

Correlation between pollen counts and symptoms in two different areas of the Iberian Peninsula: Cordoba (Spain) and Evora (Portugal)

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Summary. This work was designed to analyse the symptoms of pollen allergy in two different cities of the Iberian Peninsula, Cordoba and Evora.

Fifteen patients with pollinosis in Cordoba and twenty-seven in Evora were included in this study. Rhinitis symptoms scores were recorded in both cities in order to correlate these data with those of pollen counts. Linear regression analyses were performed in order to find out the contribution of different taxa to the sign of allergy symptoms in the allergenic population. Skin prick tests were also considered.

A high and significant correlation was found for *Poaceae* (0.89), *Olea* (0.73) and *Plantago* (0.56) in Cordoba and *Olea* (0.53) in Evora. Results also suggest that the incidence of the different pollen types in allergy patients is higher in Cordoba than in Evora. A rural lifestyle in Evora that confers a better protection from environmental agents in addition to a less contaminated atmosphere could be the cause.

Key words: Aerobiology, pollen allergy, allergic rhinitis, pollinosis, seasonal symptoms.

Introduction

Symptoms that normally affect most people with pollen allergy are sneezing, itching, nasal discharge, ocular itching, etc. These symptoms can have a significant impact on everyday activities at work or school and during spare time. Moreover, some reports suggest increased prevalence and severity of allergenic diseases in industrialized countries over the last few years.

Some studies carried out in the last decade tried to explain the cause of the high incidence of allergic diseases in the population. Some authors suggest that changes in crops might produce an increase of hay-fever [1]. Another study claims that the effect of climatic change could cause a higher production of airborne allergens, and therefore an increase in the severity of symptoms and the number of people becoming

sensitized [2]. Another factor in the increasing sensitization to the different allergens might be the worsening of pollution experienced in the cities of industrialized countries [3, 4]. Some works suggest that a rural lifestyle implicates a less incidence of allergies in the population [5]. In this sense, the hypothesis that acquisition of certain infections or exposure to naturally occurring microbial exposures as encountered in the farming environment confers protection to asthma and allergies has gained considerable scientific support over the past years [6-8].

Most of the parameters that may influence allergy symptoms in sensitive people or result in a higher concentration of patients in a given area have already been considered [9-12]. The aim of the present work was to analyse the differences in the symptoms of pollen allergy in two different cities with similar climate but different environment and lifestyle. The two cities are:

Cordoba, with an urban lifestyle and some environmental problems, and Evora, with a rural lifestyle and a less polluted atmosphere.

Córdoba is a medium-sized city located in the south-western part of Spain with 300000 inhabitants; there is little industrial development in the area, although several industrial estates have developed on the outskirts. The land is mainly devoted to cereal and sunflower cultivation at the areas closest to the city, and to olive groves further to the south. The climate is influenced by the Mediterranean Sea, the annual average temperature being 17.6 °C and total annual rainfall 536 mm.

Evora is a small sized city with 60000 inhabitants, located in the south-eastern part of Portugal. The city is located essentially in a rural area. Farming, predominantly oak plantations, vineyards and olive trees are the core of the local economy. In the last few years, there has been a development in the area related to tertiary sector. Evora's climate is influenced by the Atlantic Sea. The average annual temperature is 15.8 °C and the average precipitation is 686 mm.

Methods

The study was performed in two different sites of the Iberian Peninsula, Cordoba (Spain) and Evora (Portugal). The position of the two cities is shown on the map (Figure 1).



Figure 1. Location of Evora and Cordoba on map.

Airborne pollen concentrations were measured using a stationary Hirst-type volumetric sampler in both cities Cordoba and Evora, situated at a height of 15-20 metres above sea level. The daily samples obtained from the samplers were analysed using the standard methodology proposed by the Spanish Aerobiology Network [13]. Weekly pollen index for different allergenic taxa was obtained accumulating daily pollen concentration during 7 days.

