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DYNAMIC CHANGES IN ETHIOLOGICAL STRUCTURE OF POLLEN SENSITIZATION IN CHILDREN WITH SEASONAL ALLERGIC RHINITIS

Allergic rhinitis is the leading nosology among allergies. According to reports provided by scientists from all over the world, in recent years between 10% and 40% of the world's population have suffered from allergic rhinitis. Despite the age and sex differences, this disease usually has a negative impact on the patients' quality of life. Therefore, the issues of early diagnosis and the organization of timely therapeutic and preventive measures are still remaining relevant. The aim of this study is to investigate the spectrum of sensitization in children with seasonal allergic rhinitis using retrospective data, followed by the development of a regional panel of allergens for skin prick-test. To investigate the dynamic changes of the etiological structure, 892 archived medical records of patients who were examined and treated at the Paediatric Department (allergy beds) of Poltava Regional Children's Clinical Hospital from 2010 to 2020 were reviewed. The highest proportion of patients with sensitization to weed pollen was 86.6% of the total number of cases examined, with ragweed, wormwood and cyclachaena taking the leading positions. Almost equal sensitization to cereal grass was found in nearly every third child, including maize (37.2%), timothy (32.5%), meadow fescue (34.0%) and ryegrass (33.9%). The dynamics of hypersensitivity to tree pollen had an unstable variability with a relatively low numerical load. One in 5 patients was found to be sensitive to birch (22.6%), alder (22.9%) and one in 10 to hazel. The volume of work carried out enabled to assess in detail the features of sensitization in patients with seasonal allergic rhinitis over an eleven-year period and to identify the most common aeroallergens. The data obtained have an important diagnostic value, as they make it possible to isolate and include the leading causative pollen allergens in the diagnostic allergy panel, taking into account regional characteristics.

Key words: children, seasonal allergic rhinitis, retrospective study, sensitization, skin allergy testing.

Connection to scientific programs, plans, topics. This work is a part of research project "Optimization of early diagnosis, treatment and determination of prognosis of the most common diseases of childhood" held by the Department of Pediatrics №2, Poltava State Medical University (state registration number 0122U001876.)

In paediatric practice, allergic rhinitis (AR) is the leading nosology among allergies and occupies the leading place in the structure of upper respiratory tract diseases. It is characterized by Ig-E-mediated inflammation of the nasal mucosa and the presence of symptoms such as nasal congestion and/or discharge, sneezing, itching, etc. [1]. A persistent chronic inflammatory process is typical for patients with both a seasonal and a year-round course. The manifestation of allergic rhinitis as an independent nosology is most common in children of preschool age, 4-6 years [2]. Genetic predisposition, hyperactivity of the nasal mucosa, passive and active smoking, inhalation of pollutants (irritating chemicals) and nasal anatomical disturbances act as contributors to the development of this disease. Moreover, the current climatic and geographical conditions have a great impact on regional plant pollen characteristics both in Ukraine and neighbouring countries [3].

According to international scientists, in recent years AR has affected between 10% and 40% of the world population [4]. Due to statistics, allergic rhinitis is a widespread nosology among the European population, with a 16% increase in its prevalence among adults in Denmark in particular [5]. An epidemiological study in China shows that the incidence of verified cases of AR increased from 11.1% in 2005 to 17.6% in 2011 in 18 metropolitan areas of the country [6]. A recent retrospective cohort study in the United States demonstrates a 19.9% prevalence of childhood AR [7] that is consistent with epidemiological data from

the UK, where allergic rhinitis is diagnosed in one out of five patients [8].

At present, official statistics in Ukraine do not provide accurate information on the prevalence of allergic rhinitis in both children and adults. According to separate data from national epidemiological studies, rates range from 12.4% to 20.7% among children, depending on age and regional characteristics [9].

