

High Levels of *Olea europaea* Pollen and Relation with Clinical Findings

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Key Words

Olea europaea pollen · Olive · Rhinitis seasonal
allergic · Pollen level

Abstract

Background: *Olea europaea* pollen is an important cause of seasonal allergic rhinitis and bronchial asthma in southern Spain. For patients allergic to grass pollen the critical concentration of airborne pollen is 50 grains/m³, but in the case of *Olea* pollinosis no data is available. **Methods:** Fifty-six seasonal allergic rhinitis patients (29 in 1994 and 27 in 1995) were included in this study, all of whom lived in Jaen. Daily symptom card were filled in and pollen counts during May and June were performed in both years. A linear regression model was used for analysis of the airborne pollen concentration and the symptom score. **Results:** Significant correlations among daily counts of *Olea* pollen and rhinitis symptoms were obtained. Most of our monosensitized patients needed a high *Olea* pollen concentration in the atmosphere (around 400 grains/m³) to suffer at least from mild allergic rhinitis symptoms. **Conclusion:** Local conditions with a wide area dedicated to olive tree cultivars result in a high concentration of this pollen in the atmosphere. Monosensitized *Olea* patients in our area seem to need exceptionally high levels to suffer from allergic symptoms.

Introduction

The olive (*Olea europaea*) is a long-lived tree which has been cultivated by man for more than 5,000 years for its fruit, oil and wood. It probably originates in Asia Minor and then spread across the whole Mediterranean basin [1]. In Spain it is cultivated in all the regions with the exception of the north but, in spite of being widely spread, the olive is mainly concentrated in the south, in the region of Andalusia, where more than a million hectares are cultivated representing more than 60% of the total of olive groves in the country [2].

Of the eight provinces which form Andalusia, it is the province of Jaen with more than 500,000 hectares cultivated where the concentrations of pollen of this tree in the atmosphere are the highest, reaching a weekly average of 500 grains/m³ and exceptional daily peaks higher than 5,000 grains/m³ [3]. As in other Mediterranean countries (as for example certain areas of Italy) [4] the intensive olive tree cultures seems the most probable cause of these surprising high pollen levels.

The pollination of the *Olea* is entomophilus but also anemophilus when pollen produced is abundant [5] and varies from one region to the next. However, the pollination period with high and medium levels is not very long, lasting about 1 month. In our area it mainly covers the months of May and June [6].

The allergen dose (i.e. number of grains/m³) required to elicit clinical symptoms in pollen allergy models is not known and appears to vary among sensitive patients. Based on a mathematical approach, the classical study by Davies

and Smith [7] demonstrated that concentrations higher than 50 grains/m³ of grass could be considered high in general for patients clinically sensitive to grasses, but in *Olea pollinosis* we lack such important information.

To clarify the threshold level of *O. europaea* pollen required for eliciting symptoms of seasonal allergic rhinitis (SAR) in patients living in our area, we performed a prospective study during 2 consecutive years. A linear regression was used for analysis of the airborne pollen concentration and the symptom score.

Materials and Methods

Fifty-six patients (29 in 1994 and 27 in 1995) were studied. Twenty-three were males and 33 females with an average age of 19 (range from 17 to 32 years). All of them were consecutively selected before spring time in both years, if they fulfilled the following criteria: (1) a history of SAR during the spring months for at least 2 consecutive years, (2) a positive skin prick test and a high level of specific IgE to *O. europaea* pollen, (3) no positive reaction to other common aeroallergens and (4) no previous treatment with specific immunotherapy. Patients were all living in Jaen and no further than 20 km from the sampling site.

Allergological Study

Skin Tests. These tests were performed by the prick test method on the volar forearm surface of each of our patients, using 16 commercial aeroallergen extracts: *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Blatella germanica*, cat dander, dog dander, *Alternaria alternata*, *Aspergillus fumigatus*, *Cladosporium herbarum*, *Olea europaea*, *Lolium perenne*, *Dactylis glomerata*, *Platanus hybrida*, *Plantago lanceolata*, *Parietaria judaica*, *Artemisia vulgaris* and *Chenopodium album* (Alergia e Immunologia Abello, Madrid, Spain). Histamine dihydrochloride (10 mg/ml) and phosphate buffer solution glycerol were used as positive and negative controls, respectively. All skin test sites were evaluated after 15 min and a wheal larger than 3 mm or more than that of the negative control was considered positive.

Specific IgE Titration. Specific IgE was determined by the fluoroimmunoassay Pharmacia CAP System (Kabi Pharmacia Diagnostic, Uppsala, Sweden). Measurements were performed according to the manufacturer's instructions. A specific IgE value greater than 3.5 kU/l (class 3) was considered as positive.

