

Short communication

15-Year aeroallergen records. Their usefulness in Athens Olympics, 2004

Introduction: About 5–25% of 16 000 athletes involved in preparation for the Athens 2004 Olympics may encounter respiratory allergy (asthma and rhinoconjunctivitis) triggered by exposure to aeroallergens (pollen and fungi spores).

Aim: Provide information about circulating aeroallergens in three Olympic cities and ensure safety for the allergic athletes who will visit Greece from January to September 2004.

Methods: Aeroallergens were recorded using a Burkard volumetric trap. The most frequently implicated pollen (cypress, hazel, wall pellitory, plane, olive, grasses, goosefoot and mugwort) and fungi spores (*Alternaria* spp., *Cladosporium* spp.) are presented. These data derive from a 15-year database created by the Pulmonary Department, Thessaloniki, a 2-year database (University of Heraklion-Crete) and a 6-year database by the Pediatric Department, Athens. The above data and the current aeroallergen counts will be continuously announced by the mass media and Internet during the Athens 2004 Olympics.

Results: Are expressed as: (A) Presentation (Graphs, Tables) of the fluctuation of mean daily values of pollen grains or fungi spores/m³. (B) Presentation (Tables) of the start, peak and end time of aeroallergen circulation. Peak pollen concentrations were observed between March and May (athletes preparation time). During the 2004 Olympics (August–September) relatively high concentrations of goosefoot, mugwort, *Alternaria* and *Cladosporium* will be observed. Aeroallergens circulate in Athens 10–15 days earlier than in Thessaloniki and 10 days later than in Heraklion.

Conclusions: The data presented in the study are expected to help allergic Olympic athletes achieve peak performance under prophylactic measures.

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Allergic athletes often experience significant problems triggered by exposure to aeroallergens (pollen grains and fungi spores) to which they are sensitive, disabling them to achieve their peak performance (1). The intensity of allergic symptoms depends on the density of aeroallergen circulation and on the duration of exposure (2). Epidemiological surveys support that asthma affects 5–30% of children and 2–30% of adults (3). Rhinitis affects 40% of the population, 30% of which concerns seasonal and 10% perennial symptoms (4). Seasonal allergy affects more than 5–25% of the population in Europe (3, 5). The participation of asthmatics in sports, even in championships, has also increased (5, 6). Katelaris et al. (1) studied 214 Australian Olympic athletes during their training for the Sydney Olympics (2000) and concluded that 21% of the athletes were suffering from asthma and 29% from seasonal allergic rhinitis because of exposure to aeroallergens. The authors expect that Olympic athletes will be exposed to high pollen levels, both during the preparation

time and the main sporting event, a fact that would decrease their performance. The number of athletes and accompanying individuals expected to arrive at Greece for the Athens Olympics in 2004 is about 16 000 and among them at least 3200 (20%) are estimated to suffer from respiratory allergies, according to the above epidemiological survey. This percentage is significantly increasing, taking into consideration all visitors in Greece during that period, members of the international media, spectators and tourists.

Aim of the study

The aim of this study is to provide information for delegates of the countries intending to participate in the Athens Olympics in 2004. This information concerns presentation of data, through the Internet, on circulation of aeroallergens in the atmosphere of three Greek cities

(Athens, Thessaloniki and Heraklio-Crete), selected as the venue for the Athens Olympics from January to September 2004. This presentation aims at protecting athletes from experiencing respiratory symptoms, so as to ensure a pleasant sojourn for them in Greece and aid in their peak performance.

Material and methods

The method applied is the one carried out by all researchers worldwide (7, 8), using the *Burkard* trap for weekly records. Sampling was made on a daily basis and the recorded concentrations of aeroallergens were expressed as fungi spores and pollen grains per m³ of air, a measurement unit that has been established by the majority of scientists (9).

