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# Seasonal allergic symptoms and their relation to pollen exposure in south-east France

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**Summary**

In order to evaluate the relationship between pollen exposure and prevalence of allergic respiratory symptoms, we performed a cross-sectional epidemiological study in 2 areas with contrasted exposure to cypress and grass pollens. The study population consisted of 5427 subjects 18 to 65-years-old representative of the general population. All answered an abridged version of the 1978 ATS questionnaire and a sample had a skin test evaluation including grass and cypress pollens. Prevalence of hay fever symptoms was equal to 31·5% and 14·1%, respectively, in exposed and less exposed community ($P < 0{\cdot}001$). Prevalence of hay fever symptoms together with a positive skin test to pollen was also significantly higher in the exposed (13·6%) vs less exposed community (5·5%, $P < 0{\cdot}001$). In contrast, overall prevalence of asthma was equal to 4·5% and 3·4%, respectively. Prevalence of asthma with positive skin tests was also not statistically significant, equal to 2·5% and 1·9%, respectively. Thus, high exposure to pollen is a risk factor for developing hay fever but not asthma.

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## Introduction

The prevalence of both rhinitis and asthma is much higher in atopic than non-atopic individuals [1]. However, several recent cross-sectional epidemiological surveys suggest that the risk of bronchial hyperreactivity [2–4], as well as the risk of asthma [5] in children and young adults is mostly increased in individuals sensitized to perennial allergens as compared to seasonal allergens. In contrast, risk of hay fever would be higher in the latter than in the former group [6].

Thus, one would expect a higher prevalence of hay fever in communities heavily exposed to pollens, whereas prevalence of asthma would not be increased as much, compared to less exposed communities. In this cross-sectional epidemiological study, we evaluated the prevalence of respiratory allergy in two areas with contrasting levels of exposure to cypress and grass pollens.

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## Material and methods

### *Location of the study*

The study was performed in two towns in south-east France, Senas and Marseille, from January to April, 1988. Senas, which has 2570 inhabitants, is located in the Rhone Valley, close to mouth of the river. In the 1950s and 1960s several hundred thousand cypress trees were planted in this farming area to protect crops and orchards from a strong wind blowing southward down the Rhone Valley. Marseille is a seaside town with 800 000 inhabitants. It is south-east of the Rhone Valley, 50 km away from Senas. The dominant north wind carries some pollen from the Rhone Valley to Marseille. Mean annual $SO_2$ levels in 1988 were equal to 14 $\mu g/m^3$ in Senas and 29 $\mu g/m^3$ in Marseille.

### *Pollen counts*

Figures 1 and 2 show cypress and grass pollen counts performed in Senas and Marseille from December 1987 to July 1988. Pollen was collected using a Burkart appara-

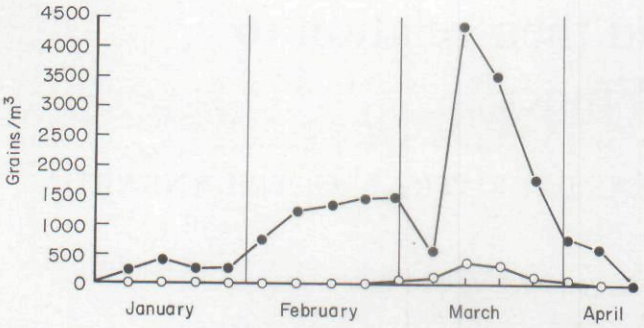


**Fig. 1.** Mean daily cypress pollen counts expressed in number of grains per cubic metre for each week from January to April. ●, Senas. ○, Marseille.

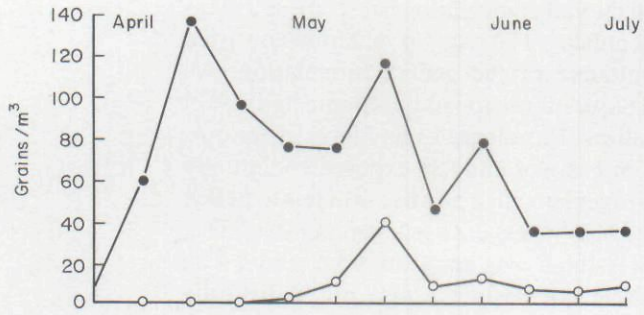


**Fig. 2.** Mean daily grass pollen counts expressed in number of grains per cubic metre for each week from April to July. ●, Senas. ○, Marseille.

tus. Counts were performed by the same investigator and results were expressed as mean daily number of grains per cubic metre of aspired air for each week from January to April.

