Original Article

Pollen allergy in Cordoba city: frequency of sensitization and relation with antihistamine sales

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Abstract. The occurrence of symptoms in pollen allergy patients in urban areas may be affected by local environmental factors such as sources of pollution, natural and ornamental vegetation, local architecture impeding dispersion, etc. The aim of this study was to analyse the frequency of sensitization in pollen allergy patients and the relationship with antihistamine sales.
For this study, a large number of clinical records, together with pharmaceutical and pollen data, were collected between 1999 and 2001 in the city of Córdoba, in the south of the Iberian Peninsula.
Differences were observed in the symptoms suffered by pollen allergy patients in different areas of the city due to varying local emission of both biological and non-biological particles. Temporal distribution of symptoms over the three study years was influenced by meteorological factors, especially rainfall patterns; higher water supply to plants was associated with increased airborne pollen concentrations.
Air pollution might be one of the main factors affecting the distribution of pollen allergy patients within the city. Recent years have seen a worsening of symptoms and increased sensitization to urban species such as plane-trees.

Key words: Aerobiology, antihistamine sales, distribution of patients, pollen allergy, seasonal symptoms, urban pollinosis.

Introduction

Some reports suggest increased prevalence and severity of allergy diseases in industrialized countries over the last few years [1].

Seasonal allergy symptoms, which classically include sneezing, itching, nasal discharge, nasal congestion, ocular itching, redness and tear production, as well as itching of the palate, can have a significant impact on everyday activities at work or school and during leisure time. In addition, there is a growing body of evidence that points to a close association between allergic sensitization and asthma [2,3].

The presence of a certain amount of pollen in the atmosphere may also prompt some worsening of allergic symptoms and asthma. Development of symptoms in allergic patients may be correlated with the particular nature of their immediate environment. Studies have reported a relationship between increased incidence of allergic symptoms and the height of the patient's urban residence, due to the irregular vertical distribution of pollen grains once they are released from the plants [4]. The presence of other traditional air pollutants (NO_x, SO_2, CO and non-biological particle matter) also plays a major role in modifying and even increasing the allergic potential of pollen grains [5,6]. Other studies have related the spatial distribution of allergy patients in a given area to the presence of different sources of emissions, both natural and anthropogenic, and also to certain architectural features leading to formation of local islands [7].

The city of Córdoba has been the subject of several aerobiological and allergy-related studies, due to several particular characteristics: Mediterranean climate, that allows flowering plants to be in bloom virtually throughout the year, abundant natural vegetation; a large variety of exotic species used as ornamentals, and proximity to one of the world's largest olive-producing areas. 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 [8,9], however, sales of antihistamines in the various districts of the city, used as an indicator of patient background, has not hitherto been addressed.

The aim of this study was to analyse the spatial and temporal distribution of allergy patients within the city, and all the parameters affecting this distribution, using a large number of clinical records, together with pharmaceutical and pollen data, collected between 1999 and 2001. It is hoped that the results obtained might allow allergy specialists to plan treatments and allergy sufferers to plan their activities. The conclusions could be applied to other cities of similar characteristics in southern Spain.

Methods

The study was performed in the city of Córdoba (4º45´W, 37º50´), south-western Iberian Peninsula. Córdoba is a medium-sized city with 316,516 inhabitants and a surface area of 50 km^2; there is little industrial development in the area, although several industrial estates have settled in the outskirts. Farming, predominantly olive and rain-fed cereal crops, is the core of the local economy. The climate is influenced by the Mediterranean sea, the annual average temperature is 17.6ºC and total annual rainfall 536 mm (according to records of the Spanish National Institute of Meteorology for the last 30 years).

Five districts were defined in the city according to various characteristics, including similarity of urban architecture and presence of natural/ornamental vegetation (Figure 1). The districts studied were the following:

Northern area: suburban area, comprising numerous buildings and a high prevalence of species used as ornamentals in private gardens, and also natural Mediterranean vegetation in the nearby mountains.

