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Date of birth and hay fever risk in children and adolescents of Kazakhstan

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ABSTRACT

Introduction the first months of life are the most vulnerable period in allergic disease development and it is not clear enough whether inhalant pollen allergen exposure predisposes the risk of consequent allergic reactions.

Objective: To study the clinical and epidemiological criteria of hay fever with special emphasis on investigation of the relationship between the date of birth and seasonal allergic rhinitis development in children and adolescents in Kazakhstan.

Methods: The prospective hospital based study was conducted during pollen season from the beginning of May to the end of October in two consequent years 2010 and 2011. 184 children and adolescents at the age of 1–17 years underwent consultations and skin prick tests in the allergological center “Umit” (Astana, Kazakhstan). Special allergological questionnaires were developed and adapted for local residents. The assessment of symptoms severity was performed using a scoring system. Skin prick tests were performed in 112 patients. The number of patients was explained by the age limitations. Correlation analysis between skin prick test results and the month of birth were performed.

Results: It was found that in summer months there were the highest number of patients with seasonal allergic rhinitis 68 (36.9%), followed by spring 44 (23.9%), then autumn 37 (20.1%) and the lowest percent of patients 35 (19.1%) was born in winter. Rhinoconjunctival syndrome was diagnosed in 180 (97.8%) patients, pollen induced bronchial asthma in 76 (41.3%) and pollen induced urticaria in 35 (19.0%) patients. Mono sensitization among Kazakhstan children and adolescents was determined only to several species of the plants, mainly to *Artemisia Absinthium* (68.2%) and Sunflower (25.7%), whereas multiple sensitization to the mix of weeds was determined in 75 (66.9%) patients, to the mix of meadow grass in 33 (29.4%), mix of meadow grass + mix of weeds in 25 (22.3%) and mix of trees in 9 (7.1%) patients. The mean of symptoms severity of total scoring (24) was 15.5. The mean of IgE level in blood tests was 323.2 IU/ml.

Conclusions: Our results proved that first months of life are the crucial period and inhalant pollen allergen exposure, particularly to the weeds pollen, predisposes the risk of consequent allergic reactions development in children and adolescents in Kazakhstan. This fact may predetermine the risk of consequent allergic reactions development and the awareness of patients about it helps to prevent following severe clinical manifestations.

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1. Introduction

It is well known, that all rhinitis can be divided into three main groups—allergic (persistent or intermittent), non-allergic and

infectious. Allergic rhinitis is a prominent problem due to its wide prevalence and high under-diagnosis rates, annual growth of widespread morbidity, frequent complications, as well as a sharp decline in work ability and quality of life [1,2]. Recent publications of several researches in different countries stated an increased incidence rate of hay fever [3,4]. In Kazakhstan it is the most common pathology among all allergic diseases [5]. The true incidence of hay fever in children in the Republic of Kazakhstan is still not known because there are no generally accepted and

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standardized diagnosis criteria, but according to the recent data it ranges from 0.5% to 30% [6].

Typical distinctions of allergic rhinitis, such as sleep disorders, impaired daily activity and inability of exercising, lack of sufficient rest, lack of opportunity to study and work, leading to general quality of life worsening, an increase of both direct and indirect economic government losses take place nowadays [7,8]. Leading specialists have elaborated diagnostic and therapeutic guideline of allergic rhinitis and its impact on asthma (ARIA), including allergic rhinitis classification, diagnosis and treatment approaches. According to this guideline allergic rhinitis is considered in the light of integrated upper and lower airway conception, “one tube–one disease” [9].

Children and adolescents have specific features of clinical manifestations and it is very important to note that the problems in allergic rhinitis risk factors assessment, timely diagnosis and treatment very often cause great difficulties in this population group. According to the publications of the Pediatric Allergies in America, nasal congestion is the main symptom affecting children [10]. More severe clinical course of allergic process and earlier clinical manifestations of rhinitis symptoms with the subsequent poly sensitization formation take place due to high allergenic reagents exposure. Climate and geographical features of the flora play an important role in seasonal allergic rhinitis development [11,12]. The most important inhalant allergens are plant pollen and fungus spores, which cause the development of hay fever. But there is still an important gap in scientific understanding of major etiology factors that influence on hay fever clinical manifestations. The first months of life are the most vulnerable period in allergic disease development. To our knowledge, this is the first research in children and adolescents in the Republic of Kazakhstan, investigating the relationship between the date of birth in summer pollen season and clinical manifestation peculiarities of seasonal allergic rhinitis.

2. Objective

To study the clinical and epidemiological criteria of hay fever with special emphasis on investigation of the relationship between the date of birth and seasonal allergic rhinitis development in children and adolescents in Kazakhstan.