The above methodology was applied to three Greek Olympic cities, Athens, Thessaloniki and Heraklion-Crete, where the majority of sports events will be held during the 2004 Olympics. The records in Athens correspond to 6-year counts (1995–2001) and come from the second Pediatric Department, University of Athens (Supervisor: Assoc. Prof. F. Saxon, cooperators: Mrs A. Syrigou and Mrs G. Mpaka). The ones in Thessaloniki correspond to 15-year counts (1987–2001) and come from the Pulmonary Department, Aristotle University of Thessaloniki (Supervisor: Assoc. Prof. D. Gioulekas) and those in Heraklion-Crete correspond to 2-year counts (1999–2000) and come from the Otorhinolaryngologic Department, University of Heraklion (Supervisor: Prof. N. Chelidonis, cooperator Mr A. Pagkalos).

The aeroallergens selected for presentation comprise the most common ones for patient sensitization and provocation of respiratory allergy, not only for the Mediterranean and Europe (9–11), but also worldwide (7, 12–15). They include Grasses family (f. *Poaceae/Gramineae*), Olive family (c. Olive, Ash, f. *Oleaceae*), Nettle family (c. Wall pellitory, f. *Urticaceae, Parietaria* spp.), Cypress family (c. Cypress, Juniper, Cedars, f. *Cupressaceae*), Composites family (c. Ragweed, Mugwort, f. *Asteraceae/Compositae-Tubuliflorae*), Plane family (c. Plane/Sycamore, f. *Platanaceae*), Goosefoot family (c. Goosefoot, Saltbushes, f. *Chenopodiaceae*), Hazel (*Corylus* spp., f. *Betulaceae*) and the fungi spores of *Cladosporium* spp. and *Alternaria* spp.

Moreover, the predicted dates of start, peak and end of each aeroallergen circulation season for the three cities were assessed from the 15-year aeroallergen records, using statistical methods (STATISTICA, SPSS) and are presented.

The start of the aeroallergen circulation season is the time when the spores constitute 5% of the total average amount of aeroallergens recorded throughout the previous years. The peak is the specific day on which the highest number of aeroallergens was recorded. Similarly, the 95% value is the end of aeroallergen dispersion season, compared with the mean values of the previous years. Therefore, this appears to be the clinical onset, peak and end, respectively, of the fungi or/and pollen circulation season, which appears to be the beginning, maximizing and end of the clinical symptoms of allergic patients (16).

Results

The presentation consists of:

1. Graphical presentation (Fig. 1) of fluctuation of 10 aeroallergen concentrations selected in three Olympic

cities (Athens, Thessaloniki and Heraklion-Crete). The values are expressed in moving average values per 10 days (running means per 10 days).

(*Running mean* or *Moving average values* for a specific period of time is a statistical technique used for the smoothing of values that present a wide-range variation. In this way, the general trend of variation is more easily observed. Thus, we are able to forecast the inter-day variations of aeroallergens, which are more important than the actual daily values).

2. Numerical presentation (Table 1) of each aeroallergen average daily concentrations per 10 days in every city.

(The average values result from the daily aeroallergen records made in every city, for the respective period of sampling).

3. Presentation (Table 2) of each aeroallergen concentrations following values in every city. That is, the predicted dates of start, peak and end of aeroallergen circulation season are presented for all the cities studied. Simultaneously, the respective values to these dates are presented inside brackets.

Discussion

The correlation between exercise and symptoms of asthma is well known since antiquity, as documented by Aerateus of Cappodicia (17).

Twenty years ago it was inconceivable for an asthmatic to participate in sports. It appears that the main factors for the increased incidence of asthma in highly competitive athletes are allergy to different aeroallergens and exercise-induced asthma (5, 6) – terms strongly related one with the other (1). It is known that an individual in steady state inhales 5–8 l/min, during normal breathing < 15 l/min of air are consumed, whereas speed and power athletes consume up to 200 l/min (6). When they perform in the open air, increased ventilation results in inhalation of huge quantity of aeroallergens in periods of dense circulation, thus leading to asthmatic symptoms (1, 6, 17). The frequency of active asthma varies between different sports; for example, up to 50% of cyclists suffer from asthma symptoms (1, 17, 18). Wilber et al. (18) have documented that winter sports show an increased frequency of asthma, i.e. 23% of the total number of US athletes who participated in the 1998 Olympics. This percentage reaches up to 50% for long-distance skiers (cross-country ski). However, in these occasions the responsible factor is mainly the inhalation of cold air and not allergy. It has also been reported that high performance and endurance athletes, bikers, swimmers and long-distance runners show an increased prevalence of exercise-induced asthma.

