

BIRCH (*BETULA SP.*) POLLEN IN THE ATMOSPHERE OF SKOPJE

Snežana Milkovska¹, Jovanka Kradžinska Bislimovska¹, Vlado Matevski², Snežana Risteska-Kuc¹, Jordan Miniv¹

¹Institute of Occupational Health - WHO Collaborating Center, Skopje, R. Macedonia

²Institute of Biology, Faculty of Natural Science and Mathematic, Skopje, R. Macedonia

E-mail: milkovska_s@yahoo.com

Summary. Allergic diseases of airways, caused by *Betula* pollen, represent a considerable clinical problem in up to 10-20 % of the population in Northern and Central Europe. The analysis of specific IgE antibody by RIDA Screen Allergy-test, conducted by the Department of Allergy, Institute of Occupational Health, WHO Collaborating Center, Skopje, in patients with indication of allergy problem, shows that *Betula* pollen is the most significant allergen (19%) compared to other tree pollens in R. Macedonia. To prevent the appearance of the symptoms, physicians need precise and early information on the pollination data of the major allergenic species. The aim of this study was to determine characteristics and occurrence of *Betula* pollen in Skopje atmosphere, based on a 3-year observation (2003–2005), and to compare pollen season start dates calculated by different methods. Pollen samples were collected using the Hirst volumetric method with a 7-day LANZONI VPPS 2000 sampler. Two-hour counts were used to establish diurnal periodicity with one transverse traverse of the slide being counted every two hours, and the appropriate factor applied. Three methods (Sum 75, 30 and 1 pg/m^3) were used for determination of the start dates of the *Betula* pollen season and the results were compared. The total annual pollen sum increased during the observed period. In 2003, 2004 and 2005, the highest daily pollen concentrations were 97, 460 and 131 pg/m^3 , respectively. The earliest *Betula* pollen season starts were calculated by the 1 pg/m^3 method.

Key words: *Betula*, pollen, pollen season, pollen allergy, Skopje

Introduction

Betula is a genus of the *Betulaceae* family. Species included in the *Betula* genus are anemophilous trees or shrubs that inhabit most of Europe, from Norway to Sicilia (1), except for the southeast Mediterranean areas. The species, *Betula pendula*, can be found in the Republic of Macedonia, presenting the southern border of European birch area. These birch species often grow in the beech region, from 300 to 1900 m above sea level. *Betula pendula* can be found in the mountains of Korab, Desat, Bistra, Jakupica, Osogovo, Kozuv, Belasica, Skopska Crna Gora and Šar Planina.

In Skopje Valley, the only natural species of this genus is also *Betula pendula* Roth. (syn.: *Betula verrucosa* Ehrh.), which grows in groups in Jakupica mountain, but in the mountains of Vodno and Skopska Crna Gora, solitary samples can be found (2,3,4). In the city of Skopje, *Betula pendula* is the most common tree, often planted in gardens and parks. *Betula papyrifera* Marsh is an introduced species in the Botanic garden of the Faculty.

Atmospheric birch pollen is of special aerobiological interest in Northern and Central Europe as one of the most common causes of spring-time pollen allergy as it triggers symptoms of asthma and seasonal rhinitis or conjunctivitis. In R. Macedonia allergic diseases of airways, caused by tree pollen represent a considerable clinical problem in up to 10.8% of the population (5).

The analysis of specific IgE antibody by RIDA Screen Allergy-test, which was implemented in Skopje, Institute of Occupational Health, Department of Allergy, to patients with indication of allergy problems, shows that *Betula* pollen is the most significant allergen (19%) in the Republic of Macedonia when compared to other tree pollen taxa (6).

It is known that *Alnus* and *Corylus* pollen can act as a primer for *Betula* pollen allergy resulting in an extended season (7). There is cross reactivity of *Betula* pollen with other genus of the *Betulaceae* and the *Fagaceae* families, as well as with several fruits (especially apples and hazelnut) and vegetables.