3. Methods

Our research is as prospective hospital based study. The study was conducted during pollen season from the beginning of May to the end of October in two consequent years 2010 and 2011. In our observation were randomly enrolled 184 children and adolescents at the age of 1–17 years, who underwent consultations at the allergological center “Umit” (Astana, Kazakhstan). Study group was divided into 4 subgroups according to the age–1–3, 4–7, 8–11 and 12–17 years old.

On the basis of previous research work, special allergological questionnaires were developed and adapted for local residents [13]. Physical examination was conducted and detailed case records were completed. Clinical data included passport data, nationality, age, sex, presence or absence of nasal symptoms. Patients with a history of any nasal or adenoid surgery and those with nasal polyps were excluded. The assessment of symptoms severity was performed using a scoring system, and included the following 10 symptoms: (1) Daily activity–In general, how limited was daily activity? (2) Sleep quality. On average, how severe discomfort was present, (3) Nasal congestion, (4) Itchy nose, (5) Sneezing, (6) Restlessness, (7) Itchy eye, (8) Eye inflammation, (9) Thirst, (10) Fatigue.

All patients signed written informed consent for publication, and the study was approved by the ethics committee of JSC “Medical University Astana”, Astana, Kazakhstan in accordance

with the ethical standards of the responsible committee on human experimentation and with the Helsinki declaration of 1964, as revised in 2008 [14].

Diagnosis of allergic rhinitis included generally accepted methods. Rhinitis symptoms included nasal congestion, runny nose, sneezing and itching. Based on the ARIA guidelines, intermittent allergic rhinitis (also known as seasonal allergic rhinitis or hay fever) was determined in the presence of symptoms for less than 4 days during a week or less than 4 consecutive weeks, whereas persistent allergic rhinitis was determined in the presence of nasal symptoms for more than 4 days during a week or over 4 weeks [9].

The number of patients 112 with skin prick tests was explained by the age limitations, it were performed by doctors in children elder than five years using the same standard procedure. The results were evaluated by standard method and assumed as positive if the mean diameter was 3 mm or more. The specific serum IgE level was assessed.

Statistical analysis was performed using the statistical package for social sciences (SPSS) version 11 (SPSS Inc., Chicago, IL, USA). Quantitative data were expressed as mean $\pm$ SD while, qualitative data were presented as number and percentage. Correlation analysis between skin prick test results and the month of birth were performed. Significance tests were done using the student's *t*-test to compare quantitative variables, and chi-square (χ^2) test to compare qualitative variables. Statistical significance and reliability of the differences between groups were considered as *P* value of less than 0.05.

4. Results

Allergic rhinitis was diagnosed in all 184 patients. The mean age was 13.9 ± 3.1 years. It was more frequent among females 101 (54.9%) versus males 83 (45.1%). The average onset of the disease was 7.5 ± 4.5 years. Rhinoconjunctival syndrome was diagnosed in 180 (97.8%) patients, pollen induced bronchial asthma in 76 (41.3%) and pollen induced urticaria in 35 (19.0%) patients. Study group was divided into four subgroups according to the age–1–3 years (39 (21.2%)), 4–7 (45 (24.5%)), 8–11 (48 (26.0%)) and 12–17 (52 (28.3%)) years old.

Analysis of questionnaire data revealed, that breastfeeding is enough prolonged in all the patients with a mean duration of 9.9 ± 3.6 month. Presence of atopic dermatitis in early childhood was determined in 91 (49.5%), house plants in 129 (70.1%) and allergic rhinitis family history in both maternal and paternal lines in 34 (18.5%). It was found that 134 (72.8%) patients had allergic diseases in the family; the parents themselves had hay fever in 89 (48.3%) cases, among them in both maternal and paternal lines 34 (18.5%).

Table 1 shows skin prick test results, which revealed a high sensitization level to the weed plant pollen. This high sensitization level was determined due to high monosensitization to only several species of the plants, mainly to *A. Absinthium* (68.2%) and Sunflower (25.7%).

It was found, that among Kazakhstan children and adolescents polysensitization to the mix of weeds was determined in 75 (66.9%) patients, to the mix of pratal grass in 33 (29.4%), mix of pratal grass + mix of weeds in 25 (22.3%) and mix of trees in 9 (7.1%) patients (Fig. 1).

