The analysis of birch pollen season in selected cities of Poland in 2021

Joanna Rapiejko[1], Małgorzata Puc[2], Małgorzata Malkiewicz[3], Krystyna Piotrowska-Weryszko[4], Monika Ziemianin[5], Grzegorz Siergiejko[6], Katarzyna Dąbrowska-Zapart[7], Dariusz Jurkiewicz[8], Agnieszka Lipiec[9]

[1] Allergen Research Center, Warsaw, Poland
[2] Institute of Marine & Environmental Sciences, University of Szczecin, Poland
[3] Laboratory of Paleobotany, Department of Stratigraphical Geology, Insitute of Geological Sciences, University of Wroclaw, Wroclaw, Poland
[4] Department of Botany and Plant Physiology, University of Life Sciences in Lublin, Poland
[5] Department of Clinical and Environmental Allergology, Medical College, Jagiellonian University, Cracow, Poland
[6] Pediatrics, Gastroenterology and Allergology Department, University Children Hospital, Medical University of Bialystok, Bialystok, Poland
[7] Faculty of Natural Sciences, Institute of Earth Sciences, University of Silesia, Sosnowiec, Poland
[8] Department of Otolaryngology with Division of Cranio-Maxillo-Facial Surgery in Military Institute of Medicine, Warsaw, Poland
[9] Department of Prevention of Environmental Hazards, Allergology and Immunology, Medical University of Warsaw, Warsaw, Poland

Abstract:
The study aims to monitor the birch pollen season in selected Polish cities: Bialystok, Bydgoszcz, Cracow, Lublin, Olsztyn, Opole, Sosnowiec, Szczecin, Warsaw, Wroclaw and Zielona Gora in 2021. Pollen concentrations were recorded using a Burkard-type sampler operating in a continuous volumetric mode. The birch pollen season of 2021 started during the first and second decade of April. In south-western Poland it began about 10 days earlier (April 7th or 10th) than in north-eastern regions (April 18th or 19th). The average length of the season was 31 days. The highest daily concentrations and annual pollen grains sum (seasonal pollen integral) were the most variable season characteristics. The maximum concentrations of birch pollen were recorded between April 21st (in Wroclaw) and May 1st (in Sosnowiec and Warsaw). It ranged from 222 p/m^3 in Cracow up to 1997 p/m^3 in Wroclaw. SPI was the lowest in Cracow (1573) and Sosnowiec (1763) and the highest in Bydgoszcz (5474) and Wroclaw (5072). The longest exposure to high concentrations of birch pollen, lasting 16–18 days, was detected in Szczecin, Olsztyn and Bydgoszcz. The abundance of birch pollen in Poland in 2021 was not as high as in 2019 and 2020, which, combined with the protective effect of mouth and nose masks due to COVID-19 pandemic, may have resulted in less severe allergy symptoms in sensitized individuals than in previous years.

Key words: birch (*Betula*), pollen concentration, allergens

Introduction

The genus *Betula* belongs to the family *Betulaceae* Gray. It is widespread in Europe , especially in its northern part [1, 2]. In Poland *Betula pendula* Roth and *Betula pubescens* Ehrh. are the most common species [2].

The occurrence of birch pollen in the air is significantly influenced by meteorological factors, so it may vary from year to year. In central Europe birch flowering generally starts in the first half of April [3]. Due to their small size (19–22 μm), *Betula* pollen

Alergoprofil 2022, Vol. 18, Nr 1, 29-34
DOI: 10.24292/01.AP.181040322

Received: 20.02.2022
Accepted: 1.03.2022
Published: 4.03.2022

grains are easily transported long distances, contributing to pollen concentrations [4].

Betula is the most important source of tree pollen allergens in Europe. In general populations in Europe the prevalence of birch pollen allergy ranges from 8% to 16% [5]. Also in Poland birch pollen is the most common cause of pollinosis in the springtime [6]. In the Polish epidemiological study ECAP the prevalence of positive skin prick tests with birch pollen allergens in the representative population suspected of pollen allergy reached 14.9% [7].