Southern area: semi-rural, semi-urban area comprising both densely built-up zones and open spaces. Vegetation comprises natural riverbank plants, ornamental plants and crops surrounding the city.

Eastern area: this is the most populated and the most industrialized area. There is some grassland and crops.

Western area: open rural area with few buildings and one industrial site. There is a prevalence of rain-fed crops and weeds, with a certain amount of natural Mediterranean vegetation (holm oak woods), and ornamental species.

Central area: typical urban area with many buildings and intense traffic, particularly during rush hours. Exotics and ornamentals are used abundantly in gardens for shade.

Clinical records of hay-fever patients were provided by the Allergy Unit at Córdoba´s Reina Sofia University Hospital. The study initially screened all patients attending the Allergy Unit in 1999, 2000 and 2001 with respiratory pathologies classified Class 8 of the ICD-9-CM diagnosis code as 493: Asthma and 477: Allergic rhinitis. Patients were mostly from the province of Córdoba and other areas of Andalusia. A population sample was selected from this preliminary group including all those patients habitually resident in the urban area of the city of Córdoba, according to the postal address appearing in the records. Thus, the preliminary pool of 6,103 patients was reduced to 2,444 charts, corresponding to patients resident in the city of Córdoba; of these, 983 tested 2+ or higher to skin-prick tests with commercial aeroallergen extracts (*Chenopodium album, Lolium perenne, Cynodon dactylon,* pollen IV (*Dactylis, Festuca, Lolium, Phleum* and *Poa*), *Olea europaea, Plantago lanceolata, Parietaria judaica* from ALK Abelló, Madrid, Spain; *Helianthus annus* from Bial Aristegui, Bilbao, Spain; *Platanus hybrida* from C.B.F. Leti, Barcelona, Spain) standardized in Biological units (BU) and containing 10 mg/ml histamine phosphate as

Figure 1. Division of areas within the city.

Table 1. Main characteristics of the districts.

Zone	Districts	Surface (km^2)	Residents	Pollen allergic patients	Allergic patients/ inhabitants ($x10^{-3}$)
North	1,6	16.28	97350	255	2.6
South	9	4.62	42798	151	3.5
East	2,5	18.82	101389	366	3.6
West	10	8.96	55167	172	3.1
Centre	3,4,7,8	1.32	19812	39	1.9
Total		50.00	316516	983	3.1

a positive control. The patients' postal addresses enabled them to be grouped according to their residential zones, following the zonal distribution established by the Spanish National Institute of Statistics (INE). Time spent in the various districts was also estimated: 41.6% of patients spent most of the day in the same district whether at home, school or work; 21.3% moved to other parts of the city during working hours and the remainder had no routine habits [8].

Data on monthly sales of 50 common antihistamines during 1999, 2000 and 2001 were used in order to determine indirectly the temporal symptoms in allergy sufferers. The antihistamines considered in this study were suggested by the Allergy Unit at Córdoba´s Reina Sofia Hospital; all of them include one of the following active pharmaceutical ingredients: azelastine hydrochloride, cetirizine hydrochloride, ebastine, levocabastine, loratadine, emedastine, ketotifen, mizolastine, dexchlorpheniramine and fexophenadine hydrochloride. Data on antihistamine sales have been grouped taking into account the area where they were bought, in order to calculate antihistamine units sold by area and antihistamine units sold in each area by number of inhabitants.

Airborne pollen concentrations were measured using a stationary Hirst-type volumetric sampler. The trap was located at a height of 15 metres above ground level, following Aerobiology guidelines, on the flat roof of the School of Pedagogy in the western area (position shown on map). The daily samples obtained from the Hirst-type sampler were analysed using the standard methodology proposed by the Spanish Aerobiology Network [10].

Spearman´s correlation test was performed to determine the relationship between monthly pollen indices and monthly antihistamine sales between 1999 and 2001.