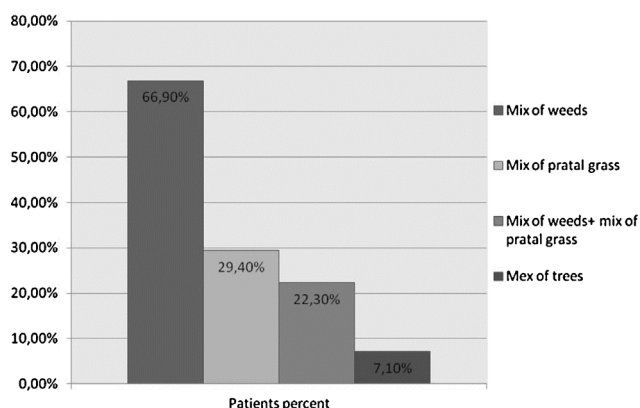
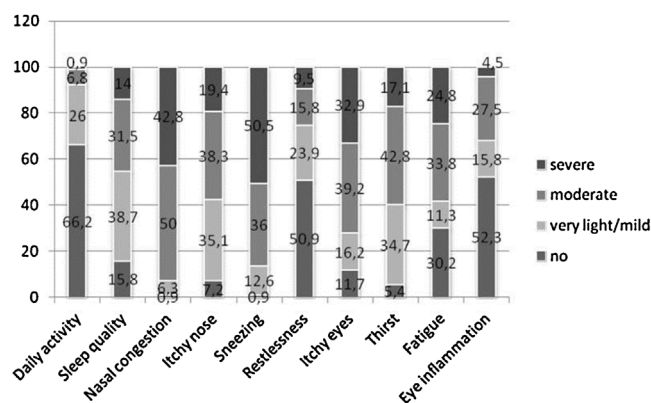
Frequency of symptoms in the studied patients is presented in Fig. 2. The mean of IgE level in blood tests was 323.2 ± 264.9 with a minimum of 31 IU/ml and a maximum of 990 IU/ml.

Results of the date of birth distribution among all patients are shown in the Fig. 3. It was found that in summer months there were the highest number of patients with seasonal allergic rhinitis 68 (36.9%), followed by spring 44 (23.9%), then autumn 37 (20.1%) and the lowest percent of patients 35 (19.1%) was born in winter.

Table 1

Skin prick test results among patients, expressed as valid percent after exclusion of missing data.

Allergens	Weak	Moderate	Strong	Very strong	Weak
Sunflower	14.9	18.9	13.5	27.0	25.7
A. Absinthium	4.5	5.7	5.7	15.9	68.2
Ambrosia	18.8	37.5	21.9	15.6	6.3
Orach	33.3	46.7	6.7	0	13.3
Timothy	31.7	38.1	14.3	4.8	11.1
Fescue	22.9	29.2	20.8	14.6	12.5
Hemp	49.2	28.8	8.5	3.4	10.2
Dandelion	31.8	45.5	9.1	13.6	0
Rye	20.0	74.0	6.0	0	0
Foxtail	31.1	37.8	15.6	2.2	13.3
Meadow grass	44.7	21.1	26.3	7.9	0
Birch	14.3	28.6	28.6	28.6	0

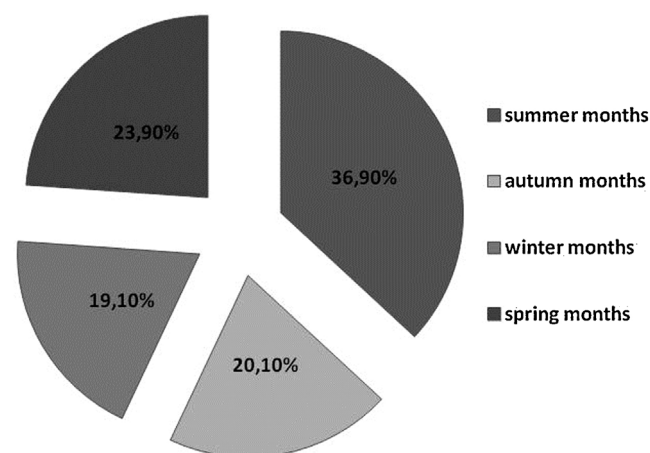
**Figure 1.** Sensitization type to different pollen allergens**Figure 2.** Percentage distribution of symptom severity.

Nevertheless, the real causes of allergic rhinitis in our patients were not the one special parameter, but the complex of family history, clinical symptoms, skin prick test results and increased serum IgE level.

Results of the date of birth distribution among all patients are shown in the Fig. 1. It was found that in summer months there were the highest number of patients with seasonal allergic rhinitis 68 (36.9%), followed by spring 44 (23.9%), then autumn 37 (20.1%) and the lowest percent of patients 35 (19.1%) was born in winter.

5. Discussion

As it was mentioned, allergic rhinitis is common allergic pathology and in recent study was found that prevalence of rhinitis symptoms is high among 16 to 18 years old adolescents in Saudi Arabia, and

**Figure 3.** Patients' distribution according to the season of birth.

symptoms are more common in girls compared to boys. Rhinitis symptoms are also associated with a high frequency of asthma symptoms [15]. During research work implementation, our essential goal was an investigation of the relationship between the date of birth in the pollination season with high pollen allergen exposure and determination of the most common mechanisms of allergic rhinitis formation in children and adolescents of Kazakhstan. It is a well-known fact, that environmental circumstances are responsible for specific allergological sensitization with following symptoms development and clinical manifestation peculiarities [3,16], but at the same time hereditary and inner factors play not the last role.