The marker of sensitization to birch, its main allergen, is the *Bet v* 1 molecule, belonging to the PR-10 family of proteins, to which up to 95% of birch sensitized patients react [8]. The *Bet v* 2 molecule, which belongs to the profilin family (panallergens in the kingdom of plants), is recognized by the antibodies of 25% of birch allergy sufferers [8]. As the results of cross-reactivity within the above families of proteins an individual allergic to birch pollen may also react to pollens of the other members of *Fagales* (such as alder or hazel), as well as to some fruits and vegetables (pollen-related food allergy/oral allergy syndrome) [9].

Aim

The study aims to compare the birch pollen season in selected Polish cities in 2021: Bialystok, Bydgoszcz, Cracow, Lublin, Olsztyn, Opole, Sosnowiec, Szczecin, Warsaw, Wroclaw and Zielona Gora.

Material and method

Airborne birch pollen monitoring was conducted during the 2021 season. Pollen concentrations were recorded, according to international standards, using the volumetric method with a Burkard-type sampler operating in continuous volumetric mode [10]. Counts were recorded in 7-day cycles and microscopic analysis was performed for each 24-hour period. The following variables were analysed:

- length of the birch pollen season, determined by the 98% method, where the beginning and the end of the season determine 1% and 99% of the annual total pollen catch, respectively [11]
- seasonal pollen integral (SPI) defined as the sum of the daily average pollen concentrations during the season [12]
- maximum daily pollen concentration for the season (expressed as the number of pollen in 1 m^3 of air per day) and its date
- the number of days with above-threshold pollen level (for the development of allergy symptoms), adopted according to the available literature [13].

The study results are presented in table 1 and in graphs (fig. 1–6).

Results and discussion

In 2021, the birch pollen season began on April 7th (in Zielona Gora and Opole) and April 10th in Wroclaw, while at the other 8 studied sites it started in the second decade of April, even as late at April 19th (in Bialystok) (tab. 1, fig. 1–4). It generally occurred later than in 2020, when at all monitoring sites the season began in the first decade of April, with the exception of Olsztyn [14].

The average length of the birch pollen season in 2021 was 31 days, while in 2020 it was 26 days. The longest season (36 days) was recorded in Lublin and Opole, while the shortest (24 days) in Bydgoszcz and (27 days) in Cracow and Olsztyn (tab. 1, fig. 2, 4–6).

Table 1. *Characteristics of Betula pollen season in 2021.*

Feature of pollen season	Olsztyn	Opole	Bydgoszcz	Szczecin	Sosnowiec	Lublin	Warsaw	Bialystok	Wroclaw	Cracow	Zielona Gora
Duration of pollen season (98% method) and number of days	18.04–14.05 (27)	7.04–12.05 (36)	19.04–12.05 (24)	15.04–12.05 (28)	11.04–15.05 (35)	13.04–18.05 (36)	12.04–13.05 (32)	19.04–16.05 (28)	10.04–12.05 (33)	17.04–13.05 (27)	7.04–11.05 (35)
Seasonal pollen integral (SPI)	4116	3971	5474	3711	1763	3241	2955	2030	5072	1573	4093
Peak value and peak date	426 (29.04)	436 (22.04)	897 (29.04)	601 (29.04)	230 (1.05)	509 (30.04)	265 (1.05)	328 (29.04)	1997 (21.04)	222 (30.04)	354 (22.04)
Days ≥ 20 pollen/m^3 * [13]	24	23	25	24	21	22	23	19	21	18	24
Days ≥ 75 pollen/m^3 * [13]	17	15	18	16	9	13	13	8	15	7	15