Many studies have proved that participation of asthmatics in highly competitive teams – and especially

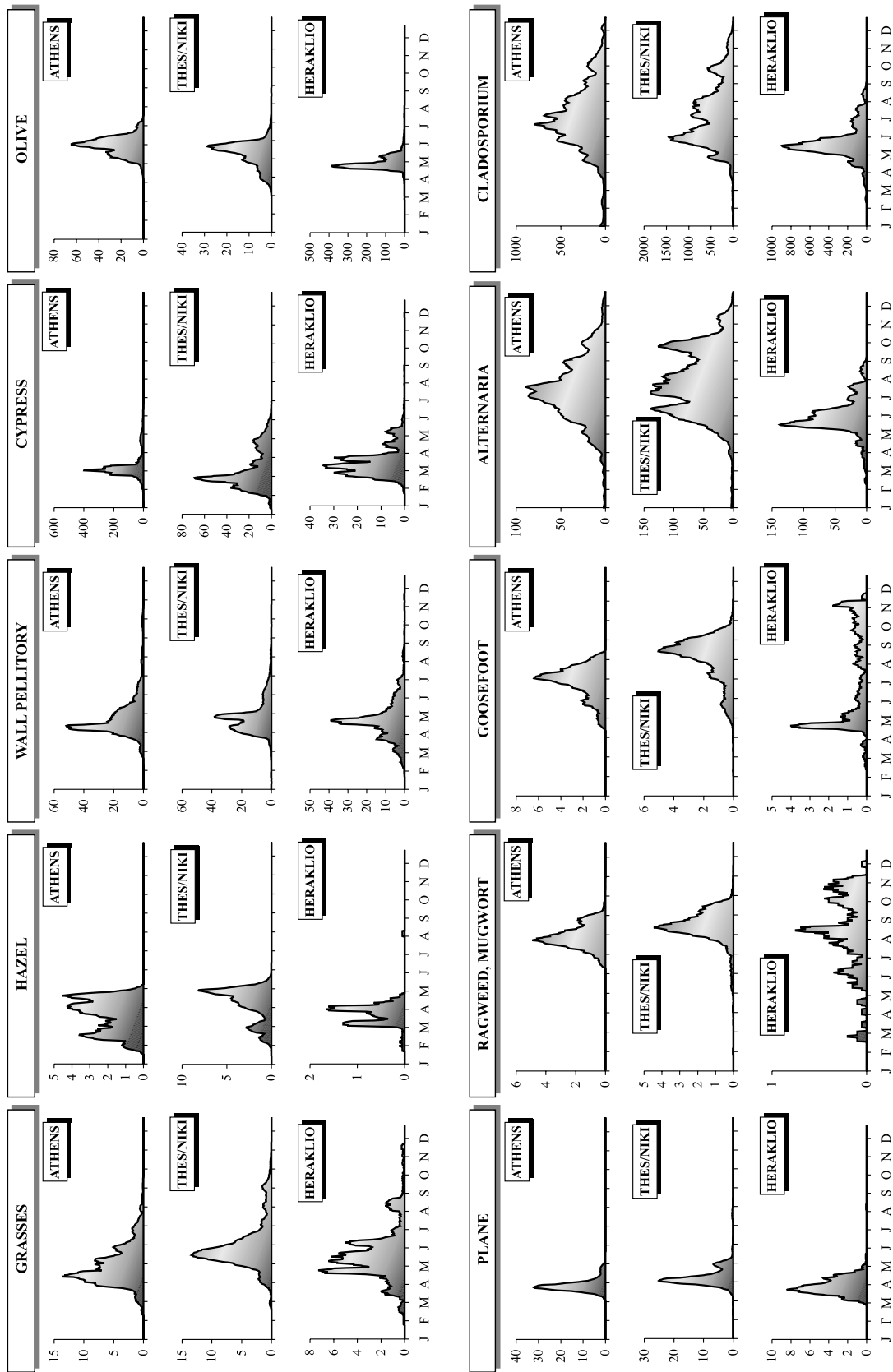


Figure 1. Group of graphs 1: Fluctuation of 10 aeroallergen concentrations selected in three Olympic cities – Athens, Thessaloniki and Heraklio. The values are expressed in daily running means per 10 days (the pollen grains/fungi spores per cubic metre are presented on vertical Y-axis and the month on horizontal X-axis).

Table 1. Average daily values per 10 days of each aeroallergen per cubic meter in every Olympic city

Average 10 days																													
Taxon	City	February			March			April			May			June			July			August			September			October			
Grasses	Athens	0	0	0	1	1	2	8	11	11	7	8	4	5	3	1	2	1	1	0	0	0	0	0	0	0	0	0	
	Thessaloniki	0	0	0	0	0	0	1	2	2	5	10	13	10	6	4	2	2	1	1	1	1	1	2	1	0	0	0	
	Heraklio	0	0	1	0	0	2	1	1	3	6	6	6	3	4	2	1	1	0	0	1	1	1	0	0	0	0	0	
Wall pellitory	Athens	0	0	0	2	2	5	18	50	24	21	17	9	7	4	4	2	1	1	1	1	1	0	0	0	1	1	0	
	Thessaloniki	0	0	0	0	1	2	17	27	20	38	9	6	5	5	3	2	1	1	0	1	1	0	0	0	0	0	0	
	Heraklio	0	1	2	3	6	8	12	12	26	31	12	7	7	5	4	4	2	1	0	1	1	0	0	0	0	0	0	
Ragweed mugwort	Athens	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2	4	4	3	2	2	0	0	0	0	0	0	
	Thessaloniki	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	3	4	3	2	2	1	0	0	
	Heraklio	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	
Goosefoot	Athens	0	0	0	0	0	0	0	0	0	1	1	1	2	2	2	4	6	4	2	1	0	0	0	0	0	0	0	
	Thessaloniki	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1	2	3	5	4	3	1	1	0	0		
	Heraklio	0	0	0	0	0	0	0	0	2	3	1	1	0	1	0	0	0	0	0	1	1	0	0	0	1	1	1	