On the basis of previous studies [17,18] we supposed that there is a growing evidence in relationship between the date of birth and increment of following sensitization to pollen allergens. Thus, our analysis of clinical data in patients who were born in different seasons of the year revealed statistically significant impact of the date of birth on weed plants sensitization. Our obtained results are in accordance with work, conducted by Graf N. et al. in Switzerland on the basis of Swiss research on air pollution and lung diseases, which proved the hypothesis about concrete inhalant allergen exposure during the first months of life influence on the consequent atopic disease development [18]. Vovolis V. et al. also determined an important and meaningful influence of the date of birth on the following respiratory allergy to parietaria and olive plant development in adults [19].

In country with moderately continental climate like Kazakhstan, extending over a large territory in the middle of Asia, with the range of temperature from -30°C in winter and $+30^{\circ}\text{C}$ in summer, the main cause of seasonal allergy was found to be monosensitization to weeds pollen of *A. Absinthium* and sunflower spices, and polysensitization to the mix of weeds (in 66.9%), whereas sensitization to meadow grass mix (29.4%) and trees mix (7.1%) was determined in the less of cases. In contrast, in countries with a hot dry climate like Oman, the pattern of sensitization to environmental allergens as in other reports from Arabian Peninsula was shown in 689 patients and demonstrated that the most common allergens are house dust mites. About one third of patients were sensitized to mesquite tree and Russian thistle, which are the most common plants in Oman [20].

On the other hand, Bremer SA and co-authors investigated another hypothesis—whether an early life exposure to antibiotics, vaccination or specific infections influence the development of allergic diseases [21]. It was found that pollen allergy risk seemed plausible in the case of early exposure to microbial agents and concurrent grass pollen [22].

The substantial finding of our study is that among all our patients the most frequent clinical syndrome of seasonal allergic

rhinitis was rhinoconjunctival (in 97.8%), whereas the high incidence of concomitant pollen-induced bronchial asthma and even pollen urticaria took place. Therewith, Duggan EM et al. stated that rhinoconjunctivitis and eczema have become increasingly prevalent. We also established that the atopic children and adolescents had a higher male incidence compared to females, and again, these results are in accordance with Irish schoolchildren survey. The authors proved that males had a significant higher incidence of atopic disease when compared to females, especially before the age of nine years [23].

As we have found, breastfeeding is enough prolonged in all patients with mean duration of 9.9 ± 3.6 month, indicating fine habits among Kazakhstan population because prolonged breastfeeding is considered as one of the most important protective practice in reducing the probability to develop allergic pathology [24].

Revealed risk factors significantly influence and cause peculiarities of allergic rhinitis in children and adolescents of Kazakhstan. Presence of atopic dermatitis in early childhood, family history in both maternal and paternal lines and presence of house plants are important risk factors for allergic rhinitis formation in Kazakhstan children and adolescents. The same results were obtained in recent asthma research, conducted by Korean scientists. Male sex, history of atopic dermatitis, history of allergic rhinitis, parental asthma, use of antibiotics during infancy, exposure to molds in the house during infancy and development or aggravation of asthma symptoms within six months after moving to a new house, could be risk factors for wheezing within 12 months [25].

Kazakhstan patients who were born in the pollination season from the beginning of May to the end of October showed the highest risk of weed plants pollen sensitization. This fact determines the trend in allergic reactions. Our research showed that emerging botanical, climate and geographical conditions in Kazakhstan are favorable for the widespread and dissemination of pollen allergy. Among pollen allergens sensitization the most prevalent is weeds (especially *A. Absinthium*) and pollen allergy development is accompanied by high level of poly sensitization.

The weak point of our study is relatively small sample and a failure to obtain the follow up data for all patients. These limitations restricted the generalizability of the results in this study. The future research, involving more patients with the use of more sophisticated tools and assessment in molecular, chromosomal and genetic level should be performed for better investigation of the possible mechanisms related to the environmental influence.

6. Conclusions

Developed allergological questionnaire let us to diagnose allergic rhinitis initiation, especially on early stage. Our results demonstrated that in Kazakhstan, as well as in other parts of the world, the first months of life are the crucial period and inhalant pollen allergen exposure, particularly the weed pollen, predisposes the risk of consequent allergic reactions development. The issues dealt with in this study may require further research with a larger sample population over an extended period of time to verify these conclusions.

Declaration of interest

The authors report no conflicts of interest. The authors are solely responsible for the content and writing of the paper.

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