Lastly, the percentage of sensitization to the different pollen types was compared with those from a previous study carried out in the city of Cordoba from 1984 to 1990 in order to find out differences.

Results

Table 1 shows the main characteristics of the districts. Taking into account the city as a whole, the percentage of male and female patients was very similar (47.3 v. 52.7). Most of the patients (63.2% of the total) were aged between 11 and 30 years old.

Table 2 shows the prevalence of allergic reactions to different pollen types from the standard battery used in skin prick-tests in each area. *Olea* and Poaceae affected the highest percentage of patients in the five districts. *Platanus* and *Parietaria* were among the least important causes of allergy in the resident population. The eastern and southern areas showed the highest prevalence of allergy, whereas the central area showed the lowest one.

Fig 2 shows monthly antihistamine units sold in the city of Córdoba, units sold by area and units sold in each area by number of inhabitants between 1999 and 2001. All areas showed a similar tendency but, as shown by the third graph, the highest number of antihistamine units sold per inhabitant was recorded in the central area. In the first graphs of antihistamine sales, a considerable peak during months with highest airborne pollen concentrations, i.e. from March to June, has been observed. This is clearly related to the seasonal allergy period.

Table 3 shows correlations between monthly pollen indices and monthly antihistamine sales between 1990 and 2001. A significant positive correlation was found for *Plantago*, *Platanus*, *Poaceae* and *Olea*. In contrast, a poor, non-significant correlation was observed for *Parietaria*, *Chenopodium* and *Helianthus*.