Olive	Athens	0	0	0	0	0	0	0	0	1	3	18	32	47	53	27	6	5	0	0	0	0	0	0	0	0	0	0	
	Thessaloniki	0	0	0	0	0	1	5	5	6	12	13	26	20	3	2	1	0	0	0	0	0	0	0	0	0	0	0	
	Heraklio	0	0	0	1	2	1	2	9	117	321	103	73	16	7	4	2	1	1	2	1	0	0	0	0	0	0	0	
Cypress	Athens	2	15	38	260	222	35	11	8	20	20	11	5	4	3	2	0	0	0	0	0	0	0	0	0	0	0	0	
	Thessaloniki	4	28	31	69	27	18	10	9	13	16	9	5	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Heraklio	1	3	15	28	34	25	11	3	9	3	8	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	
Plane	Athens	0	0	0	0	1	22	23	5	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Thessaloniki	0	0	0	0	0	2	17	18	5	6	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Heraklio	0	0	0	0	3	7	7	4	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Hazel	Athens	1	3	3	2	2	3	4	4	4	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Thessaloniki	0	1	1	3	1	1	3	4	4	8	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	Heraklio	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Alternaria	Athens	1	3	1	3	2	6	4	11	18	20	25	26	45	51	57	70	85	83	69	51	39	45	38	22	22	26	15	
	Thessaloniki	4	2	3	3	2	3	8	6	9	24	35	54	92	113	125	79	129	132	109	118	88	77	59	72	115	106	42	
	Heraklio	0	2	2	2	4	4	7	7	16	13	34	138	86	84	42	23	23	23	16	5	11	5	1	0	0	0	0	
Cladosporium	Athens	28	40	29	19	21	26	67	83	185	223	291	306	543	488	670	660	635	455	470	437	329	227	215	176	140	194	155	
	Thessaloniki	24	14	16	23	18	30	73	66	116	574	403	841	1365	1103	877	589	905	832	756	834	481	396	247	285	527	438	208	
	Heraklio	0	3	9	3	22	28	45	35	185	197	617	895	480	166	134	142	117	100	69	20	50	12	3	0	0	0	0	