*Selection of the study groups*

In Marseille, our goal was to select a random sample of the general population, aged 18 to 65 years. Prior to the sampling, we computed the estimated sample size at a 95% confidence level. These calculations were based on an estimated cumulated prevalence of asthma close to 6% [7] and a standard error equal to 1%. Because we used a cluster sampling method, we doubled the estimated sample size [8]. Thus, the estimated sample size was roughly equal to 4000 subjects who were chosen at random from 40 neighbourhoods throughout the city (100/neighborhood). Under these conditions mean cluster values tend to have a normal distribution [9]. The probability was proportional to the size of each neighborhood (systematic sample). In each neighbourhood, we randomly selected a group of households or cluster and conducted interviews in each. The interviewers started on a randomly selected corner visiting households once, usually in the evening until they had seen 100 people in the selected cluster.

In Senas, the target population was all adults, aged 18 to 65 years, as listed on the 1982 census. Interviewers visited every house at least three times before stating that the subject could not be contacted.

*Protocol*

For each subject a standardized questionnaire was completed. In addition to an abridged version of the 1978-ATS questionnaire [10] for adults, this questionnaire included extra questions about rhinitis symptoms. The wording of the question about hay fever was 'Have you ever had hay fever, i.e. in spring, sneezing with runny and itchy nose and eyes?'. Perennial rhinitis was diagnosed if a subject answered 'yes' to the following questions: 'Do you usually have a runny or stuffy nose?' and 'Does it last 3 months of the year?'

Skin prick tests using the Stallerpoint® (Laboratoire Stallergène, Paris, France) lancet were proposed to all subjects with a history of asthma and one out of three subjects with a history of hay fever. The following allergens were used: house-dust, house dust mites (*Dermatophagoides pteronyssinus*), cat danders, grass pollen and cypress pollen. All of these extracts, except cypress, are standardized using a RAST inhibition technique by comparison with an internal standard. Their potency is expressed in terms of biological units ('reactivity index'). Cypress extract is a 1/20 weight/volume extract as there is no standardized cypress pollen available in the world. The same batch was used in both locations. Negative control (50% glycerol saline) and positive control (9% codeine phosphate) tests were also performed. All tests were performed on the volar surface of the forearm near the elbow bend. They were recorded after 20 min by outlining the weal with a felt pen and transferring the mark to a sheet of paper. The mean of the largest and smallest diameters were computed for each test. A test was considered as positive if it induced a weal whose diameter was at least equal to half the diameter of the weal induced by codeine phosphate and larger than the negative control test.

*Statistical analysis*

Comparison of prevalence figures used a chi-square test. Comparison of mean values used an unpaired *t*-test.

*Logistics*

In both towns, articles were published in local newspapers a few days before the start of the study and radio reports

**Table 1.** Prevalence of seasonal allergic rhinitis based on the questionnaire alone or on the questionnaire and skin tests to pollens

| | Marseille | Sénas |
|---|---|---|
| Males/females | 1727/2281 | 694/725 |
| Mean (±s.d.) age | 40·8±14·5 | 36·6±13·2 |
| Prevalence of hay fever | | |
| questionnaire | 14·1 | 31·5 |
| questionnaire and skin tests | 5·5 | 13·7 |

were broadcasted. Posters asking for public cooperation were placed in public places and shops. In Senas, copies of the newspaper article were distributed in each mailbox.

## Results

In Marseille, 4008 subjects were interviewed and 187 underwent skin testing. Mean (±s.d.) age of tested subjects was 39·2±12·2 years. Because of the sampling mode, the response rate could not be determined. In Senas, 1556 subjects belonged to the age range 18–65 years according to the 1982 National Census adjusted for population movement between 1982 to 1987. A total of 1419 subjects, i.e. 91·2%, were interviewed and 131 underwent skin testing. Their mean (±s.d.) age was 38·2±13·6 years. The main characteristics of these two study groups are listed in Table 1.

### *Prevalence of hay fever in both communities (Table 1)*

Based on the questionnaire, 31·5% of subjects from Senas and 14·1% from Marseille ($P<0·001$) acknowledged a history of hay fever. The percentage of subjects complaining of hay fever and having positive skin tests to grass or cypress pollens was 13·6% in Senas and 5·5% in Marseille ($P<0·001$). In subjects born and having spent their life in each of the towns, these figures were equal to 15·9% and 7·6%, in Senas and Marseille, respectively. The percentage of hay fever patients with skin sensitivity to grass pollens, alone or combined with cypress pollen sensitivity, was significantly ($P<0·001$) higher in Senas (11·3%) than in Marseille (4·9%) (Table 2). Similarly, the percentage of hay fever patients with skin sensitivity to cypress pollens, alone or combined with grass pollen sensitivity was significantly ($P<0·001$) higher in Senas (9·2%) than in Marseille (2·6%). The proportion of hay fever patients with sensitivity to cypress pollen alone was low in both places, but it was nevertheless four times higher in Senas.

