Session 2: Environmental Aerobiology

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Allergic skin diseases – still an up-to-date clinical challenge

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According to World Allergy Organization White Book, allergic diseases are increasing worldwide with unprecedented complexity and severity. It has to be emphasized, that children bear the greatest burden of allergic diseases. The most common allergic conditions in children are food allergies, atopic dermatitis (AD), asthma and urticaria. Exact causes of this increase in allergic diseases are not fully understood, but as numbers of affected patients increase, so does the research and development, and progress is being made.

AD is the most common chronic inflammatory skin disease with a varied clinical spectrum. It is often the first manifestation of the atopic patient and early intervention may offer an opportunity to impede or stop the atopic march. On the other hand, urticaria is a heterogeneous group of disease subtypes characterized by wheals and/or angioedema. Skin lesions are elicited by particular stimuli, including physical factors. Urticaria occurs frequently with a lifetime prevalence above 20% – moderate to severe urticaria requires specialist treatment; however, in many health care systems worldwide, access to specialty care is insufficient.

Allergies should be recognized as a public health problem and efforts should be made towards their prevention and optimal treatment. What is more, we should provide appropriate training and education for patients and families as it is fundamental to the management of allergic diseases.

The role of *Fusarium moniliforme* molds in allergic rhinitis caused by grass pollen allergy

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In daily practice, we observed that patients with grass pollen allergy had symptoms before the onset of pollen fall season. In accordance with the above-mentioned, we decided to analyse the influence of mold spores on the mucus of upper respiratory tract in patients with grass pollen allergy.

111 adult patients were examined. 99 patients with grass pollen allergy and 12 healthy persons as a control group, aged 27.7 and 22.1, respectively. In all, skin prick test (SPT) with inhalant allergens as grass, tree, weeds pollen, house dust mite, cat and dog fur and blood concentration of specific IgG against molds (as *Fusarium moniliforme, Aspergillus niger* and *Candida albicans)* were performed.

In the examined group, 47% of patients had positive test only against grass pollen, 32% against grass and tree pollen, 21% against grass pollen and other inhalant allergens (as weeds, house dust or cat). In the control group, patients showed negative SPT. In the grass pollen allergy group, 80% of patients had very high IgG concentration against *Fusarium moniliforme*, average concentration was 69.40 µg/ml (normal is <2.5 µg/ml). IgG against *Aspergillus niger* was 28.59 µg/ml, IgG against *Candida albicans* was 48.55 µg/ml. In the

control group, IgG concentrations against these molds were at the normal range.

Fusarium is a mold, which is very widespread in nature. It grows in soil, in plants and in air-conditioners. It develops infections of plants. *Fusarium* produces mycotoxins: fumonisins B1 and B2, which are in their spores, too. Their spores appear after winter in the air, when the temperature and the humidity increase before grass pollen season. The concentration of *Fusarium* spores is high from January until July. They induce the inflammation of mucus of respiratory tract – fusariosis. The organism produces antibody against *Fusarium* – in acute infection- IgM, which lives 10 days only, next IgG – in chronic infection.

Conclusions: Patients with grass pollen allergy had a high concentration of IgG against *Fusarium moniliforme*. Along with my hypothesis, fusariosis of the respiratory tract mucus starts before grass pollen season. When pollens of grasses get into mucus, mycotoxins from *Fusarium* spores damage the framing of pollen and in that manner the allergic protein is released from pollen. Immunologic response starts, IgE against pollen proteins are produced and inflammation increases.

The role of airborne allergens in atopic dermatitis

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Atopic dermatitis (AD) belongs to chronic inflammatory dermatoses, emerging in early childhood. It is characterized by remarkably intensely itchy skin, frequent recurrences and characteristic morphology and localization of skin lesions. Coexistence of other atopic diseases such as asthma or allergic rhinitis is often observed in one patient. There are genetic factors that play a key role in the development of AD symptoms, but there are numerous additional factors that may exacerbate the dermatological condition. These include airborne and food allergens, microbes, stressful situations, climatic factors. Airborne allergens, such as house dust mites, plant pollen allergens, animal epidermis, or mold allergens are environmental factors to which the patient is exposed through inhalation but also more importantly, by direct skin contact with allergens suspended in the air. According to literature data, there is a possibility to elicit AD-specific dermal lesions through a direct application of airborne allergens on epidermis surface. This procedure is referred to as atopic patch tests and, although it is still not routinely performed, may provide important help in diagnosing an AZS patient.