For this study a total 15 patients were considered in Cordoba and 27 patients from the Espirito Santo Hospital in Evora. These patients were selected at random between allergic people who visited the Allergy Unit in Córdoba and Evora. The rhinitis symptoms, considered as a whole (sneeze, nasal discharge, etc), were recorded using an ordinal scale (0 = no symptoms; 1 = mild; 2 = moderate; 3 = severe). Rhinitis symptom scores in allergenic patients were measured differently in the two cities. In Cordoba, symptom scores were obtained once a week by weekly phone calls from 2nd April to 8th July, 2001. In Evora, symptom scores were registered daily on cards from 1st March to 30th June, 2001. A seven-day mean was obtained to transform daily scores in weekly scores to homogenize these data with those of Cordoba city.

Skin prick tests were considered in order to know the percentage of patients displaying reaction to the different pollen types. Positive reaction was considered in Skin-prick test when a ++ or higher score was obtained by using commercial aeroallergen extracts standardized in Biological units (BU) and containing 10 mg/ml histamine phosphate as a positive control. The patients were characterized by sensitization to pollen allergens only.

Spearman's correlation test was performed to determine the relationship between weekly pollen indices in the air and weekly symptom scores during 2001 in Cordoba and Evora. Weekly symptom scores have been previously calculated as a mean value of the symptoms considering all patients selected in each city. A multiple linear regression was also built in the two sites in order to find out the contribution of various taxa to the sign of symptoms in allergenic patients. *Beta coefficients* have been considered in linear regression equations instead of B coefficients. The *beta coefficients* are the regression coefficients it would have obtained if it had first standardized all of the variables to a mean of 0 and a standard deviation of 1. Thus, the advantage of *beta coefficients* (as compared to B coefficients that are not standardized) is that the magnitude of these allows us to compare the relative contribution of each independent variable in the prediction of the dependent variable.

Table 1. Distribution of patients by age, gender and diagnosis (%).

	% Age						% Gender		% Diagnosis	
	1-10	11-20	21-30	31-40	41-50	>50	Male	Female	Rh*	Rh + Asth**
Cordoba	6.66	26.68	46.66	20.00	0.00	0.00	46.66	53.34	66.66	33.34
Evora	0.00	32.14	17.86	17.86	17.86	14.28	28.58	71.42	60.71	39.29

* Rh = Rhinitis; ** Asth = Asthma.

Table 2. Percentage of patients displaying reactions to several pollen types according to skin prick tests (%).

	Cordoba	Evora
<i>Chenopodium</i>	20.00	14.28
<i>Olea</i>	86.66	39.28
<i>Parietaria</i>	13.33	14.28
<i>Plantago</i>	13.33	21.42
<i>Platanus</i>	40.00	10.71
<i>Poaceae</i>	100.00	85.71

Table 3. Sum of daily pollen counts during the study period in Cordoba and Evora.

	Cordoba	Evora
<i>Chenopodium</i>	511	598
<i>Olea</i>	17184	6118
<i>Parietaria</i>	6130	240
<i>Plantago</i>	606	184
<i>Platanus</i>	3285	4076
<i>Poaceae</i>	7219	25193

Table 4. Spearman's coefficient as a result of correlation between pollen counts and symptoms in Cordoba and Evora.

	Cordoba	Evora
<i>Chenopodium</i>	0.24	0.48
<i>Olea</i>	0.73*	0.53*
<i>Parietaria</i>	0.18	0.06
<i>Plantago</i>	0.56*	0.36
<i>Platanus</i>	–	-0.33
<i>Poaceae</i>	0.89*	0.43

* 95% significance

Results

Table 1 shows the distribution in percentage of all patients included in this study by age, gender and

diagnosis in Cordoba and Evora. The percentage of female patients in Evora is considerably higher than in Cordoba. The table also shows that the majority of patients in Cordoba (73.34 % of the total) were aged between 11 and 30 years old whereas in Evora, the percentage of patients included in this group reached 50 %.

Table 2 shows the percentage of patients displaying reactions to several pollen types according to skin prick tests. Taking into account these results, *Olea* and *Poaceae* affected the highest percentage of patients in both cities although the percentage of sensitization is higher in Cordoba. Evora in case of *Parietaria* and *Plantago* shows the highest percentage of sensitization, whereas in Cordoba this percentage was higher when considering *Plantago* and *Chenopodium*.

The sum of daily pollen counts during the study period varies depending on the city and the taxa. In this sense, the different amount of pollen collected in the two sites is showed in Table 3.