Olympic teams – has considerably increased in the last 20 years(1, 17–19). Weiler et al. (19) support that more than 11% of the athletes who represented the USA at the Los Angeles Olympics in 1984 were reported to have exercise-induced asthma and, in addition, more than one of every 10 elite athletes were suggested to have asthma. Furthermore, 16.7% of the athletes who represented the USA at the Atlanta Olympics in 1996 were reported to have asthmatic symptoms. That is, 76 athletes – 1/6 of the total of the USA Olympic athletes – were suffering from asthma. The authors do not consider asthmatic athletes as inferior to healthy ones, as they successfully competed them. It is worth mentioning that 24 of the 76 asthmatic athletes (32.9%) won 31 medals, whereas, this percentage, surprisingly, was slightly lower for healthy athletes (28.7%). Evidently, the right choice of athletes for each sport is the cornerstone of winning medals.

Many researchers (1, 5, 6, 14, 17) suggest the thorough clinical examination of athletes suffering from respiratory

allergy and, afterwards, the appropriate recommendation of prophylactic treatment, aiming particularly at aeroallergen avoidance, especially during peak concentrations in the atmosphere. The study performed by Katelaris et al. (1) in athletes who represented Australia at the Sydney Olympics in 2000 draws the conclusion that team managers and medical officers need to adequately prepare athletes for the possibility of exposure to high pollen levels during this most important sporting event. For that reason, we have decided to present our records, wishing to offer a new perspective to athletes suffering from respiratory allergy, as, by the means of protection, they will be able to achieve their highest performance.

This study is the fruit of years of research, aiming at recording aeroallergen concentrations in the area of Thessaloniki and, generally, in Greece. These records are a piece of information missing from all the major sports events or other manifestations, where sensitized individuals crowded together are prone to respiratory

Table 2. Dates of start, peak and end of each aeroallergen circulation season in every Olympic city

Prediction system 5–95%				
Taxon	City	Start (5%)	Peak	End (95%)
Grasses	Athens	26 Mar (34)	23 Apr (35)	9 Jul (644)
	Thessaloniki	17 Apr (33)	26 May (17)	6 Sep (628)
	Heraklio	26 Mar (22)	2 May (22)	27 Aug (417)
Wall pellitory	Athens	31 Mar (87)	16 Apr (117)	10 Jul (1660)
	Thessaloniki	5 Apr (70)	5 May (101)	29 Jun (1335)
	Heraklio	12 Mar (73)	1 May (88)	7 Jul (1394)
Ragweed	Athens	25 Jun (8)	15 Jul (6)	26 Aug (169)
Mugwort	Thessaloniki	9 Jul (9)	17 Aug (6)	27 Sep (166)
	Heraklio	23 Mar (3)	27 Aug (3)	12 Nov (51)
Goosefoot	Athens	16 May (14)	15 Jul (9)	9 Aug (258)
	Thessaloniki	27 May (13)	27 Aug (7)	24 Sep (249)
	Heraklio	21 Apr (8)	1 May (12)	18 Nov (160)
Olive	Athens	15 May (95)	11 Jun (107)	1 Jul (1814)
	Thessaloniki	8 Apr (48)	28 May (39)	14 Jun (908)
	Heraklio	27 Apr (331)	2 May (982)	31 May (6291)
Cypress	Athens	24 Feb (329)	6 Mar (1396)	6 May (6260)
	Thessaloniki	11 Feb (123)	5 Mar (151)	17 May (2346)
	Heraklio	24 Feb (72)	30 Mar (100)	18 May (1364)
Plane	Athens	22 Mar (28)	31 Mar (61)	29 Apr (523)
	Thessaloniki	2 Apr (26)	10 Apr (48)	12 May (495)
	Heraklio	17 Mar (12)	26 Mar (15)	28 Apr (230)
Hazel	Athens	8 Feb (13)	18 Feb (10)	1 May (252)
	Thessaloniki	20 Feb (14)	4 May (14)	15 May (271)
	Heraklio	15 Feb (2)	10 Apr (7)	23 Apr (45)
<i>Alternaria</i>	Athens	26 Apr (436)	14 Jul (101)	18 Oct (8293)
	Thessaloniki	15 May (854)	29 Jul (283)	29 Oct (16 230)
	Heraklio	23 Apr (272)	25 May (215)	31 Jul (5168)
<i>Cladosporium</i>	Athens	15 Apr (3746)	28 Jun (1102)	20 Oct (71 165)
	Thessaloniki	3 May (6309)	5 Jun (2047)	22 Oct (119 873)
	Heraklio	23 Apr (1663)	3 Jun (1250)	29 Jul (31 597)

