The analysis of Betula pollen season in Poland in 2019

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Abstract:
The aim of this study was to compare Betula pollen seasons in 2019 in 12 cities located in different regions of Poland. Pollen monitoring was conducted in Bialystok, Bydgoszcz, Cracow, Lublin, Olsztyn, Opole, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wroclaw, and Zielona Gora. Airborne pollen was monitored by the volumetric method using Burkard or Lanzoni pollen samplers. Pollen season length was determined by the 98% method. The pollen season start date was recorded earliest in Wroclaw and Zielona Gora, and latest in Bialystok. The highest Betula pollen concentration values were found in Lublin, whereas the lowest ones in Bialystok. In most of the cities, the maximum daily Betula pollen concentration was recorded on April 19th or 20th. Exceptionally, in Wroclaw the peak value occurred on April 8th, while in Bialystok as late as April 29th. The annual pollen sum reached the highest values in Warsaw and the lowest ones in Bialystok. The highest risk of allergy in people sensitive to the pollen of this taxon was found in Bydgoszcz, Zielona Gora, Szczecin, Opole, and Warsaw.

Key words: aeroallergens, pollen concentration, risk of allergy, birch, 2019

The range of trees of the genus Betula is limited to the Northern Hemisphere where they are predominantly found in the temperate and cold zones. In Poland B. pendula and B. pubescens are the most common [1]. Betula pollen grains are recorded across almost the whole of Europe, from Scandinavia to central Spain and Italy. The highest pollen concentrations of this taxon are reported in the Boreal region, among others in Latvia, Finland, and Poland. The average seasonal pollen index (SPI) for Betula calculated based on data from several hundred pollen monitoring sites in Europe reached a value 32 708 [2]. On the other hand, the total annual birch pollen sums, calculated as means from five years (2001–2005) for six Polish cities (Cracow, Lublin, Poznan, Szczecin, Sosnowiec, and Rzeszow) were 4665–14 551. The highest average values were recorded in Lublin, where during this period the maximum annual count was found in 2003 and it was 34 134 pollen grains [3].

Betula pollen dispersion is most frequently considered at the regional scale of about 100 or 120 km [4, 5]. However, we need to take into account the fact...
that only the fraction of emitted pollen remains as the „regional component” [6]. *Betula* pollen grains are easily carried by air currents for large distances due to their small size, which is 19–22 µm [7]. Long-range transport of *Betula* pollen from East to West Europe and in the opposite direction has been recorded many times. Skjøth et al. [8] report about episodes of *Betula* pollen transport from Poland and Germany to Denmark. Pollen from Russia has been recorded in Finland [9], while pollen from Latvia, Sweden, Denmark, Belarus, Ukraine, Moldova, Germany, and Poland has been found in Lithuania [10].

*Betula* pollen allergens are one of the most common causes of pollen allergy in Poland [4]. Research demonstrates that in Poland 28% of patients exhibit sensitization to birch pollen [11]. Because it has been found that there is a linear statistically significant relationship between airborne pollen concentration and clinical allergy symptoms [12], it is very important to continually monitor the pollen content in the aerosol at many monitoring sites.

**Aim**

The aim of this study was to compare birch pollen seasons in 2019 in selected cities of Poland.

**Material and method**

In 2019 monitoring of airborne birch pollen was carried out in Białystok, Bydgoszcz, Cracow, Lublin, Olsztyn, Opole, Piotrkow Trybunalski, Sosnowiec, Szczecin, Warsaw, Wrocław, and Zielona Gora. Airborne pollen concentrations were investigated by the volumetric method using Burkard or Lanzoni pollen samplers. Microscopic observations were performed on slides obtained in a 7-day cycle with assessment of 24-hour periods. Pollen concentrations were expressed as the number of pollen grains in 1 m³ of air per day (P/m³). Season start and end dates, maximum pollen concentrations, and annual pollen sums were determined. The length of birch pollen seasons was determined by the 98% method. The start and end of the season were defined as the date when 1% and 99% of the seasonal cumulative pollen count was trapped, respectively. The number of days on which the threshold values were recorded, at which the first allergy symptoms occur in people sensitized to birch pollen (20 P/m³) and symptoms in all allergic patients (75 P/m³) [13], was calculated for each of the cities. The study results are presented in graphs and shown in a table (figs 1–6, tab. 1).

**Results**

In most of the cities, the birch pollen season in 2019 started in the first or second week of April (tab. 1). The earliest pollen season start was recorded in Wrocław and Zielona Gora (April 3rd), whereas the latest one in Białystok (April 18th). The end of the birch pollen season was observed between May 1st and May 10th (tab. 1). Maximum daily pollen concentra-