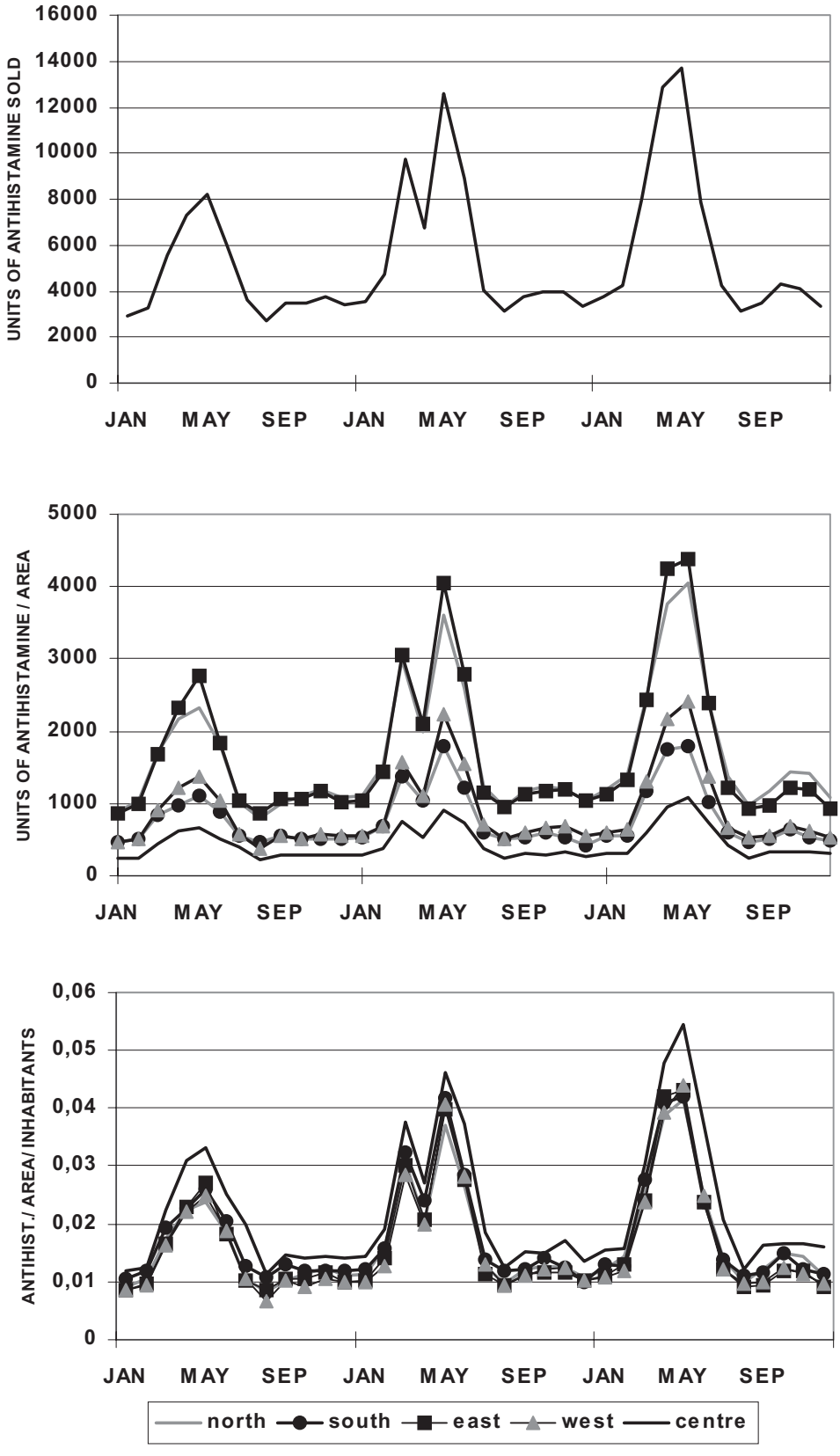

Figure 2. Monthly antihistamine units sold in the city, units sold by area and units sold in each area by number of inhabitants between 1999 and 2001.

Table 2. Prevalence of allergic reactions to different pollen types in each area ($x10^{-2}$).

	North	West	South	Centre	East
Chenopodium	8.01	8.33	10.50	6.56	13.70
Helianthus	9.55	9.78	13.55	5.55	14.10
Poaceae	18.79	23.20	25.23	14.13	26.72
Olea	20.64	25.19	28.03	14.63	29.58
Plantago	9.24	10.15	11.21	6.05	12.52
Platanus	5.64	7.06	5.60	3.02	6.90
Parietaria	3.28	3.62	3.50	3.02	4.04

Table 3. Correlations between monthly pollen indices and monthly antihistamine sales between 1999 and 2001.

Pollen type	Spearman R
Plantago	0.69*
Platanus	0.62*
Poaceae	0.55*
Olea	0.52*
Parietaria	0.27
Chenopodium	0.15
Helianthus	- 0.04

* 95% of significance.

Table 4. Percentage of patients displaying reactions to several pollen types (%).

	1984-1990	1999-2001
Chenopodium	22.50	32.65
Olea	60.80	80.26
Parietaria	2.50	11.59
Plantago	29.16	33.87
Poaceae	82.50	73.00
Platanus	No tested	19.73

Table 4 charts the percentage of patients displaying reactions to several pollen types, comparing the results of the present study with those of previous studies performed in the city of Córdoba from 1984 to 1990 [9].

Discussion

Results suggest that the pollen types most troublesome to allergy patients are *Olea* and *Poaceae*. Similar findings are reported in previous studies carried out in the city of Córdoba [11], in Spain as a whole [12] and in other Mediterranean countries [13]. Within the city of Córdoba, the highest incidence of pollen allergy occurs in the eastern and southern zones. These are the areas containing the bulk of the industrial sites. They also constitute the main routes in and out of the city, where there are frequent traffic jams. This would support the relationship already observed between pollution and a higher incidence of allergy [6,14].