Symptoms Score

The rhinitis symptom score was registered diary on cards from 1st May to 30th June, 1994 and 1995. Each patient was asked to evaluate his symptoms daily just before bedtime: nose (sneezing, nasal congestion and runny nose) and eyes (itching and redness). Each symptom was recorded using an arbitrary scale (0 = no symptoms; 1 = mild; 2 = moderate; 3 = severe) [8]. Total points for nasal and eye symptoms (maximum = 15) were divided between the five symptoms, consequently 3 points per symptom were the maximum. Symptomatic treatment was allowed, but the patients were instructed only to use the following drugs when needed and not prophylactically: antazoline eye drops (three times a day), azelastine nasal inhaler (twice a day) and cetirizine tablets (once daily).

O. europaea Pollen Count

The pollen count was done according to a previously described technique [9] with a volumetric spore trap (Burckard Manufacturing, Rickmansworth, UK) installed on the roof terrace (about 25 m high) of a central building in the city of Jaen (37° 46' N; 3° 47' E, 560 m above seal level), and near olive groves (<2 km). The tapes were removed from the trap, and the number of pollen grains were counted and expressed as total number in cubic meters during 24 h. The sampling period included the months of May and June in 1994 and 1995.

Threshold Level of *O. europaea* Pollen Concentration

We defined the threshold level of *O. europaea* pollen concentration as that required to suffer in a 24-hour period from at least mild allergic symptomatology (mean symptom score = 1) in the whole population.

Statistical Analysis

The Kolmogorov-Smirnov test was used to determine whether distributions were gaussian. Pollen concentration values were transformed into logarithms before analysis because they showed a skewed distribution. Lineal regression analysis was used to illustrate the relationship among pollen concentration logarithms and the SAR symptom score.

Results

All our patients exhibited sensitization only to *O. europaea* pollen extract (positive skin prick test and CAP > class 3) with constant negative results for the rest of the aeroallergen extracts tested. The clinical profile of our patients based on the mean score of their symptom diary card is summarized in table 1.

O. europaea Pollen Count

In both years, concentrations of *O. pollen* in the atmosphere (fig. 1) exceeded 3,000 grains/m³, being higher than 500 on 28 days of 1994 and 23 days of 1995. The highest daily peak count was 3,829 and 5,475 grains/m³, respectively.

Symptoms Score

Significant correlations between daily counts of *Olea* pollen and SAR symptoms were obtained in both study seasons: in 1994 $r = 0.8463$, $p < 0.001$ and in 1995 $r = 0.8366$, $p < 0.001$. Rhinitis symptom score and log pollen concentration are shown in figures 2 and 3 which represent the lineal regression in 1994 and 1995, allowing us to calculate the regression equations. Using these equations, we found that 368 grains/m³ (95% CI: 269–503) in 1994 and 415 grains/m³ (95% CI: 307–558) in 1995 were the lowest concentrations necessary to suffer from SAR symptoms in *Olea* pollen-monosensitized patients from our area (table 2).

Table 1. Clinical profile of patients based on the mean score of their symptom diary card

Days	Sampled days in 1994		Sampled days in 1995		Days	Sampled days in 1994		Sampled days in 1995	
	(n = 29) pollen grains/m ³	symptoms score	(n = 27) pollen grains/m ³	symptoms score		(n = 29) pollen grains/m ³	symptoms score	(n = 27) pollen grains/m ³	symptoms score
May					June				
1	340	1.14	882	0.78	1	1,183	0.83	135	0.59
2	555	1.07	1,323	1.15	2	740	0.97	119	0.56
3	783	1.45	2,041	1.26	3	92	1.00	421	0.48
4	3,412	1.76	1,812	1.37	4	97	0.79	443	0.56
5	2,295	1.72	2,764	1.37	5	232	0.76	600	0.44
6	3,829	1.76	3,852	1.74	6	540	0.72	724	0.44
7	3,461	1.62	3,006	1.41	7	966	0.66	167	0.44
8	2,376	1.79	2,365	1.52	8	265	0.52	238	0.41
9	1,468	1.86	5,475	1.81	9	140	0.48	6	0.33
10	1,209	1.90	5,310	1.81	10	351	0.41	33	0.30
11	1,992	1.83	2,268	1.67	11	432	0.48	27	0.22
12	777	1.72	1,771	1.59	12	108	0.38	16	0.30
13	336	1.66	432	1.67	13	102	0.38	33	0.19
14	778	1.48	491	1.59	14	119	0.41	38	0.37
15	518	1.41	1,458	1.44	15	184	0.38	38	0.33
16	988	1.17	1,242	1.63	16	70	0.41	54	0.26
17	562	1.24	702	1.52	17	124	0.31	11	0.19
18	399	1.24	713	1.48	18	54	0.34	43	0.33
19	264	1.24	454	1.41	19	65	0.34	33	0.26
20	648	1.45	562	1.30	20	44	0.21	70	0.26
21	1,269	1.34	713	1.07	21	114	0.24	22	0.22
22	1,371	1.41	999	1.26	22	200	0.28	5	0.19
23	1,496	1.24	707	1.19	23	16	0.21	38	0.19
24	599	1.38	599	1.04	24	25	0.21	23	0.22
25	491	1.34	416	0.89	25	11	0.17	5	0.26
26	642	1.07	151	1.04	26	16	0.17	0	0.22
27	443	1.10	432	1.19	27	5	0.14	11	0.19
28	799	1.07	351	1.44	28	27	0.14	27	0.07
29	373	1.10	437	1.00	29	11	0.14	0	0.11
30	535	1.14	214	0.93	30	16	0.17	6	0.07
31	604	1.00	405	0.89					