As *Betula* species are dominant tree species in Skopje and its vicinity, it is important to evaluate the occurrence of airborne *Betula* pollen in Skopje, in order to assist clinicians and patients, particularly due to the fact that there is an increase in planting of birch trees in public and private gardens. A significant fact is that *Betula* species produce great amounts of pollen grains (8). However, studies of airborne *Betula* pollen, conducted in Macedonia, show that the value of the seasonal *Betula* pollen index in pollen spectra is high (with an average of 8.5%). According to many authors, it is clinically vital that patients be informed about the possibility of an early start of the pollen season due to pollen transport from other regions.

Aim

The aim of this study was to determine the characteristics of *Betula* pollen occurrence in Skopje atmosphere by measuring daily pollen concentrations and comparing *Betula* pollen season start dates calculated by different methods, as the base for a future forecasting model.

Materials and Methods

Pollen monitoring was conducted in Skopje (42°01' N, 21°27' E at the altitude of 275 m above sea level), situated in the Skopje Valley (R. Macedonia). Pollen samples were collected employing the Hirst volumetric method (9) with a 7-day LANZONI VPPS 2000 sampler in 2003, 2004 and 2005. The trap was situated on the roof of approximately 9 m above ground level.

A seven-day trap was used, and pollen grains were observed and counted with a fluorescent microscope of 400x magnification. The sampling tape was divided into 48 mm segments, each corresponding to 24h. Four horizontal scans were performed over each segment and daily pollen concentrations (pg/m³) were calculated by multiplying the cumulative observed pollen count with the correction factor.

Two-hourly counts were used to establish diurnal periodicity with one transverse traverse of the slide being

counted every two hours, and the appropriate factor applied.

Three methods were used for determination of the start dates of the *Betula* pollen season and the results were compared:

- The 1 pg/m³ method identified the start of the season as the first of five consecutive days with the concentration equal or above 1 pg/m³, as was used for *Olea europea* (10,11).
- The 30 pg/m³ method identified the start of the season as the day when the *Betula* pollen concentration reached 30 pg/m³ for the first time, as this is often considered a threshold for the start of allergy symptoms by patients sensitive to birch pollen (12).
- The Sum 75 method identified the start of the pollen season as the day when the cumulative average daily *Betula* pollen concentration reached 75 (13).

Results

The analysis of airborne pollen showed year-to-year variations in the characteristics of the period during which *Betula* pollen was captured in the atmosphere. In 2003, 2004 and 2005, the highest daily pollen concentrations were 97, 460 and 131 pg/m³, respectively. Daily pollen concentrations reached 30 pg/m³ or more, for 7, 16 and 9 days in 2003, 2004 and 2005, respectively (Fig. 1).