Olea and *Poaceae* reached the highest airborne pollen concentrations in both Cordoba and Evora. These results agree with those of skin prick tests previously commented. However, *Poaceae* pollen concentration in the air was by far higher in Evora than in Cordoba. This could be related to the large area of grasslands located in Evora, whereas in Cordoba grassland are going down due to urban development around the city that brings grasses to an end. *Olea* pollen concentration in the air was higher in Cordoba. This could be related to the great areas of olive crops located in the Andalucía region.

Table 4 shows Spearman's correlation coefficients as a result of correlation between weekly pollen indices for different allergenic taxa and weekly symptom scores in Cordoba and Evora. The results revealed a positive and significant correlation for *Poaceae*, *Olea* and *Plantago* in Cordoba and *Olea* in Evora. Date for *Platanus* was omitted because the main pollination period of *Platanus* had ended in Cordoba when symptom surveys started on April the second.

Multiple linear regression equations obtained in Cordoba and Evora are as follows:

$$WSS_C = 0.67 Poaceae + 0.76 Plantago + 0.58 Chenopodium + 0.32 Parietaria$$

$$\text{Adjusted } R^2 = 0.92 \quad p < 0.00001$$

$$WSS_E = 1.73 Poaceae - 0.56 Platanus - 1.31 Plantago$$

Adjusted $R^2 = 0.73$ $p < 0.00046$

Where:

WSS_C = Weekly symptom scores in Cordoba.

WSS_E = Weekly symptom scores in Evora.

Poaceae = accumulated daily *Poaceae* pollen concentration during a week.

Plantago = accumulated daily *Plantago* pollen concentration during a week.

Chenopodium = accumulated daily *Chenopodium* pollen concentration during a week.

Parietaria = accumulated daily *Parietaria* pollen concentration during a week.

Platanus = accumulated daily *Platanus* pollen concentration during a week.

Discussion

Skin prick tests results suggest that the pollen types most troublesome to allergy people included in our study are those of *Olea* and *Poaceae*. Similar findings are reported in previous studies carried out in the Mediterranean region [14, 15]. Grass-induced pollinosis is the most common pollen allergy in Europe and the most allergenic tree pollen is produced by olives in the south [16].

It has been observed that there is not a clear relationship between the amount of pollen collected in the air and the incidence in allergy people. Thus, *Poaceae* reached the highest pollen index in Evora whereas the highest correlation with symptoms was obtained for *Olea*. In Cordoba occurs the same process but in reverse. Taking into account previous studies performed in Cordoba, a high percentage of patients with pollinosis are sensitive to *Platanus* [17]. Allergic patients in this study shows 40 % of prevalence to *Platanus* in skin prick tests. A poor and non-significant correlation was observed for *Platanus* in the case of Evora. This fact could be related to the location of *Platanus* in the city, concentrated in the center whereas the population sample is highly distributed in the whole city but also in the countryside. Population in the countryside usually has no contact with *Platanus* so the correlation between pollen index and symptoms was very low.

Taking into account regression model results, the contribution of various taxa to the sign of symptoms in allergic patients was better explained in Cordoba, with 92% of accuracy, than in Evora, with 73%. We also found that except for *Chenopodium*, all taxa showed a lower percentage of correlation in Evora than in Cordoba. These results suggest a lower incidence of allergic diseases related to pollen in the city of Evora. This fact could be explained by two main causes. Firstly, 73.34 % of patients in the city of Cordoba were aged between 11 and 30 years old, whereas only 50% of patients were included in this group. A study performed across Spain

reported that the 14-25 age-group was the most affected by pollinosis [18].

Secondly, the population in Evora has maintained a rural lifestyle for a long time (food, contact with animals, etc) whereas in Cordoba people have changed to an urban lifestyle along the last decades. Some studies suggest that acquisition of certain infections or exposure to naturally occurring microbial exposures as encountered in the rural environment could confer protection from allergic diseases [19,20].

In addition, we also report that the atmosphere in Evora is by far less contaminated than in Cordoba where the main source of solid material emissions into the air is road traffic, since the city lies on the route for goods transported from the southern to the central regions of the country [21]. Several authors have already reported the relationship between pollution and a higher incidence of allergic diseases [22-25].

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