Symptom score as daily mean values are shown.

Discussion

This study was carried out in the Spanish province with the greatest surface dedicated to olive tree cultivation representing one of the biggest areas in the world (around 500,000 hectares) [2]. *Olea* is the most important cause of pollinosis in our area, with 84% of patients sensitized to pollen. Of those only 14% react exclusively with olea allergens [3, 10, 11]. The high significant correlation between pollen count and SAR symptoms suggests that the concentration in the atmosphere necessary to suffer at least from

Table 2. Summarized data of correlation studies between concentration of *O. europaea* pollen in the atmosphere and allergic rhinitis symptoms

	Rhinitis symptoms	
	1994	1995
<i>Olea</i> pollen concentration, grains/m ³	368	415
95% CI	269–503	307–558
r value	0.8463	0.8687
p value	<0.001	<0.001

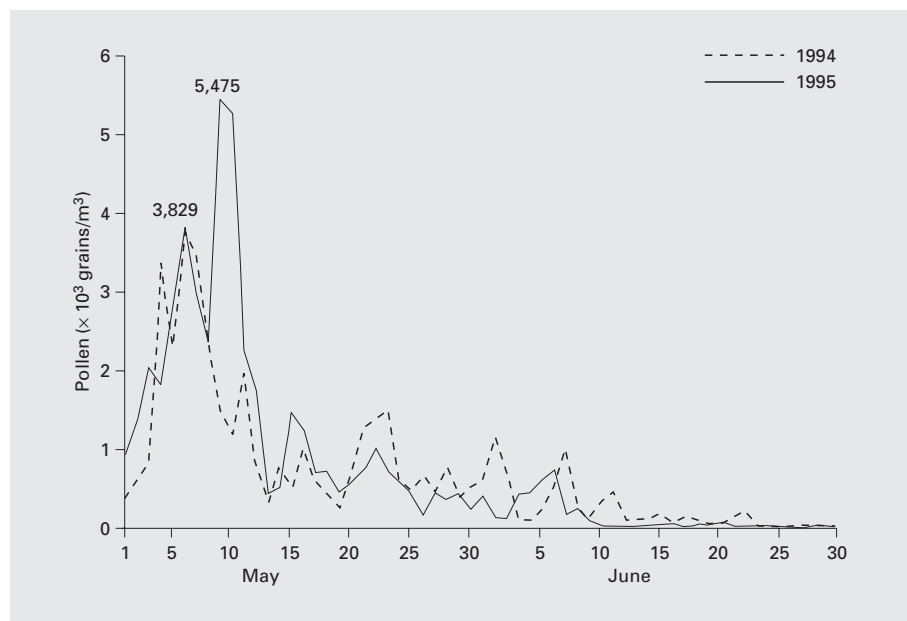


Fig. 1. Concentration of *O. europaea* pollen in the atmosphere in Jaen from 1st May to 30th June, 1994 and 1995.