Sensitization prevalence to selected inhalant allergens among a group of students of Faculty of Biology, Adam Mickiewicz University, Poznań based on skin prick tests

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Grass pollen (including rye, *Secale cereale*), birch pollen (*Betula* spp.), mugwort pollen (*Artemisia* spp.) and house dust mites are recognized as key airborne allergens which induce most of the allergic diseases in our country. According to data obtained from the Epidemiology of Allergic Diseases in Poland project (ECAP) conducted in the period from 2006 to 2008, the average prevalence of allergic diseases in our country was 20% to 30%, depending on age groups. In this pilot study, we present results concerning the prevalence of positive skin prick test (SPT) reactions to common aeroallergens among students from the Faculty of Biology at the Adam Mickiewicz University in Poznań.

Twenty two-students (19 females, 3 males) 22-23 years of age voluntarily participated in this examination during environmental epidemiology classes in April 2015. Skin prick tests with the following six allergens: birch, grasses/rye, mugwort, house dust mites, cat fur were used to evaluate sensitization of the participants. The size of the wheal after 20 minutes was determined by measuring the diameter in two perpendicular directions.

The most common positive skin prick test response was grass/rye (27.3%) followed by house dust mites (23%; *Dermatophagoides pteronyssinus, D. farinae*). Furthermore, 9.1% of the participants exhibited positive SPT responses to birch and cat fur. Three (27.3%) out of eleven allergic students were sensitized to at least two different allergens.

This pilot study should encourage commencement of systematic studies on sensitization prevalence to airborne allergens among students of the Faculty of Biology. It seems especially important for students in the field of environmental biology, since they regularly take part in various outdoor activities, which expose them to natural allergens. The prevalence of positive SPT reactions to grasses and house dust mites correspond to those observed in the out-patient ECAP study (21% and 23%, respectively; Samoliński *et al.* 2014. Alergologia Polska – Polish Journal of Allergology, 1: 10-18).

Variability in the concentration and composition of pollen grains and atmospheric dusts and their impact on human health in Sosnowiec

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Airborne allergy is an important problem in terms of public health, both in Europe and Poland. Symptoms occur in allergic persons every year with varied severity depending on the aeroalergens concentration in the air. Increased number of airborne allergies was stated in urbanized areas, which is associated with higher air pollution. Environmental pollution has a significant impact on the growth of allergic diseases. Organic and inorganic substances, motor exhaust fumes accumulate on the surface of pollen grains and are inhaled with them.

Surveys of respiratory disease symptoms were conducted among children aged from 7 to 13 years who attended primary school (I-VI class), from October 2012 to August 2013. Allergologists from the Institute of Occupational Medicine and Environmental Health in Sosnowiec, based on the available literature, domestic and foreign sources, and based on their own medical experience have developed a Symptoms Card of the Respiratory Tract, which is self-observation questionnaire of reported problems. Alongside questionnaire forms, the concentration measurement of pollen grains and collection of samples of dust particles PM10 in Sosnowiec was carried out. Test points and the school are in the same district.

Allergy symptoms from the respiratory tract occurred with varied severity during the research period. The most commonly reported symptoms include: blocking the nose, leaking watery secretions from the nose, and coughing. Exacerbation of symptoms in children was found in November, December 2012, January, April and June 2013. Allergic symptoms in the autumn-winter period were caused by high concentration of dust particles PM10. The particles composition consisted of soot units that were composed of calcium sulphate (mostly gypsum), chloride sodium and ammonium chloride (salmiac). Sharp-edged grains of quartz, and balls of aluminosilicate enamel were found in smaller quantities

In the spring-summer period, the cause of the reported problems was plant pollen. April is a period of intensive blooming of trees (alder, birch, ash tree). After the 5th April 2013, an increase of symptoms was recorded. It was a period of intensive blooming of alder tree, cypress and birch. June is a period of grass and ryes blooming. The first half of June was characterized by the largest occurrence, after November 2012, of negative symptoms of respiratory system ailments caused by the exposure to the pollen of grasses and rye. In July 2013, fewer symptoms throughout the research period were reported, while in August 2013, between 15th and 20th, a sudden increase in the recorded symptoms caused by exposure to the pollen of Mugwort and ragweed were observed.