In brackets, the respective dates of peak concentrations of aeroallergens per cubic metre are displayed. In addition, start concentrations constitute 5% of the average annual aeroallergen values per cubic metre, whereas end concentrations constitute 95%.

allergy. If the visiting period coincides with a certain aeroallergen circulation season, particularly athletes may display increased symptoms and worse performance.

The originality of this presentation derives from the lack of existing records of aeroallergens and, also, from the duration of aeroallergen records (15 years in Thes-

saloniki and 6 years in Athens). Because of long-term sampling, aeroallergen concentrations in the atmosphere are minimally influenced. As far as Heraklion-Crete is concerned, the records available are just for 2 years. Any allergic athlete intending to participate in the Athens Olympics may be informed about the circulation season of the aeroallergens. The choice of visiting Greece at the most appropriate season – when the amount of pollen grains and/or fungal spores in the air is less – should be left to the discretion of the athlete. Our main purpose is to establish our work as a routine methodology, proposing that similar records from other countries organizing forthcoming Olympic games should be applied as standard information to be used by athletes.

The aeroallergens presented have been chosen on the basis of their allergenicity and the provocation of respiratory allergy symptoms to sensitized patients (2, 7, 10–15). Among these aeroallergens spore concentrations of *Cladosporium* and *Alternaria* would be at their peak, coinciding with the duration of Olympic games. *Alternaria* has been attracting all the scientific attention lately, because it is implicated in severe asthma symptoms, during periods of high fungal spore concentrations (7, 12, 15).

Sampling was performed using a volumetric *Burkard* trap for weekly records and the records are expressed as daily number of pollen grains or fungi spores per cubic metre of air (9). The exact amount of aeroallergens cannot be easily specified, because many factors influence their fluctuation. However, researchers (1) claim that 20 pollen grains/m³ are usually sufficient for the onset of respiratory allergy symptoms to sensitized individuals. The most important aspect of the occurrence of these symptoms seems to be the degree of sensitization of the athlete and the duration of exposure to aeroallergens (1, 7, 17).

In conclusion, the use of this kind of database for the dispersion of aeroallergens in the atmosphere is undoubtedly important, as they can help athletes to safely train for the Olympics, even during the full circulation season. Moreover, they can adjust drug administration, in order to achieve highest performance. In this direction, our research team will present daily reports on aeroallergen circulation during 2004, which are going to be promoted to mass media (Internet, television, radio and newspapers) with the aid of the Olympic Committee 2004.

References

1. KATELARI CH, CARROZZI FM, BURKE ThV, BYTH K. A springtime Olympics demands special consideration for allergic athletes. *J Allergy Clin Immunol* 2000;**106**:260–266.
2. BORROWS B, SEARS M, FLANNERY E, HERBISON P, HOLDAWAY MD. Relations of bronchial responsiveness to allergy skin prick test reactivity, lung function, respiratory symptoms, and diagnoses in 13-year old Zealand children. *J Allergy Clin Immunol* 1995;**95**:548–556.
3. ANNESI-MAESANO I. Epidemiological evidence of occurrence of rhinitis and sinusitis in asthmatics. *Allergy* 1999;**54**(suppl. 57):7–13.