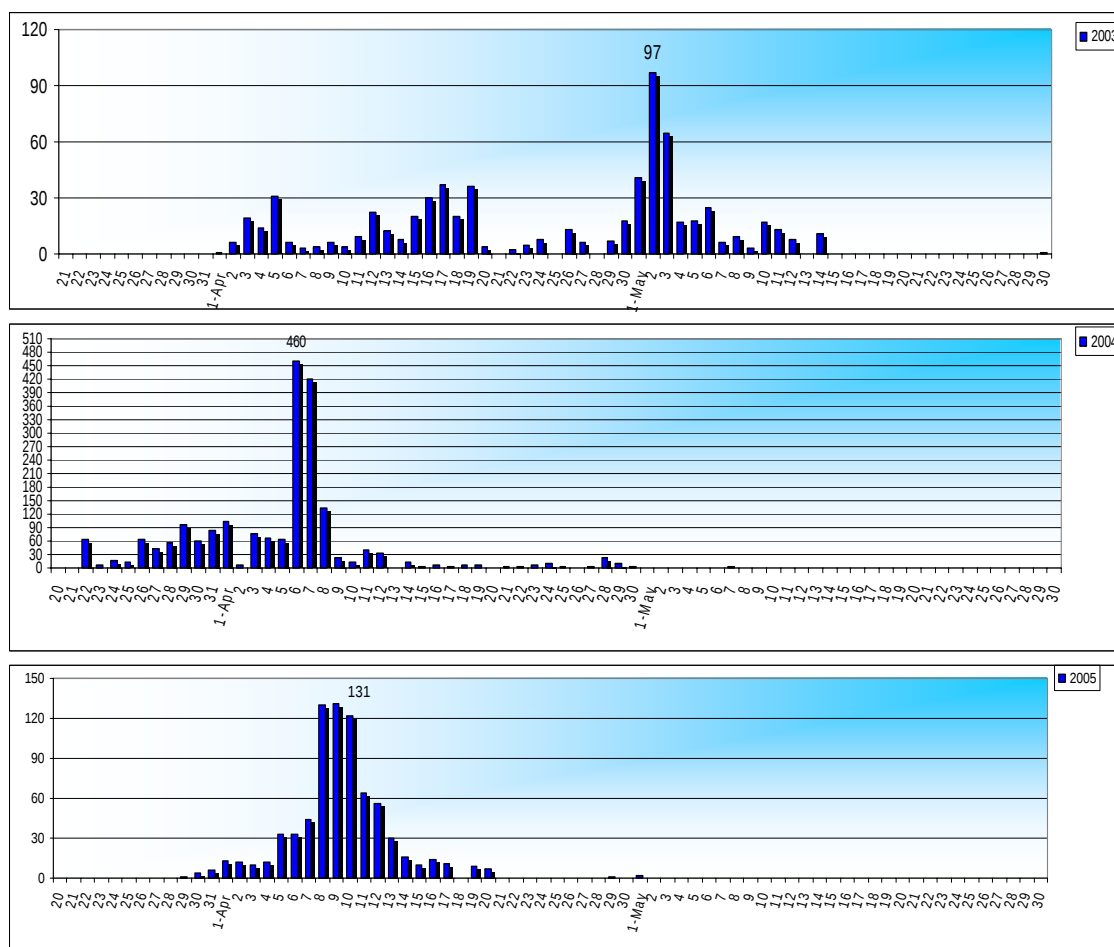


Fig. 1. Daily *Betula* pollen concentrations in Skopje in 2003, 2004, and 2005.

The total annual *Betula* pollen sum, daily pollen concentrations and duration of the period when *Betula* pollen was captured in the air reached the highest values in 2004. It was shown that the capturing period of *Betula* pollen in the atmosphere of Skopje is long (Table 1).

Calculation of the *Betula* pollen season start by using different methods showed approximately the same date. The 1 pg/m³ method showed the earliest pollen season start (Table 2). The number of days from the start date calculated by the 1 pg/m³ method to the start date obtained by the Sum 75 method is two to six days. However, the number of days from the start date obtained by the 30 pg/m³ method to the start date calculated by the Sum 75 method is only two days.

Table 1. Characteristics of *Betula* pollen occurrence in the atmosphere of Skopje

Year	Total annual pollen sum	Duration ^a	The day of the first <i>Betula</i> pollen grain capture ^b
2003	682	41	91
2004	2065	41	72
2005	771	24	79

^a Number of days when pollen was captured in the air

^b Number of the day counted from the first of January

Table 2. The *Betula* pollen season start dates, with number of days (in parenthesis) during which *Betula* pollen was captured

Method	2003	2004	2005
1 pg/m ³	1 April	22 March	29 March
30 pg/m ³	5 April	22 March	5 April
Sum 75	6 April	24 March	5 April

There was characteristic diurnal periodicity of *Betula* pollen in Skopje (Fig. 2). The highest mean concentration of March and April were from 14-18 hours.

Discussion

Results of continuous monitoring of *Betula* pollen should be considered as an important guideline to allergic patients, clinicians and public services according to which they could plan activities in order to diminish

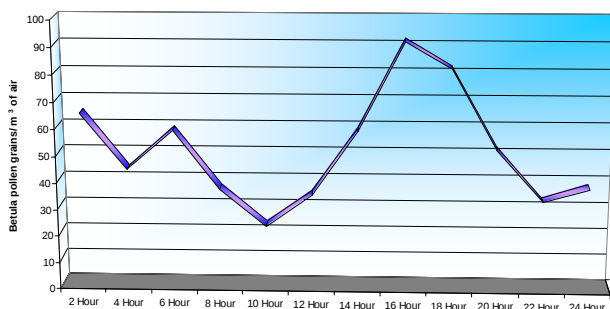


Fig. 2. Mean *Betula* diurnal periodicity for all days (2005).

problems caused by pollen allergy.