Research in the group of children aged 7-13, from Pogoń district in Sosnowiec indicated a high incidence of allergies to grass pollen and birch allergens, as well as to ammonium chloride (salmiac).

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Bioaerosol of salt chambers in the Health Resort of "Wieliczka" Salt Mine, Poland

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"Wieliczka" Salt Mine chambers with their specific stable, microclimatic conditions, like low temperature, high relative humidity, salt aerosol saturation, and low allergens content provide a unique place, where pulmonary and allergy-related diseases are treated. Permanent therapy requires microbiological control of chambers, which were monitored only occasionally in the past to estimate the qualitative and quantitative composition of biological components. The aim of the study was to determine the occurrence of biological particles in the air of "Wieliczka" Salt Mine in relation to the place and time of the study.

Twenty measurements were performed quarterly in 2012-2016, in six places in two salt chambers of the Health Resort (Wessel Lake – two sites, Eastern Mountains – four sites). Pollen and fungal spore concentrations were measured using the volumetric method, bacterial and fungal spore colonies were analysed applying the microbiological, impact method, while mite and cut allergens were measured using the FEIA assay. The results of pollen and fungal spore concentration were compared to the results obtained in Krakow, on the same days by the volumetric method. Statistical Mann-Whitney test and Kruskal-Wallis ANOVA test were applied to compare the results obtained in the studied samples, in relation to different site and time of measurements.

The highest spore concentrations were obtained in summer in both methods; *Cladosporium* spores dominated in the volumetric method, while *Penicillium* in the impact method. Mean daily concentrations of up to 300 CFU/m^3 and 100 FS/m^3 were achieved. Among bacteria, two types *Micrococcus* spp. and Coagulase negative *Staphylococcus* prevailed definitely. Bacteria particles dominated in summer; the mean concentration exceeded 3.500 CHU/m^3. No statistically significant differences between fungal spores and bacteria concentrations measured before and during patients were indicated. On the other hand, statistically significant differences among the study sites were found, in the case of *Alternaria* and *Cladosporium* in the volumetric method, and *Penicillium* vs. *Geotrichum* and *Micrococcus*, *Bacillus*, *Corynephorm* in the impact method. The differences were found also among the time of measurements, treated as the following seasons, for spores and bacteria, but these relations were different. In the volumetric method, *Alternaria* and *Cladosporium* concentration differed between spring and summer, summer and winter; moreover, in the impact method, both taxa concentrations differed between summer and autumn. Differences between the content of bacteria in spring and autumn were observed. Pollen grains were observed in the underground chambers rarely and in low quantities. Two situations were distinguished: (1) in autumn and winter pollen grains were observed in the air samples in salt chambers, while in the ambient air they were absent, (2) in spring and summer pollen grains of taxa occurring in the ambient air were also observed in the underground. No statistically significant differences between the content of Der p1 and Fel d1 allergens in both measurement conditions as well as among study places and time (four seasons) were found.

The qualitative content of microorganisms in the air of salt chambers seems to be related to the biological material carried in by patients and staff. The low concentration of particles favours the treatment of patients with allergy diseases.

Microclimate of selected types of large-volume buildings in which heat gains from people occur in the context of mold risk

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Selected aspects of air temperature and some other microclimate parameter changes caused by heat emission from people staying inside some types of large-volume buildings are presented. Here are shown example results of the research conducted inside unheated and low-heated sacral buildings (including tall) and as partially reversed cases inside selected residential apartment buildings. The study was part of the research work carried out by the author at the Warsaw University of Technology and at the Cardinal Stefan Wyszyński University in Warsaw. The research involved large-volume sacral buildings (including tall ones) and residential apartment buildings.