Figure 1. *Birch pollen concentration in Zielona Gora in 2021.*

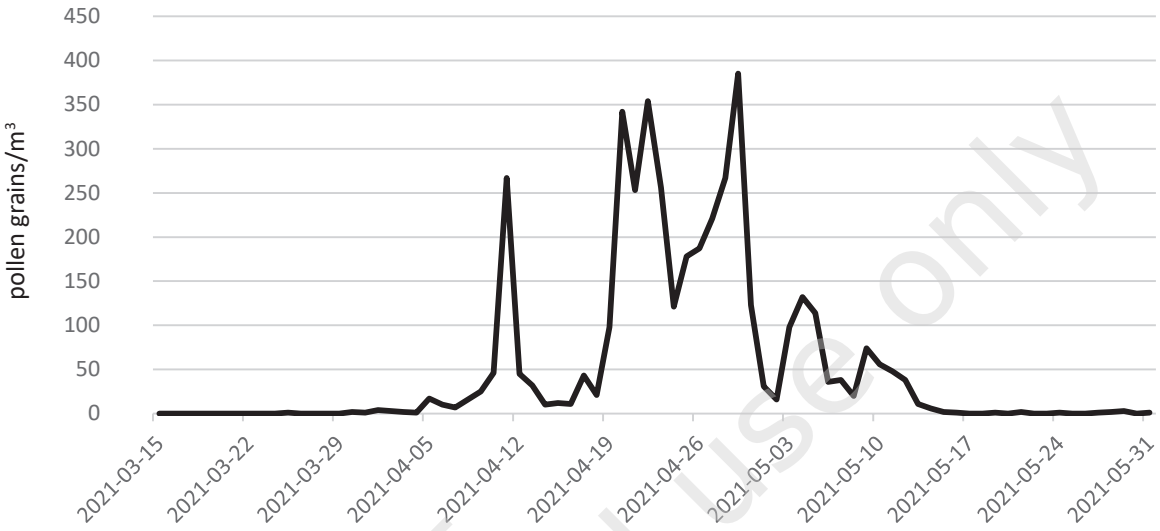


Figure 2. *Birch pollen concentration in Warsaw and Opole in 2021.*

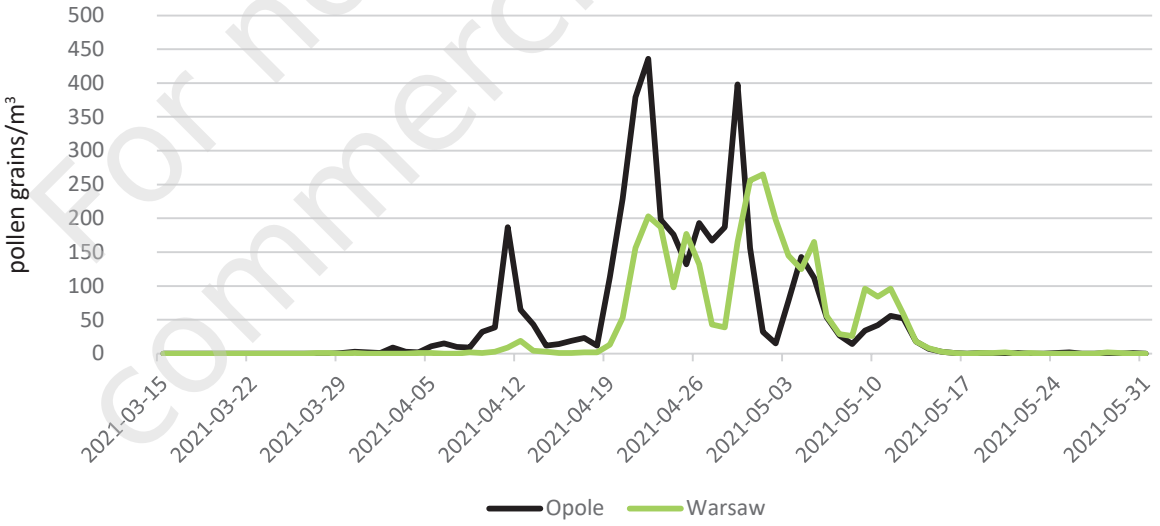


Figure 3. *Birch pollen concentration i Szczecin and Wroclaw in 2021.*

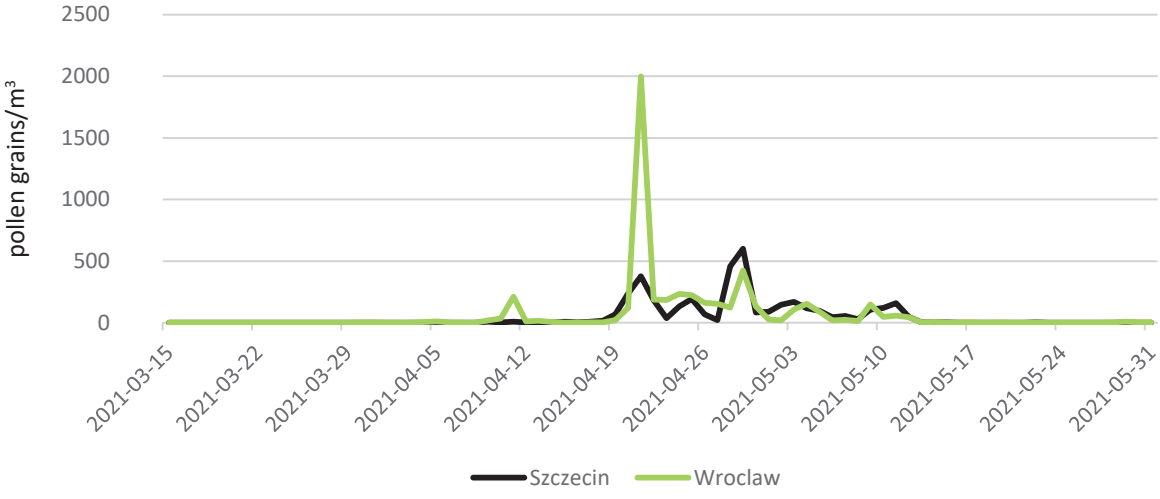


Figure 4. *Birch pollen concentration in Bialystok and Olsztyn in 2021.*

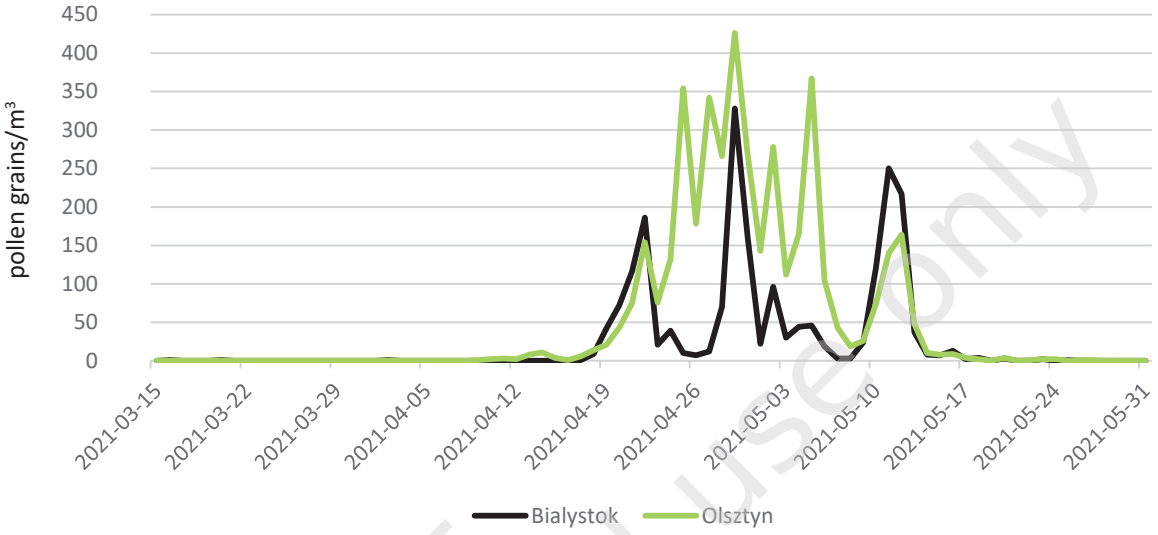