4. SIBBALD B, STRACHEN D. Epidemiology of rhinitis. In: BUSSE W, HOLGATE S, editors. *Asthma and rhinitis*. Boston: Blackwell Scientific Publication, 1995:32–34.
5. DEL GIACCO S, MANCONI P, DEL GIACCO G. Allergy and sport. *Allergy* 2001;215–223.
6. HELENIUS I, HAAHTELA T. Allergy and asthma in elite summer sports athletes. *J Allergy Clin Immunol* 2000;106:444–450.
7. BUSH R. Aerobiology of pollen and fungal allergens. *J All Clin Immunol* 1989;64:1120–1130.
8. RANTIO-LEHTIMAKI A. Sampling airborne pollen and pollen antigens. In: D'AMATO G, SPIEKSMAS FTH, BONINI S, eds. *Allergenic pollen and pollinosis in Europe*. Melbourne-Paris-Berlin-Vienna: Blackwell Scientific publications, 1991:18–23.
9. SPIEKSMAS F. Regional European pollen calendars. In: D'AMATO G, SPIEKSMAS FTH, BONINI S, eds. *Allergenic pollen and pollinosis in Europe*. Melbourne-Paris-Berlin-Vienna: Blackwell Scientific publications, 1991:49–65.
10. D'AMATO G, SPIEKSMAS FT, LICCARDI G, JAGER S, RUSSO M, KONTOU-FILI K, NIKKELS H, WUDRICH B, BONINI S. Pollen related allergy in Europe. *Allergy* 1998;6:567–578.
11. GIOULEKAS D, CHATZIGEORGIOU G, SPIEKSMAS F. Allergenic pollen and pollinosis in northern Greece. In: D'AMATO G, SPIEKSMAS FTH, BONINI S, eds. *Allergenic pollen and pollinosis in Europe*. Melbourne-Paris-Berlin-Vienna: Blackwell Scientific publications, 1991:167–171.
12. GALANT S, BERGER W, GILLMAN S, GOLDSOBER A, INCAUDO G, KANTER L, MACHTINGER S, MCLEAN A, PRENNER B, SOKOL W, SPECTOR S, WELCH M, ZIERING W. Prevalence of sensitization to allergens in California patients with respiratory allergy. Allergy skin test project team. *Ann Allergy Asthma Immunol* 1998;81:203–210.
13. MITAKAKIS TZ, TOVEY ER, XUAN W, MARKS GB. Personal exposure to allergenic pollen and mould spores in inland New South Wales, Australia. *Clin Exp Allergy* 2000;30:1733–1739.
14. NELSON H. The importance of allergens in the development of asthma and the persistence of symptoms. *J Allergy Clin Immunol* 2000;105(6 pt 2):S628–S632.
15. NEUKIRCH C, HENRY C, LEYNAERT B, LIARD R, BOUSQUET J, NEUKIRCH F. Is sensitization to *Alternaria* a risk factor for severe asthma. *J Allergy Clin Immunol* 1999;103:709–711.
16. DRIESSEN M, VAN HERPEN R, MOELANDS R, SPIEKSMAS F. Prediction of the start of the pollen season for the western part of the Netherlands. *Grana* 1989;28:37–44.
17. CARLSEN KH. Asthma and allergy in sportsmen. *ACI International* 2001;13:140–146.
18. WILBER R, RUNDELL K, SZMEDRA L, JENKINSON D, IM J, DRAKE S. Incidence of exercise-induced bronchospasm in Olympic winter sport athletes. *Med Sci Sport Exerc* 2000;32:732–737.
19. WEILLER J, LAYTON T, HUNT M. Asthma in US Olympic athletes who participated in the 1996 summer Games. *J Allergy Clin Immunol* 1998;102:722–726.