The purpose of the research was to determine the effect of heat emission from people on selected microclimate parameters in selected spaces of the tested rooms. A comparison of the effects of human heat emissions in large-capacity facilities (sacral buildings) and inside residential apartments was made bearing in mind possible deterioration of air quality and occurrence of mold. The results were obtained with the use of typical microclimate research equipment – thermohygrometers and thermal imaging cameras. The tested objects were sacral buildings located in the town of Płock and residential apartment buildings located in the Masovian voivodeship in Poland.

Selected results: (1) Number of people staying in sacral buildings often generate different influence on the microclimate in them; (2) In some tested residential apartment buildings, infiltration reduction caused deteriorated air quality and mold on internal surfaces of partitions after the period of 4-8 years; (3) In large-volume facilities, there is often no need for an intensive ventilation and there is no deterioration of air quality due to the presence of a big number of people; (4) In the tested residential apartment buildings (following their thermal modernisation, reduction of external air infiltration) which consist of many separate apartments, heat streams emitted by persons were distributed in many different rooms and the natural ventilation was often not sufficient and caused mold.

Conclusions: Molds were often caused by poor ventilation in the tested residential apartment buildings. In some cases, it was possible to prevent it by ensuring right external air infiltration, earlier measurements and even simulations. Heat emitted by persons was considerable as heat gain, especially in buildings where big numbers of people were staying at the same time in one facility, like in sacral buildings. In the tested sacral buildings, it can be treated as a useful profit without risk of mold because of the large volume of facilities.

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Tree pollen calendar for central Poland – 14 years of experience

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Pollen allergy is an important public health problem in Poland. Many studies have shown that an increase in the frequency of sensitivities may be related to an increase in the pollination intensity of windflower trees. Pollen concentrations are also seen as important indicators of climate change. The aim of the study was to analyze the degree and duration of pollen exposure, as well as the long-term trends in pollen dynamics over fourteen years of research in the urban area.

The atmospheric pollen levels were recorded volumetrically with *Lanzoni* sampler (seven-day recording device) during the period 2003-16. The measurement point was situated at the distance of about 30 km from the geometric centre of Poland and in the centre of Łódź (51° 46' 17.5'' N; 19° 28'29.3''E). The analysis included tree taxa: *Corylus, Alnus, Juniperus/Taxus, Populus, Ulmus*, *Salix, Acer; Fraxinus, Betula, Carpinus, Fagus,* Pinaceae. The beginnings and ends of seasons were calculated by the 98% method.

The mean total yearly count of the examined trees was 27807, which accounted for 69% of the total pollen of the examined tree and herbaceous taxa. The highest average annual pollen values were observed for: *Betula* (12950; 47%), next Pinaceae (6175; 22%) and *Alnus* (3494; 13%). Other taxa accounted for 1-5% of pollen counts. The analysis of long-term trends for annual pollen concentrations revealed a decrease tendency for 6/12 taxa; including significantly decreasing for: *Alnus* ($p=0.01$), *Betula* ($p<0.005$) and *Fagus* ($p=0.036$).

Betula pollen: the atmospheric presence was recorded on average in 34 days. The beginnings of the seasons were observed between 29.03-21.04 and the ends between 30.04-26.06. Mean maximum daily concentrations were 2622 grains. On average, pollen concentrations were found within 30 days, ranging from 21 to >100 grains/m^3 (medium to very high level).

Alnus pollen: the average length of the season was 46 days, with the beginning of the season between 06.02 and 27.03 and ending between 11.03 and 30.05. Medium to very high daily concentrations of pollen on a scale from in m^3 were found within 17 days.

Conclusions: The exposure to the pollen of the examined taxa in central Poland was three times higher than that of the herbaceous pollen. Successive reductions in the annual sums of some important allergenic taxa did not confirm observations from Western countries, where rising trends were attributed to global warming.

Characterisation of the *Salix* spp. pollen seasons in Lublin in 2001-2016

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A majority of species from the *Salix* genus are entomophilous plants, whereas alpine and arctic species from this genus exhibit features of anemophilous plants. Airborne *Salix* pollen exerts a low allergenic effect. The aim of the study was to evaluate the course of the *Salix* pollen season in Lublin in years 2001-2016. The effect of meteorological factors on the parameters of the pollen seasons was analysed and trend lines were determined in order to examine plant response to climate change.