The issue of timely detection of allergic rhinitis has become exacerbated by the fact that the global pandemic COVID-19 does not go away from our country that impedes timely verification of allergopathology. Allergists recorded relatively fewer new verified cases during the pandemic that can be due to quarantine measures, inadequate assessment of respiratory manifestations both by patients and directly in the practice of clinicians [10, 11]. Constant contact of patients who have seasonal allergic rhinitis (SAR) with antiseptics, personal protective equipment (protective masks, respirators), psychological exhaustion caused by long-term quarantine measures, self-medication (especially the reckless uncontrolled use of decongestants), remote consultation with adequate objective examination and assessment of symptoms, significantly burdened the course and management of patients with AR as one of the common chronic diseases of the upper respiratory tract.

Despite age and sex differences, this disorder almost always has a negative impact on patients' quality of life [12]. SAR causes sleep and leisure

time disturbances, chronic fatigue, and cognitive impairment, adversely affect learning thus underlying serious problems in the healthcare, social and economic systems [13].

There is a great deal of concern about new cases of allergic rhinitis, as they are often associated with asthma and considered as a factor in its development. According to international scientists, about 40% of patients with AR are diagnosed with asthma, while 80% of patients with asthma have symptoms of allergic rhinitis [14]. This issue became particularly urgent at the beginning of 2022, due to large-scale military operations in our country that caused an increase in population migration and the elimination of full-fledged registration of new cases of the disease. A large proportion of people, including patients with seasonal allergic rhinitis, have been forced to hide in cold and damp basements, while another proportion of temporarily displaced people, having lost their accommodation, have changed territorial affiliation that has had a negative impact on the course of the disease and the risk of additional sensitization to other allergens, including mould allergens. The triggers in the development of AR also include non-infectious triggers, e.g. household, pollen, epidermal, medication and infectious (in rare cases bacterial allergens). The main etiological factors of SAR are pollen from trees, weeds, cereals, and mould allergens.

The above-mentioned importance of seasonal allergic rhinitis in the paediatric population determines the need for retrospective analysis of pollen sensitization, to study the dynamics of sensitization patterns, identify risk factors for disease development, develop algorithms for early screening and patient management, and formulate clinical recommendations for prevention and a personalized approach to the treatment of pathologies. Therefore, retrospective studies remain relevant and contribute much to the research projects. Retrospective analysis can be used to work through quantitative and qualitative indicators and provide a representative numerical assessment of the data, which will then serve as the basis for updating the methods of diagnosing and treating diseases.

Objective

To investigate the spectrum of sensitization in children with seasonal allergic rhinitis using retrospective data and to develop a recommended regional allergen panel for skin prick testing based on the most significant indicators of hypersensitivity.

Materials and methods

A retrospective independent study of paediatric allergopathology was conducted as part of the

research project at the Department of Paediatrics №2, Poltava State Medical University. We selected 892 unrepeatable clinical case histories out of 1114 archived medical records of patients with seasonal allergic rhinitis aged from 3 to 18 years, who were examined and treated at the Paediatric Department (allergology beds), the Poltava Regional Children Clinical Hospital since 2010. Mathematical and statistical processing of the findings was performed by the licensed software package STATISTICA for Windows 10 Pro.

Results and discussion

The age and sex distribution of patients with seasonal allergic rhinitis included 285 (32%) girls and 607 (68%) boys, consistent with the recognized gender characteristics of the prevalence of allergic pathology, with an average age of 8.9 ± 0.15 years. In terms of territorial affiliation, it was found that urban dwellers (81.8%) were significantly more common among the examined children, in contrast to rural children, among whom allergic rhinitis was verified in every 5 examinees. The findings can be attributed to high air pollution due to industrialization and permanent urbanization that provides further prospects for investigating the role of these factors and their impact on respiratory allergy symptoms [15].

According to a retrospective analysis of the results of skin allergy testing with standardized groups of pollen allergens presented in Figure 1, we were able to determine the dynamics of the sensitization pattern among the most common aeroallergens from the weed, cereal grass and tree groups. The highest proportion of patients with sensitization to weed pollen was 86.6% of the total number examined. Minimal exposure was reported in 59.1% of children with SAR in 2013 and had a statistically significant upward trend in 2018 (95.3%; $p=0.001$), continuing to occupy a consistently high position in subsequent years. In contrast, in 2013, hypersensitivity to cereal grass (poaceae) was highest (86.4%) with an inverse significant regression to the lowest values (50.5%) in 2017 ($p=0.001$), and a slight increase in the following three years. At the same time, the family of presented monocotyledonous flowering plants maintained second place in the sensitization pattern of patients with allergic rhinitis. The last place, respectively, was occupied by sensitization to tree pollen, sensitivity to which was found in less than half of the patients (40%). The frequency of diagnosed sensitized cases was also variable, with a peak (47.4%) in 2014 followed by a significant decrease in 2017 (29.0%; $\chi^2=4.39$; $p=0.036$). Thus, a clear overall trend of increasing sensitization to all groups of aeroallergens can be traced from 2018 to 2020.