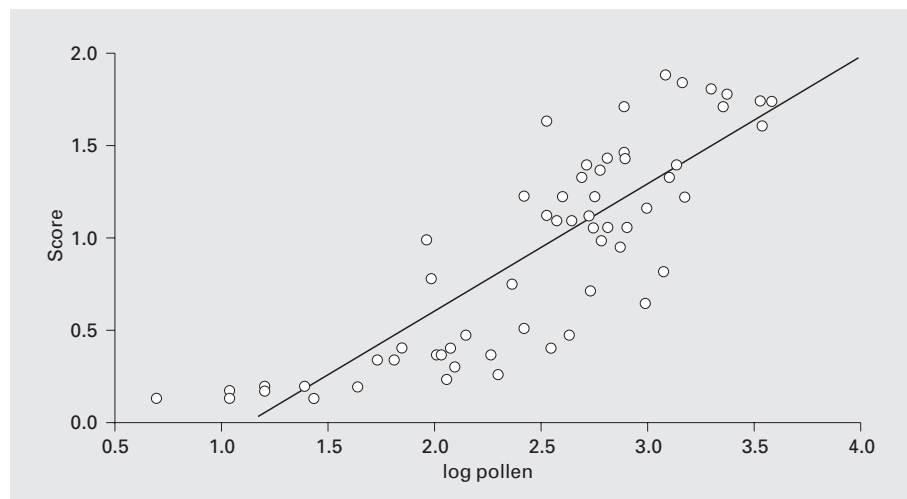


Fig. 2. Rhinitis regression analysis in 1994. Regression analysis from mean symptom scores (= score) and logarithm pollen count in grains/m³ (= log pollen) shows the following equation: score = 0.692 log pollen – 0.776.

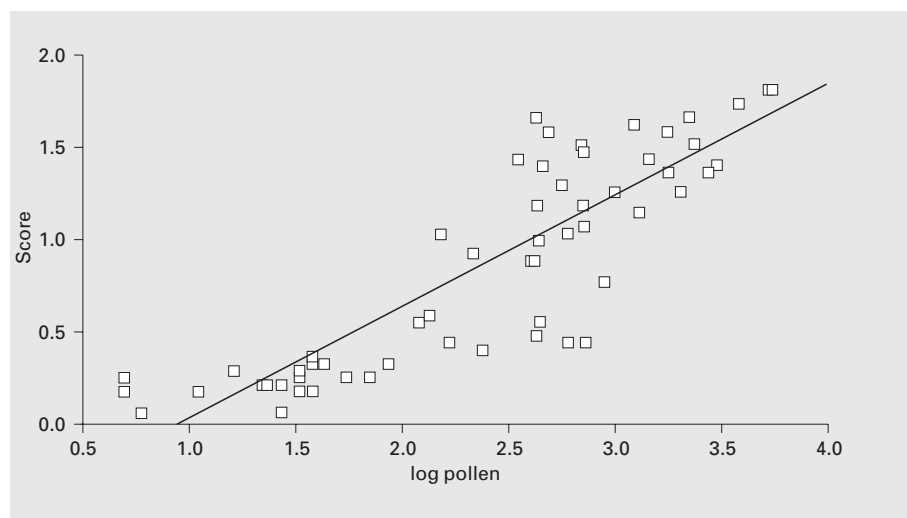


Fig. 3. Rhinitis regression analysis in 1995. Regression analysis from mean symptom scores (= score) and logarithm pollen count in grains/m³ (= log pollen) shows the following equation: score = 0.597 log pollen – 0.563.

mild symptoms in our study group (around 400 grains/m³) applies to most patients clinically sensitive to *O. europaea*.

The onset of allergic symptoms (rhinitis and/or bronchial asthma) in pollen-sensitive patients is often related to the number of airborne pollen grains [7] but this relation is not always close. Several factors such as priming or no effect [12, 13] or botanical peculiarities such as microaerosol suspension produced from allergen pollen smaller than grains [14] could contribute to the development of symptomatology in the patients. On the other hand, we have also considered an agronomic phenomenon typical of *Olea*, which is the rotation of productivity with the succession of seasons with higher and others with lower pollen production [15]. However, the explosive blooming of *Olea* pollen (for example from 2,365 to 5,475 grains/m³ registered in <24 h) allows us to correlate symptoms with pollen count and without considering other factors, at least in the early daily peak at the start of flowering.

Several reports have found a high prevalence of nasal and conjunctival symptoms induced by *Olea* [16], but this

pollen may also induce severe asthmatic symptoms [17] as in our area where more than an half of the patients, sensitized exclusively to *Olea*, display bronchial symptoms [3]. It is not clear whether the threshold level of *Olea* pollen required to elicit rhinitis and/or asthmatic symptoms is the same, and other investigations are in progress.

In conclusion, large areas with olive groves result in exceptionally high concentrations of *O. europaea* pollen, which is an important cause of SAR. Around 400 grains/m³ of *Olea* pollen are required for the onset of mild seasonal rhinitis symptoms in sensitized patients.

Acknowledgements

We would like to express our gratitude to Javier Subiza, MD, for his methodological assistance and to the nurses Seve Garzon, Angustias del Moral, Encarnación Valverde, Pilar Monteagudo and Carmen Contreras for their invaluable collaboration in this study.

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