Samples were collected with the volumetric method. The measurement station was located in the city centre. Spearman's correlations between pollen season parameters: the beginning of the season, duration, peak value, peak date, and annual total, as well as meteorological factors: temperature, humidity, rainfall, and wind speed, were calculated.

Salix pollen was shown to account for 1.25% of the total airborne pollen content in Lublin. The onset of the pollen season was noted between March 16 and April 17. The annual totals of pollen grains were in the range of 280-1277. Maximum concentrations of pollen grains were recorded between April 11 and May 1 with a mean value of 115 P/m^3. We found that temperatures in February and March had a significant impact on the onset, length, and peak date of the pollen season. The peak value and annual total were significantly correlated with the minimum temperature in January. The course of the trend line indicates a decrease in the peak value and annual total in recent years. The analysis of the annual total from the successive years indicates a biennial cycle of abundant pollen production by *Salix* species.

Conclusions: (1) The highest concentrations or airborne *Salix* pollen in Lublin were noted in the second half of April; (2) Among the meteorological factors, temperature exerted the most significant effect on the course of the pollen season; (3) The peak value and annual total declined in recent years; (4) A biennial cycle of abundant pollen production was noted in the *Salix* pollen seasons.

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Betula pollen in aeroplankton of Lviv and Ivano-Frankivsk (Ukraine) in 2013

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Betula pollen is one of the most important allergenic pollen types in Central and Northern Europe, including Western Ukraine. According to a five-point scale, the allergenicity of pollen is evaluated at the highest point and considerable concentration of it is the greatest danger for susceptible people. The aim of the study was to determine the time of the initiation, maximum and the end of pollination and to delimit the major meteorological parameters influencing seasonal variation in the atmospheric *Betula* pollen grains in Lviv and Ivano-Frankivsk. It is important not only for the analysis of the aeropalynological situation in the regions but for significant completion and enhancement of the European network.

The aeropalynological investigation was carried out in two cities: Lviv and Ivano-Frankivsk (Western Ukraine). In both cities, the gravimetric method was applied using a Durham trap. Using light microscopes (Olympus CX-300, Carl Zeiss), the pollen of allergenic plants was identified. Special factor for calculation was used in order to make the data obtained with gravimetric method comparable to those obtained with the volumetric method. All concentrations used in this study are average daily pollen grain concentrations per m^3 of air (p.g./m^3). Maximum of pollen considered the greatest value of pollen concentrations per m^3 of air.

In 2013, *Betula* pollen was present in the air of Lviv and Ivano-Frankivsk from the second decade of March (on 14.03 and 19.03, respectively). The end of the birch pollination was recorded in May in Ivano-Frankivsk and in June – in Lviv. In Lviv, maximum pollen concentration was registered on 23.04, whereas in Ivano-Frankivsk – 4 days later. In April, in both cities, the number of days when *Betula* pollen concentrations were higher than 50 p.g./m^3 were 7.

The air temperature, humidity and wind direction had considerable influence on plant pollination. As a result of the statistical analysis, a significant, positive values correlation coefficient between temperature and *Betula* pollen content in the air was founded (Lviv: r=0.6094; Ivano-Frankivsk: r=0.6857) and significant, negative values of correlation coefficient were obtained for humidity (Lviv: r=-0.4398; Ivano-Frankivsk: r=-0.5209). The increase of *Betula* pollen concentrations was registered when south-eastern and south-western winds were dominant. Probably, these pollen grains were transported from regions which are more southern than Lviv and Ivano-Frankivsk where pollination begins earlier.

In the present paper, it was found that differences between dates of the beginning of *Betula* pollination (second decade of March) and dates of appearance of maximum concentrations (third decade of April) in the cities of Western Ukraine were insignificant. This may be related to similar climatic conditions and the short distance between the cities. Certain data obtained indicate the dependence of dynamics of plant pollen concentration on temperature regime, on humidity, and on the wind direction during the pollination. It was also discovered that the threat of emergence of dangerous allergenic situations in the cities took place in the third decade of April because of exceeding of the clinically significant concentration of *Betula* pollen.