Figure 5. *Birch pollen concentration in Cracow and Lublin in 2021.*

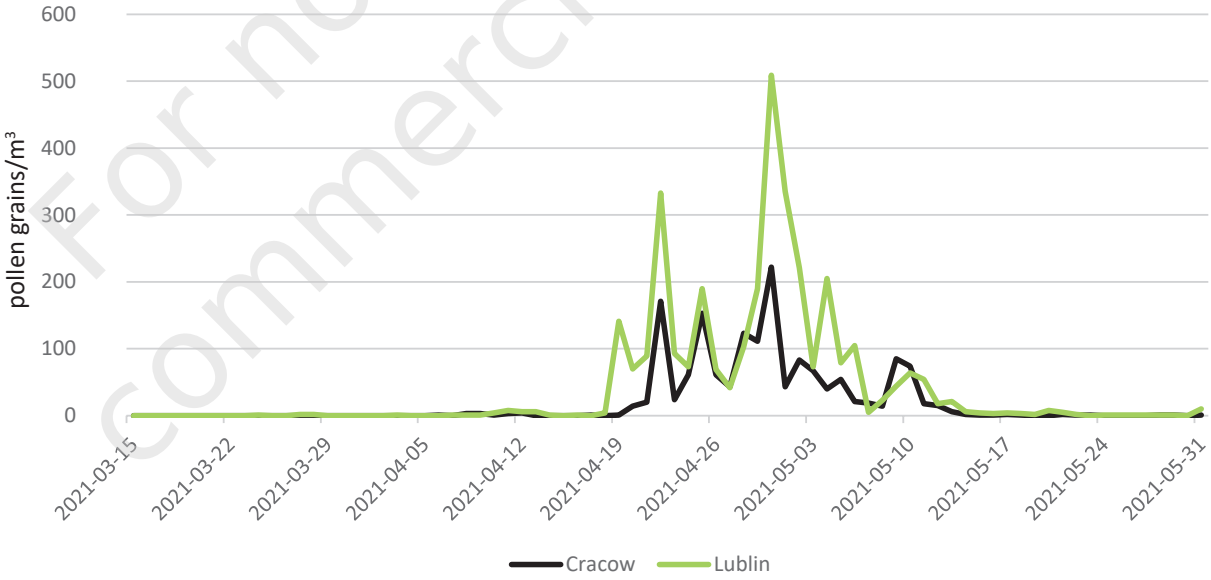
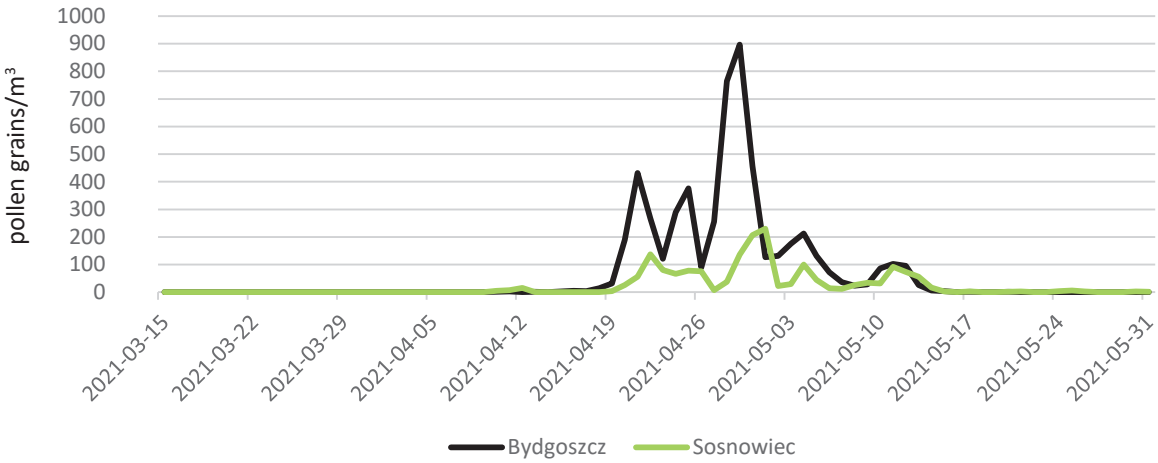


Figure 6. *Birch pollen concentration in Bydgoszcz and Sosnowiec in 2021.*



Seasonal pollen integral (SPI) differed among monitoring sites; with the lowest in Cracow (1573 pollen grains) and Sosnowiec (1763 pollen grains) and the highest in Bydgoszcz (5474 pollen grains) and Wroclaw (5072 pollen gains). While the lowest value of SPI is at the similar level as in the season of 2020, the highest value in 2021 is almost 3 times lower than in 2020 [14]. In 2021 birch pollen abundance did not reach as high values as in the seasons of 2019, when annual pollen sum (SPI) in studied monitoring sites ranged from 7591 to 32 163 [15]. It is in accordance with the observation of biennial cycles of low and high pollen concentrations [3].