Numerous authors have shown that in the cities of Europe there are significant fluctuations in the total annual birch pollen sum among the observed years (14, 15). The total annual pollen sum in 2003 is lower than in other sites in inland Croatia (16) and in Poznan, Poland (17). The total annual pollen sum variation is very similar to that for Novi Sad, Serbia and Montenegro (18). Some authors have suggested that high pollen production in one year will cost much energy inhibiting the development of flowers and, thereby, pollen in the next year (19). Previous studies on the atmosphere of Skopje have shown that the value of the seasonal *Betula* pollen index is higher than in 2003-2005 (5,20,21).

Although different methods employed for the calculation of the pollen season start date gave slightly different results, they still follow the same year-to-year pattern. This corresponds to a previous study conducted in Derby and Poznan (17) and in Novi Sad (18). However, when the value of the seasonal *Betula* pollen index is high and the seasonal period is long, the number of days from the start data calculated by different methods will probably be greater (14). Throughout the day, the highest values are recorded at 14-18 hours, which is similar to the values for other cities (17).

Future studies should evaluate the correlation between weather parameters and pollen counts as the basis for forecasting pollen release.

Conclusion

The three-year monitoring of airborne birch pollen in Skopje shows year-to-year variations in duration and the start day of the period during which *Betula* pollen was captured in the atmosphere, as well as in the annual total pollen sum.

The highest seasonal *Betula* pollen index, daily pollen concentrations and the number of days when *Betula* pollen was captured in the air is observed in 2004. Different methods used for the calculation of the pollen season start date give slightly different results but they still follow the same year-to-year patterns. The earliest season start was calculated by the 1pg/m³ method. Throughout the day, the highest values were recorded at 14-18 hours.

Whether the increasing trend in the airborne presence of birch pollen leads to a higher prevalence of allergic sensitization in the human population or not should be a matter of future aerobiological and allergological research, as this requires long- term observation.

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POLEN BREZE (*BETULA SP.*) U ATMOSFERI SKOPJA

Snežana Milkovska¹, Jovanka Kradžinska Bislimovska¹, Vlado Matevski², Snežana Risteska-Kuc¹, Jordan Miniv¹

¹Institut za medicinu rada - Kolaborativan centar SZO, Skopje, R. Makedonija

²Institut za biologiju, Prirodno-matematički fakultet, Skopje, R. Makedonija

Kratak sadržaj: Alergijske bolesti disajnih puteva uzrokovani polenom breze predstavljaju značajan klinički problem obuhvatajući 10–20% populacije Severne i Centralne Evrope. Rezultati Centra za alergiju Instituta za medicinu rada, SZO Kolaborativnog centra u Skopju u određivanju specifičnog IgE metodom RIDA Allergy Screen ukazuju da je oko 19% osoba sa respiratornim alergijskim manifestacijama senzibilisano na polen breze. Precizne i blagovremene informacije o periodu polinacije najvažnijih alergogenih biljaka neophodne su za prevenciju simptoma. Cilj ovog rada je određivanje početka i drugih karakteristika sezone polena breze u atmosferi Skopja u periodu 2003–2005 primenom različitih metoda. Skupljanje polenskih primeraka izvedeno je volumetrijskim metodom, a korišćen je LANZONI VPSS 2000 sempler. Dnevni periodicitet bio je određen rezultatima dvočasovnih merenja i korigovan odgovarajućim faktorom korekcije. Tri metoda (Sum 75, 30 i 1 pg/m³) su primenjena za određivanje početka polenske sezone sa komparacijom dobijenih rezultata. Naši rezultati ukazuju na povećanje ukupne godišnje polenske sume u ispitivanom periodu. Najveće dnevne polenske koncentracije u 2003, 2004 i 2005 bile su 97, 460 i 131 pg/m³. Najraniji početak polenske sezone bio je određen metodom 1 pg/m³.

Ključne reči: Breza, polen, polenska sezona, polenska alergija, Skopje