Nowadays it is necessary to equip the observation post with modern volumetric traps (Burkard) in Lviv and Ivano-Frankivsk which will ensure continuity of aeropalynological investigations in Ukraine as well as improve their authenticity and informativeness.

A comparative study of hourly and daily relationships between basic meteorological parameters and airborne fungal spore composition

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The release, spread and occurrence of spores in the air are determined by, among others, several interacting meteorological factors. It is useful to know how changes in the spore concentration and composition in the air come with changes in weather conditions, including a complex of variables. The aim of this study was to compare the impact of meteorological parameters on daily and hourly numbers and compositions of spores during the year, and to indicate the most important weather parameters.

The study was carried out in Szczecin in 2013 for 20 spore types: *Agrocybe, Alternaria, Chaetomium, Cladosporium, Coprinus, Curvularia, Didymella, Drechslera* type, *Epicoccum, Ganoderma, Leptosphaeria* type, *Periconia, Phaeosphaeria, Pithomyces, Pleospora, Polythrincium, Stachybotrys, Stemphylium, Tilletia, Torula* and: air temperature, relative humidity, precipitation and wind speed. Effects of a complex of meteo parameters on the hourly and daily composition of fungal spores were assessed using the software package CANOCO. Airborne fungal spore distribution patterns in relation to meteorological variables were determined by RDA and DCA.

Distribution of particular fungal spore types along meteorological gradients differed in detail between hourly and daily data. Following the gradient of increasing air temperature, the maximum abundance of *Cladosporium* and *Ganoderma* spores was related to the highest values, whereas the *Phaeosphaeria*, *Agrocybe, Leptosphaeria* type, *Fusarium, Curvularia*, *Stachybotrys* and *Stemphylium* to the lowest. The closest positive relationships were observed between the air temperature and *Cladosporium* and *Alternaria* spores in the hourly data set and *Cladosporium*, *Ganoderma*, *Drechslera* type and *Alternaria* spores in the daily data set. The second most important variable was relative humidity. Following the gradient of increasing the maximum abundance of *Leptosphaeria* type, *Fusarium*, *Phaeosphaeria* and *Curvularia* spores were related to moderate values of RH in the hourly and daily data sets, whereas the occurrence of *Ganoderma* spores differed in both data. Wind speed and precipitation were statistically significant and explained the smallest amount of the total variance in the fungal spore composition.

Basic meteorological parameters are useful in determining spore content and composition, but the modeling of hourly data needs some further elaboration. Averaging the spore number into daily mean values smooths the relationship and enhances the performance of daily models. Therefore, hourly variations in spore abundance are much more difficult to explain by meteorological parameters compared to the overall daily sum of spores in the air. The primary reason is likely that the hourly spore concentrations fluctuate considerably, while most of the meteorological parameters remain rather stable in such a period of time. Key factors in hourly prediction of spore concentration and composition may be, for example, wind characteristics. Wind speed and direction are particularly dynamic factors and may cause stochastic processes associated with spore composition in the short term. Further studies are needed to reveal additional parameters which could increase the accuracy of models for hourly spore contents.

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Multivariate statistical analysis of *Betula* pollen season in selected cities of Poland

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During the spring period, *Betula* pollen is the main cause of inhalation allergy in Poland and, therefore, it is important to monitor and forecast airborne pollen concentrations of this taxon. This study conducted a comparative analysis of the basic characteristics of *Betula* pollen seasons at the regional scale.

The study was carried out over the period 2001-2016 in five cities of Poland – Lublin, Warsaw, Cracow, Sosnowiec, and Szczecin. It was checked whether there were significant differences in all parameters investigated between these cities, using the Kruskal-Wallis test. To find the attributes of birch pollen seasons that most differentiated the individual cities, discrimination analysis (GDA) was performed, while principal component analysis (PCA) allowed us to reduce the data space and to present a scatter plot of factor scores in order to compare pollen seasons in individual cities. The contingency table was also analyzed to check whether there was a significant relationship between pollen counts in the studied years and cities. Due to high variation in seasons in each of these cities, two data groups were distinguished – group 1 composed of seasons with high pollen deposition: 2001, 2003, 2006, 2008, 2010, 2012, 2014, 2016, and group 2 comprised the other seasons. The non-parametric ANOVA and multivariate analyses, GDA and PCA, were performed on both these groups, similarly as for the entire data set.