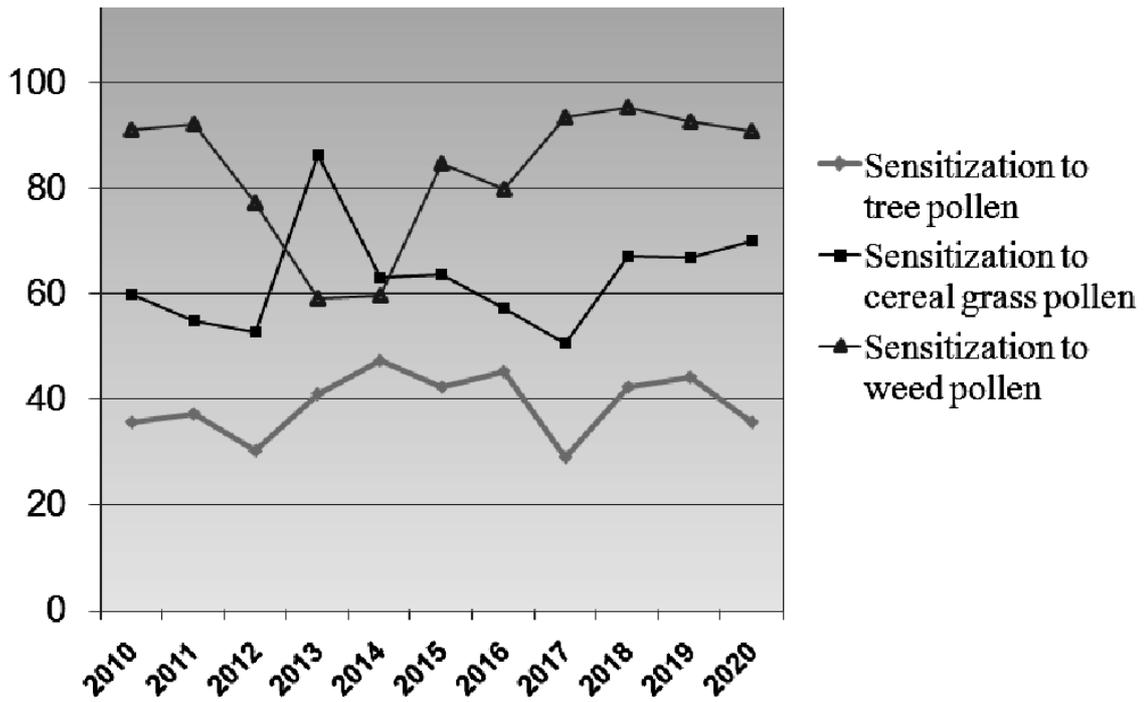


Fig. 1: Characteristics of the dynamic changes in pollen sensitization patterns in children with seasonal allergic rhinitis, taking into account regional characteristics

