, 19 people participating in our study were sensitive to these agents. It is assumed that year-round allergens are the most common cause of bronchial asthma, while the seasonal allergens are most often associated with the development of AR [40,41]. It is also known that about 10-30% of rhinitis develops into bronchial asthma, and one factor predisposing to this unfavorable progression is severe rhinitis, among others, especially in the course of allergy to year-round allergens, such as house dust mites [42,43].

The second most allergenic agents in our study were the pollen of *Artemisia* and hazel. Other sources also indicate that the former is one of the most frequently sensitizing allergens. However, the majority of publications claim that in terms of sensitizing frequency, *Artemisia* follows the grasses and birch [44,45]. It is worth noting that in our study the grasses/cereals and rye proved to be as important as mites in the development of AR coexisting with conjunctivitis. However, this may be coincidental as each patient with these diseases and mite allergy also demonstrated positive skin tests for at least one seasonal allergen.

Regarding animal allergens, our study found cat allergens to be more prevalent than dog allergens, which is similar to the results obtained by other researchers. Many sources report that feline allergens are very common even in places where finding a cat is unlikely, e.g. schools. Allergens are probably carried on the body, clothing or everyday objects of cat owners [46-50]. Cat allergens are also associated with a more frequent and more severe course of allergic diseases, especially bronchial asthma [51,52].

Similar results on the prevalence of sensitivity to specific allergens, including mites, grasses and other seasonal pollen have been presented in papers discussing countries located at different geographical latitudes [53-56]. Still, there are regions where other allergens are predominant. For example, in the US, apart from

the high contribution of mites in the development of bronchial asthma, the significant influence of cockroach allergen has also been demonstrated [57,58].

Other important allergens discussed in our paper were molds. They belong to the category of year-round allergens, but with increased concentration in the autumn. It is already known that in environments unfavorable to the development of mites, molds play an important role, especially the allergens of the *Alternaria genus* [59-61]. The species most frequently occurring inside households are *Alternaria alternata*, *Cladosporium herbarum* and *Aspergillus fumigatus* [62]. On the other hand, *Plantago lanceolata* turned out to be the least allergenic in our study, which is consistent with the recently observed trend of decreasing sensitivity to this agent. It is likely to be a consequence of planting grass from cultivated seeds, which in turn makes the exposure to this allergen less frequent.

An interesting finding in our study is that many people suffer from polyvalent allergy, i.e. they are sensitive to two or more allergens. This is consistent with the data from the US, where the exposure to numerous allergens simultaneously is also quite common, but with differences observed in scope of the dominant allergens in various households [63-66]. The study revealed that allergies as a result of exposure to environmental allergens are a major public health problem [67]. This problem is considered an important global epidemic with a significant economic burden [68-71].

Conclusions

The results of this study demonstrate that the prevalence of AR, bronchial asthma and allergic conjunctivitis are likely to be the consequence of a year-round exposure to house-dust-mite allergens. In contrast, seasonal allergens are characterized by periodic impact on the body throughout the year, i.e. are significantly shorter. Long-term exposure translates into more frequent immune responses and greater clinical responses of patients, manifested by allergic rhinitis and/or bronchial asthma or allergic conjunctivitis. However, due to the relatively small population included in this study, this issue requires further analysis. This study was retrospective and only descriptive statistical methods are used without statistical analysis, which is a limitation of the study.

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