The results of these analyses allowed us to conclude that, as regards the individual attributes of the pollen season, a significant variation between cities was found for the End parameter and, additionally, for Peak Value and Annual Total after subdivision into the above-mentioned groups. Taking into account the entire data structure, the most abundant pollen seasons were observed in Lublin, followed by Warsaw. The lowest annual totals and seasonal peaks occurred in Cracow. In terms of pollen counts, Sosnowiec was characterized by the highest seasonal variation, whereas in terms of season onset and peak date – Szczecin. A significant relationship was found between pollen counts in the studied years and cities, but its strength, as checked by Cramer's V contingency coefficient, showed that it was low (V=17%). In a group, 1 pollen seasons significantly varied between Warsaw and the other cities and, additionally, Lublin varied relative to Cracow and Szczecin. The largest differences related to the following parameters: Peak Value, Annual Total, and End. The PCA results in this group allowed us to conclude that the most abundant pollen seasons were observed in Lublin, followed by Warsaw. The lowest airborne pollen concentration was found in Cracow. In group 2, most seasons with the highest pollen birch concentration were observed in Lublin, followed by Warsaw and Szczecin. The other cities were characterized by seasons with a lower airborne pollen concentration.

Conclusion: A significant difference of the studied parameters among the above-mentioned cities was found for the End and, additionally, for Peak Value and Annual Total within both groups. In group 1, pollen seasons differed most in Warsaw and Sosnowiec, while in Cracow and Szczecin they differed the least. In both groups, most seasons with the highest birch pollen concentration were observed in Lublin, followed by Warsaw, while in Cracow airborne pollen concentration was the lowest.

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Prediction of birch and ash pollen intradiurnal concentration in Szczecin

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Birch pollen is the most important agent causing pollinosis in Europe, while ash pollen is rarely its cause; however, allergens of *Betula* and *Fraxinus* pollen show cross-reactivity, which can enhance allergy symptoms. Knowledge of intradiurnal pollination patterns and meteorological influence permits avoiding overexposure to allergens, so it should be taken into account when planning outdoor activities. Birch and ash trees are common throughout Poland. The genus *Betula* is restricted in its occurrence to the Northern Hemisphere, especially to cool and temperate zone. Also the *Fraxinus* genus is quite regularly distributed throughout Poland. All birches produce large amounts of light pollen and flower from the second half of April almost to the end of May. The beginning of pollination is closely related to air temperature within the period of 40 days prior to the occurrence of pollen in the air. Ash is wind-pollinated and begins to flower in April and continues to flower almost to the end of May.

Analysis of the hourly pollen counts was performed in Szczecin in the seasons of 2005-2015. For intradiurnal variations, only days with above average concentration of birch and ash pollen seasons and days without the precipitation were considered. Pollen and weather conditions data were analysed in the hours: 6.00 (sunrise), 14.00 (peak value) and 20.00 (sunset). The volumetric sampler of Hirst type was located at 21 m above the ground level, in the city centre. The meteorological hourly data taken into account in the assessment of the effect of meteorological conditions on airborne pollen were: wind speed, air pressure, relative humidity, average air temperature and total radiation. To determine pollen count values V (per cent of V_0) in relation to the influence of selected weather factors h (variables x and y), a quadratic polynomial of two independent variables was considered. Graphical representation of this polynomial is a curved plane in the XYZ coordinate system (3D).