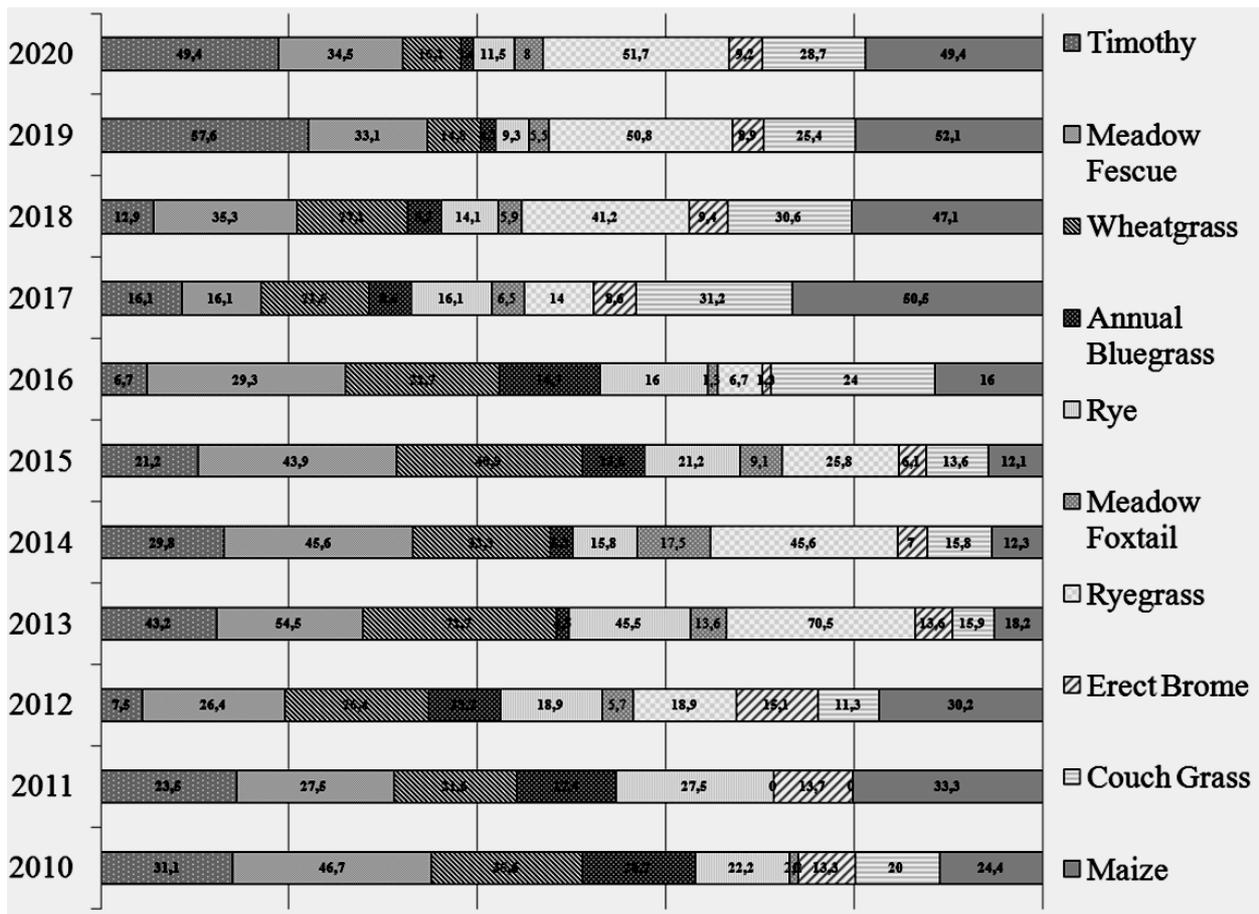


Figure 3: Structure of sensitization to cereal pollen in children with seasonal allergic rhinitis

The data presented in Figure 3 clearly show almost equal sensitization to the cereal grass, among which practically every third child was sensitive to maize (37.2%), timothy (32.5%), meadow fescue (34.0%) and ryegrass (33.9%). Sensitization to wheatgrass was found in a quarter (25.6%) of children with seasonal allergic rhinitis. Their highest indicators were recorded in 2013, followed by the maximum decline in 2016-2017. Maize is the leader in this group of allergens, the sensitivity to which peaked over the last four years of observation and was registered in every second patient with SAR (2017 – 50.5%; 2018 – 47.1%; 2019 – 52.1%; 2020 – 49.4%).

The dynamic changes in hypersensitivity to tree pollen in the patients examined over the period under study were of an unstable variability with a relatively low numerical load (Fig. 4). Thus, the probable causes of respiratory allergies of the upper respiratory tract established in every 5th patient include birch pollen (22.6%) and alder pollen (22.9%); every tenth patient is sensitive to hazel (10.4%). The feasibility of skin allergy testing is questionable with poplar, pine, oak, hornbeam allergens and etc., due to the absence or critically low sensitization rates over the 11-year monitoring period.