The centre of the city had the lowest percentage of people suffering from pollinosis. People in this area tend to be older, due to the movement of young families towards the outskirts of the city. A study performed across Spain reported that the 14 –25 age-group was the most affected by pollinosis [15]. The present study shows that most pollen-allergy sufferers in the city of Córdoba are between 11 and 30 years old. Moreover, people living in the central area usually attend allergy clinics in the city centre rather than the Allergy Unit at Cordoba´s Reina Sofia University Hospital. Therefore, their pollen sensitivity records would not be included in this study.

The graphs of antihistamine sales show differences in annual sales during 1999, 2000 and 2001. Those three years were climatologically different: 1999 was the driest of the three and this resulted in a reduction in the number of pollen grains released into the atmosphere, mainly in the case of herbaceous plants. People sensitive to pollen suffered from mild symptoms during this year. In 2000 the rainfall was average. For people sensitive to herbaceous pollens such as Poaceae, this was a moderate year with only a few days of high pollen concentrations. Two peaks can be seen in 2000. The first one was related

to high airborne *Platanus* pollen levels during March (a total of 9,442 grains/m^3), the highest in the city for the last 10 years. This caused an increase of symptoms in people sensitive to this pollen type and in consequence, a peak in the curve of antihistamines sold. The second peak was related to the usual months of higher pollen incidence. Year 2001 was very rainy, which caused an increase in airborne pollen concentrations due to the immediate response of herbaceous plants to water, and consequently a higher number of allergy episodes. Each of the three study years fitted one of the categories established by Sánchez Mesa et al. (2002), who classified a set of 20 years in terms of meteorological characteristics. There is an associated potential allergenic risk depending on the class in which a year is included [16].

All districts of the city showed similar trends for the variables studied with the exception of the center, where a larger number of antihistamine sales per inhabitant was observed. This might be because allergy patients usually buy medication in the city center, where most pharmacies and chemists are located. There are also two district Public Health Services in the center, and people often buy medicines after visiting the doctor.

A positive and significant correlation was observed between monthly pollen indices and antihistamine sales for *Plantago, Platanus, Poaceae* and *Olea*. From these results, it may be concluded that pollination in these species coincides with major allergy episodes. The high values recorded for *Plantago* may be related to its cross-reactivity with *Poaceae* [17].

The percentage of patients sensitive to the different pollen types has changed considerably over recent years. There has been an increase regarding all pollen types with the exception of *Poaceae*. Córdoba has recently seen a reduction in the number of ecosystems where grasses are able to grow, due to the expansion of the city and to town-planning changes. *Olea* has increased by almost 20 points, and it is the most important taxon, with 80.26% of sensitive patients displaying a positive reaction. This may be due to an increase in the area given over to olive-growing in the south of the Iberian Peninsula over the last few years, as a consequence of the new EU Common Agricultural Policy. In other countries, a relationship between changes in crops and variation in pollen sensitization has been observed [18]. Some authors maintain that the effect of climatic change could cause an increase in the production of airborne allergens, and therefore an increase in the severity of symptoms and in the number of people becoming sensitized [19]. Another factor for the increasing sensitization to pollen in recent years might be the worsening of pollution experienced in the city [8,20], mainly as a consequence of the rising number of diesel-engined cars. Although the potency of allergenic extracts has probably increased in the last few years with increasingly purified extracts, there is a growing body of evidence that points to a close association between the increasing sensitization to pollen and pollution. This is aggravated by increased sensitization to *Platanus* pollen over recent years: due to the problems observed during the flowering of this typical urban species in the city, plane-tree pollen has been included in the battery of allergens used in skin prick tests, and is today one of the main allergenic pollen types in the area. One of the most important findings of the study is that in spite of the low frequency of sensitization to *Platanus*, the correlation with the antihistamine sales is quite significant, suggesting that *Platanus* pollen can induce more important symptoms than other pollen types.

Acknowledgements

The authors wish to thank the Fondo de Investigación Sanitaria (FIS) for the BEFI Grant Ref: 00/9406 and Córdoba´s Reina Sofia University Hospital and Provincial Division for Heath, Regional Government of Andalusia for data supply.

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