**Table 1. Characteristics of Betula pollen season in 2019.**

| Site                | Pollen season period by the 98% method | Peak value [P/m³] | Peak date | Days number with concentration above threshold | Annual pollen sum |
|---------------------|----------------------------------|------------------|-----------|-----------------------------------------------|------------------|
| Białystok           | 18.04–10.05                      | 1033             | 29.04     | 20 15                                         | 7591             |
| Bydgoszcz           | 8.04–6.05                        | 2980             | 20.04     | 36 29                                         | 23 538           |
| Cracow              | 5.04–1.05                        | 2911             | 20.04     | 27 21                                         | 17 107           |
| Lublin              | 9.04–2.05                        | 6292             | 19.04     | 29 21                                         | 27 727           |
| Olsztyn             | 9.04–6.05                        | 3198             | 20.04     | 30 23                                         | 23 747           |
| Opole               | 4.04–1.05                        | 2897             | 19.04     | 30 26                                         | 21 296           |
| Piotrkow Trybunalski| 4.04–3.05                        | 3974             | 19.04     | 32 25                                         | 29 596           |
| Sosnowiec           | 8.04–2.05                        | 1894             | 19.04     | 23 20                                         | 10 460           |
| Szczecin            | 4.04–3.05                        | 1971             | 20.04     | 32 27                                         | 18 139           |
| Warsaw              | 7.04–2.05                        | 4637             | 19.04     | 34 26                                         | 32 163           |
| Wrocław             | 3.04–1.05                        | 2923             | 8.04      | 30 25                                         | 22 343           |
| Zielona Gora        | 3.04–1.05                        | 3268             | 19.04     | 34 27                                         | 27 256           |
Figure 1. Birch pollen concentration in Białystok and Olsztyn in 2019.

Figure 2. Birch pollen concentration in Cracow and Lublin in 2019.

Figure 3. Birch pollen concentration in Piotrkow Trybunalski and Warsaw in 2019.
Figure 4. Birch pollen concentration in Bydgoszcz and Sosnowiec in 2019.

Figure 5. Birch pollen concentration in Opole and Zielona Gora in 2019.

Figure 6. Birch pollen concentration in Szczecin and Wroclaw in 2019.
tions ranged between 1033 P/m³ and 6292 P/m³, with the highest ones recorded in Lublin and the lowest
ones in Białystok. Our study reveals that in most of the
cities the dates of maximum pollen concentration oc-
curred at a similar date, April 19th or 20th (tab. 1, figs
1–6). It was only in Wrocław that the seasonal peak
was observed on April 8th, while in Białystok on April
29th. The risk of pollen allergy due to the persistence
of pollen concentrations above 20 P/m³ was highest in
Bydgoszcz (36 days), followed by Zielona Góra and
Warsaw (34 days), Piotrków Trybunalski and Szczecin
(32 days). A very high pollen concentration of this
taxon (above 75 P/m³) was recorded longest in Bydgo-
szcz (29 days), Zielona Góra and Szczecin (27 days),
Opole and Warsaw (26 days). Pollen concentrations
exceeding 75 P/m³ occurred earliest (since April 3rd)
in the south-western part of Poland (Zielona Góra,
Wrocław, Opole), and then in Szczecin and Cracow
(since April 4th). High airborne pollen concentrations
were recorded latest in eastern Poland: in Białystok
(since April 18th) as well as in Lublin and Olsztyn (since
April 9th). The annual birch pollen sum was highest in
Warsaw (32 163 pollen grains), whereas it was lowest
in Białystok (7591 pollen grains). A relatively high
pollen count was also recorded in Piotrków Trybu-
nalski (29 596 pollen grains), Lublin (27 727 pollen
grains), and Zielona Góra (27 256 pollen grains).

Discussion

The presented data show that there was high
spatial variability in the Betula annual pollen sum
(7591–32 163) in Poland in 2019, which had also been
found in the previous years [14–16]. In 2019 birch
pollen abundance reached relatively high values at indi-
vidual monitoring sites. This is evidenced by the average
annual Betula pollen sums for the years 2016, 2017
[15, 17], and 2019 calculated for six cities (Cracow,
Lublin, Opole, Sosnowiec, Wrocław, Zielona Góra),
which are respectively 22 502, 8080, and 21 031.

Long-term research has produced results
showing that Lublin is one of the cities where Betula
pollen reaches the highest concentrations in Poland
[3, 14]. The years 2016, 2014, and 2003 were particular-
ly favorable for this taxon’s pollen production in Lublin
since the recorded annual counts were respectively
37 532, 34 631 and 34 134 [3, 17]. These values exceed
the average pollen sum calculated for several hundred
monitoring sites in Europe, which is 32 708 [2].

On the other hand, the average annual Betula
pollen sum calculated for Lublin based on the 2001–
2014 study period was 15 932 [14], which is a value
almost twice lower than the annual birch pollen sum
determined for this city in 2019 (27 727).

Wrocław and Szczecin are the cities where the
Betula pollen season started earliest in 2019 (April 3rd
and April 4th, respectively). The average start dates of
the birch pollen season in these cities calculated for the
period 2001–2014 fell later, notably on April 10th, but
at the same time it was the earliest pollen season start
date for this taxon among eight Poland’s cities com-
pared [14].

At most monitoring sites, the number of days
with the birch pollen concentration exceeding 75 P/m³
ranged 20–29 in 2019, similarly as in the year 2016
which was also characterized by high birch pollen
production and in which the number of such days was
23–28 [17].

Conclusions

In 2019 the birch pollen season started earliest
in south-western Poland and latest in north-eastern
Poland.

Pollen concentrations triggering allergic re-
actions in all pollen sensitive people occurred since
April 3rd–9th, while only in Białystok since April 18th.

The highest peak values were observed in
Lublin, similarly as in the previous years.

The greatest risk of Betula pollen allergy, asso-
ciated with the largest number of days on which more
than 75 P/m³ were recorded, was found in Bydgoszcz
(29 days), Zielona Góra and Szczecin (27 days), Opole
and Warsaw (26 days).

Birch pollen abundance in Poland in 2019 was
at a relatively similar level to that recorded in 2016.

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Ethics: The contents presented in this paper are compatible with the rules the Declaration of Helsinki, EU directives and standardized requirements for medical journals.

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