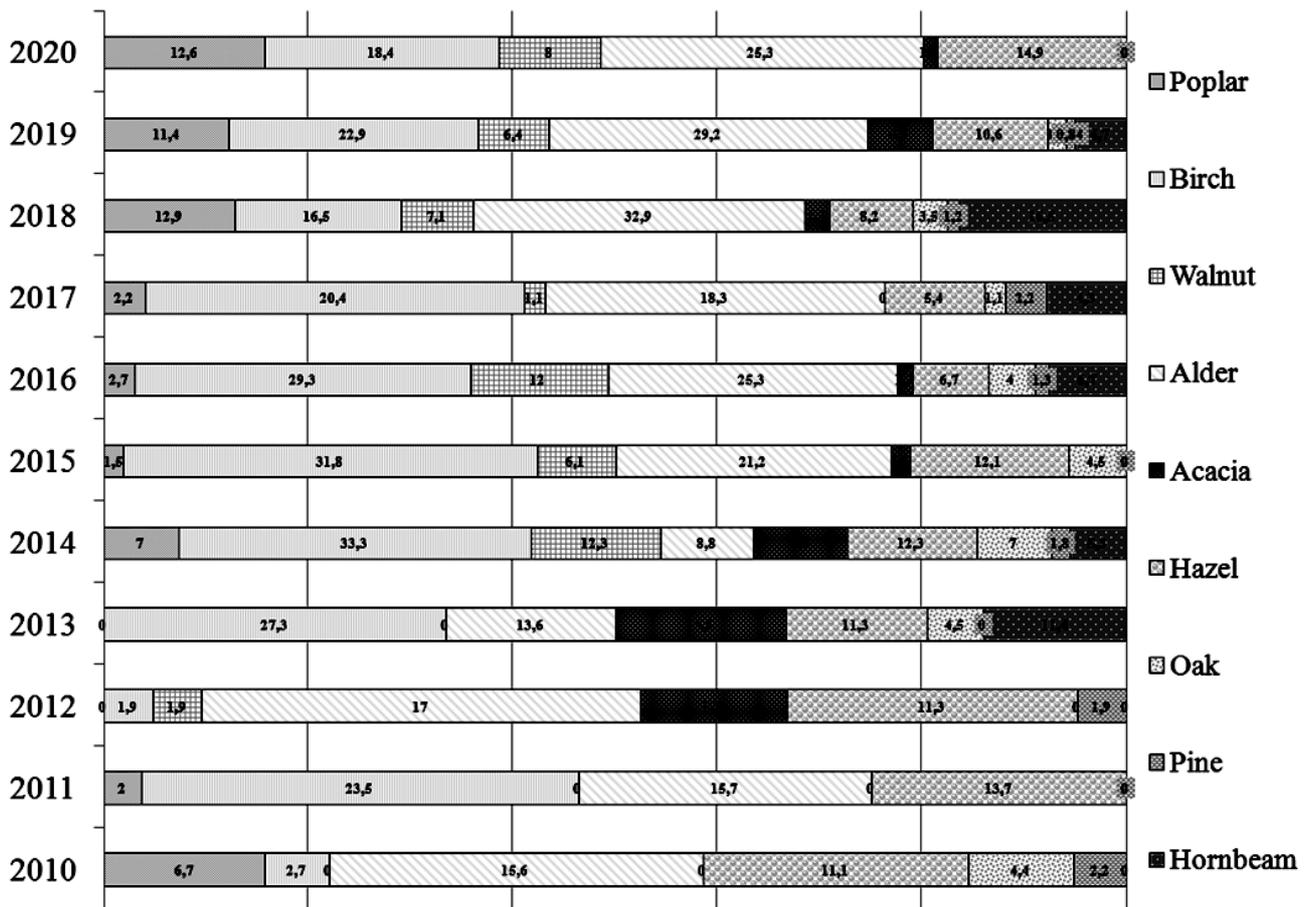


Figure 4: Structure of sensitization to tree pollen in children with seasonal allergic rhinitis