The quadratic polynomial (of degree 2) can be used as a pollen count determining tool based on two independent variables (weather conditions). For the variables, weather factors were taken. In the analysed time periods (hours 6.00, 14.00 and 20.00), a correlation was noted between 24 hour ash and birch pollen count variability and mean air temperature and total radiation 24 hour course. Correlation with 24 hour wind speed and air pressure variability (although weaker than before) was also noted. 24 hour relative humidity variability showed varying correlation with pollen counts of the analysed trees. It was an inverse proportionality with a course inversive to other variables. This was obviously due to the specificity of the thecae opening process. The understanding of longstanding pollen count prognoses, especially concerning 24 hour variability, might contribute to improvement in pollen allergy treatment efficiency and prophylaxis.

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Arboreal pollen grains in deposition and volumetric sampling – a comparison of two methods of annual pollen monitoring

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Deposition of pollen grains and their presence in the air depend mainly on dispersal ability of different pollen types, proximity and quantity of pollen sources and some environmental conditions. We investigated annual pollen spectrum of woody plants in deposition and in the air at the same sampling point. The research was carried out in Rzeszów (SE Poland) for three seasons: 2014-2016. Two methods of annual pollen monitoring were compared: (1) gravimetric – using Tauber trap for pollen deposition, located at ground level; (2) volumetric – using spore trap of a Hirst design, located at 12 m agl.

In all years, more pollen types were registered in the air than in the deposition. The majority of pollen grains registered by the aerobiological trap contained *Betula* and *Alnus* but, in one year, also *Pinus*. The sediment from Tauber trap consisted mainly of *Betula*, *Alnus* and *Pinus*. In two years, the contribution of *Betula* pollen in both methods was approximately 50%. In contrast, in 2015 *Betula* pollen concentration in the air was low (16%) and its contribution to deposition was also lower (4%) in favor of *Pinus* (50%) and *Corylus* (17%). *Corylus, Juglans, Pinus* were the only species with greater participation in Tauber trap than in volumetric sampler. Some pollen types, registered by the volumetric sampler, even with participation above 3% (i.e. *Fraxinus*, *Quercus*) were never noted (or noted in traces) in a deposition.

In conclusion, the annual spectrum of arboreal pollen types from two methods differed in their quantity and quality. We noted that participation of such pollen types: very abundant in the air (*Alnus, Betula*), originating from near vicinity (*Corylus, Juglans*), large and with high settling velocity (*Pinus*) increased or were similar in a deposition in comparison with airborne sampling.

Systematic importance of pollen morphological features of species from the genus *Erica* (Ericaceae)

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The *Erica* genus has not been investigated satisfactorily from the point of view of its palynology. Its complicated taxonomic system, a large number of species as well as extensive and disrupted range of occurrence all contribute to the fact, that few researchers undertake investigations of this species. It was assumed that research

results would be representative thanks to a complex comparative analysis of all diagnostic, morphological pollen features performed on properly selected plant material, which represents all more important, currently distinguished intrageneric taxons (45 species from all five subgenera and 22 sections), both discriminated pollen dispersal units (tetrads and monads) as well as the main centres of genus occurrence and diversification (species from Europe, RSA and Madagascar). It was further assumed that analyses of several pollen grain morphological features would provide fresh information about heathers and would make it possible to elaborate a detailed description of pollen morphology of a considerable group of species and would turn out useful in developing and improving hitherto unfinished taxonomic system of the *Erica* genus. Another aim of the study was to discriminate the studied species on the basis of pollen grain morphological features.

45 species (39 with terads and six with monads) were analysed. The pollen grains were analysed for 11 quantitative features and the following qualitative ones: outline, shape and exine ornamentation. 1350 correctly formed, acetolysed pollen grains were measured.

Our study revealed that the diagnostic features of pollen grains studied were: pollen dispersal unit, exine ornamentation, P/E ratio, tetrad diameter (D) and length of polar axis (P). On the basis of these traits, 14 *Erica* species (six creating monads and eight – tetrads) were distinguished which, in the case of pollen features, constitutes a significant number. Other heaths created small groups, usually containing two or three species, up to seven species.

Conclusions: The presented study, based on the highest number of *Erica* species (45) analysed so far, corroborated the view that palynological features could be a useful tool to clarify classification systems for large and taxonomically very difficult genus of *Erica*, in particular, at the level of the subgenus and section but also at the species level. The obtained results indicate the need to continue palynological investigations on the genus of *Erica***.**