The maximum concentrations of birch pollen were recorded between April 21st (in Wroclaw) and May 1st (in Sosnowiec and Warsaw). The highest daily birch pollen concentration was detected in Wroclaw (1997 pollen/m^3 on April 21st), followed by records in Bydgoszcz (897 pollen/m^3 on April 29th) (tab. 1, fig. 1–6). The maximum daily concentrations in 2021 were much lower in comparison to those detected in 2020 in Lublin (almost 11 times lower), Sosnowiec (7,5 times lower) or in Cracow and Warsaw (6 times lower), while similar in Bialystok [14]. The lowest peak daily birch pollen concentrations were recorded in Cracow (222 pollen/m^3 on April 30th) and in Sosnowiec (230 pollen/m^3 on May 1st) (tab. 1, fig. 5, 6). The dynamics of the birch pollen season is demonstrated on the graphs (fig. 1–6), with rapidly increasing pollen concentration and peak values related to the maximum concentration, what was also visible in previous years' studies [14–19].

Number of days with the risk of birch pollen allergy expressed in days with pollen levels exceeding the threshold value at which first symptoms of allergy occur (20 pollen/m^3) ranged between 18 in Cracow and 25 in Bydgoszcz. The longest exposure to high concentrations of birch pollen (75 pollen/m^3 and above), causing severe clinical symptoms, was recorded in Bydgoszcz, Olsztyn and Szczecin and lasted 16–18 days (tab. 1).

Conclusions

The birch pollen season of 2021 started during first and second decade of April. In south-western Poland it began about 10 days earlier (April 7th or 10th) than in north-eastern regions (April 18th or 19th).

The highest daily concentrations and annual pollen grains sum (SPI) were the most variable season characteristics, reaching the highest values in Wroclaw and Bydgoszcz.

The longest exposure to high concentrations of birch pollen, lasting 16–18 days, was detected in Szczecin, Olsztyn and Bydgoszcz.

The abundance of birch pollen in Poland in 2021 was not as high as in 2019 and 2020, which, combined with the protective effect of mouth and nose masks due to COVID-19 pandemic, may have resulted in less severe allergy symptoms in sensitized individuals than in previous years.

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ORCID
J. Rapiejko – ID – http://orcid.org/0000-0001-9832-0413
M. Puc – ID – http://orcid.org/0000-0001-6734-9352
M. Malkiewicz – ID – http://orcid.org/0000-0001-6768-7968
K. Piotrowska-Weryszko – ID – http://orcid.org/0000-0003-3827-3218
M. Ziemianin – ID – http://orcid.org/0000-0003-4568-8710
G. Siergiejko – ID – http://orcid.org/0000-0003-4084-8332
K. Dąbrowska-Zapart – ID – http://orcid.org/0000-0002-8976-7739
D. Jurkiewicz – ID – http://orcid.org/0000-0003-3729-2679
A. Lipiec – ID – http://orcid.org/0000-0003-3037-2326

Author's contributions:
J. Rapiejko: 55%; A. Lipiec 10%; other authors: 5% each.
Conflict of interests: The authors declare that they have no competing interests.
Financial support:
This work was supported by the Allergen Research Center, Warsaw, and Poland's Ministry of Science and Higher Education.
Ethics:
The contents presented in this paper are compatible with the rules the Declaration of Helsinki, EU directives and standardized requirements for medical journals.

Correspondence
Agnieszka Lipiec, MD, PhD D.H.Sc.
Department of Prevention of Environmental Hazards, Allergology and Immunology,
Medical University of Warsaw
02-091 Warsaw, Banacha 1A
e-mail: alipiec@wum.edu.pl