The amount of work carried out allowed us to perform a detailed assessment of sensitization patterns in patients with seasonal allergic rhinitis over an eleven-year period and highlight the most common key aeroallergens. The data obtained is of a considerable diagnostic value, as they enable the leading causative pollen allergens to be isolated and included in the diagnostic allergy panel, taking into account regional characteristics. Thus, we propose to develop and implement a diagnostic panel of skin allergy tests, which would include the commonest allergens (ragweed, wormwood, cyclachaena, timothy, maize, meadow fescue, ryegrass, birch, alder, and hazel) in practice of allergists in Poltava region to promote timely

verification of seasonal allergic rhinitis in children. Our data are supported by the work of international experts. For example, numerous data from European scientists, supported by the Global Allergy and Asthma European Network, exclude the need for large quantities of allergen extracts for skin allergen testing in the management of paediatric patients with respiratory (and/or conjunctival) allergy [18]. The use of a minimal number of allergens in young children remains particularly preferable. However, rational allergen testing using exclusively species-specific allergens in older children to verify SAR is equally important and relevant to reduce the antigen load on the functionally immature child's body.

Conclusion

The results of the retrospective study demonstrate the quantitative and qualitative characteristics of pollen sensitization among children with seasonal allergic rhinitis in Poltava region over the last decade. We have revealed the main causative aeroallergens affecting the children of the region and recommended to include them to a diagnostic regional panel for timely verifying seasonal allergic rhinitis and organizing rational therapeutic and prophylactic measures.

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Реферат

ДИНАМІКА ЕТІОЛОГІЧНОЇ СТРУКТУРИ ПИЛКОВОЇ СЕНСИБІЛІЗАЦІЇ У ДІТЕЙ З СЕЗОННИМ АЛЕРГІЧНИМ РИНИТОМ

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Ключові слова: діти, сезонний алергічний риніт, ретроспективне дослідження, сенсibilізація, шкірне алерготестування.

Алергічний риніт є провідною нозологією серед алергічної патології. За даними зарубіжних науковців, впродовж останніх років, на алергічний риніт страждає від 10% до 40% населення в усьому світі. Незважаючи на вікові та гендерні особливості, дане захворювання практично завжди негативно впливає на рівень якості життя хворих. Тому, актуальним залишається питання ранньої діагностики та організації своєчасних лікувально-профілактичних заходів. Метою роботи було дослідження спектру сенсibilізації у дітей з сезонним алергічним ринітом за ретроспективними даними з наступною розробкою регіональної панелі алергенів для шкірного прик-тестування. Для вивчення динаміки етіологічної структури було опрацьовано 892 архівні медичні карти пацієнтів, які знаходилися на обстеженні та лікуванні в педіатричному відділенні (алергологічні ліжка) Комунального підприємства «Полтавська обласна дитяча клінічна лікарня» з 2010 по 2020 рік. Найбільшою була частка пацієнтів із сенсibilізацією до пилку бур'янів, яка становила 86,6% від загального числа обстежених, при цьому лідируючі позиції зайняли амброзія, полин та циклахена. Встановлено майже рівнозначну сенсibilізацію до родини злакових, серед яких, практичного в кожній третій дитини визначалася чутливість до кукурудзи (37,2%), тимофіївки (32,5%), костриці (34,0%) та пажитниці (33,9%). Динаміка гіперчутливості до пилку дерев мала нестабільний варіабельний характер з відносно низьким числовим навантаженням. В кожного 5-го пацієнта був встановлений факт чутливості до берези (22,6%), вільхи (22,9%) та в кожного 10-го – до ліщини. Проведений обсяг роботи дозволив провести детальну оцінку особливостей сенсibilізації в пацієнтів із сезонним алергічним ринітом за одинадцятирічний період та виділити найбільш поширені ключові аероалергени. Отримані дані мають важливу діагностичну цінність, оскільки дають можливість відокремити й включити в діагностичну алергологічну панель провідні причинно-значущі пилкові алергени з урахуванням регіональних особливостей.