### *Prevalence of asthma in both communities*

The cumulative prevalence of asthma, i.e. subjects answering yes to the following questions: 'Have you ever had asthma?' and 'Was the diagnosis confirmed by a doctor?' was 4·5% in Senas and 3·4% in Marseille. This difference was not statistically significant. Similarly the prevalence of asthma with a positive skin test to grass or cypress pollens was not statistically different in Senas (2·5%) and Marseille (1·9%).

### *Prevalence of smoking related symptoms*

Prevalence of chronic bronchitis and dyspnoea at exertion was similar in both towns in current smokers, non-smokers as well as in ex-smokers. Overall, prevalence of chronic bronchitis was equal to 5·2% in Marseille and 6·7% in Senas. Prevalence figures for dyspnoea at exertion were equal to 10·5% and 12·5%, respectively.

## Discussion

This cross-sectional epidemiological survey compared two towns located in the same area but with contrasting pollen exposure. While the prevalence of asthma was comparable, seasonal rhinitis was much more frequent in the more exposed community. Some possible bias should be considered before accepting this difference as genuine. Firstly, persons with allergic disease may emigrate from the larger city to the countryside. The fact that subjects born in the two settings also show the same difference

**Table 2.** Prevalence of hay fever in relation to grass and/or cypress allergy

| Hay fever patients (%) with positive skin test to | Senas | Marseille |
|---|---|---|
| Grass pollen alone or together with cypress pollen | 11·3 | 4·9 |
| Cypress pollen alone or together with grass pollen | 9·2 | 2·6 |
| Cypress pollen alone | 2·4 | 0·6 |

militates against this hypothesis. Another possibility is a difference in question interpretation or the way the questionnaire was used in the two towns. However, the study was not presented as a survey on allergic diseases but rather as an inquiry on environmental diseases at large. Besides, the prevalence of chronic cough and chronic bronchitis and dyspnoea at exertion in smokers, ex-smokers and non-smokers was comparable in both settings, which seems to exclude a response bias. Some misclassification in exposure probably occurred because subjects living in Senas may work in Marseille. However, such a misclassification only tends to lower the relationship between exposure and disease.

In the community heavily exposed to pollens, prevalence of hay fever was roughly twice and half as much as in the less exposed community. This statement holds true whether hay fever was defined only on the basis of answers to a standardized questionnaire or to this questionnaire plus positive skin tests to pollens. Interestingly, the percentage of hay fever patients with sensitivity to cypress pollen in Senas was almost twice the percentage of hay fever patients with sensitivity to grass pollens in Marseille (Table 2).

Despite the fact that cypress trees pollinate much more than grass (Figs 1 and 2), skin sensitivity to grass pollen and hay fever in association with grass pollen allergy is higher to such reactions to cypress pollens in our geographical area. Although the quality of the cypress allergenic extract for skin testing is not excellent and cypress allergy may have been underestimated, this finding suggests that cypress pollen allergenicity is lower than grass pollen allergenicity. This study also underlines the poor predictive value of the standardized questionnaire study for the diagnosis of seasonal allergic rhinitis in epidemiological survey. In our study group (see Table 1), more than 50% of subjects with a history of seasonal allergic rhinitis had negative skin tests to pollens. This may be partly related to the wording of the question which refers to a lifetime history of hay fever. Moreover, perennial rhinitis and non-allergic rhinitis, vasoactive rhinitis or even common colds can be mistaken for hay fever. The low reliability of symptoms to diagnose atopy has recently been exemplified [11]. In this latter study, this was especially true in females and middle age individuals, compared to young males.

In this study, the prevalence of asthma was similar in the two communities. Recent evidence indicated that exposure to pollen is a strong risk factor for allergic rhinitis while exposure to perennial allergens is a strong risk factor for allergic asthma. In a group of 419 schoolchildren, Shibasaki *et al.* [6] showed that the prevalence of asthma correlated with Dermatophagoides-specific IgE levels but not with orchard grass-specific IgE levels, whereas the prevalence of seasonal allergic rhinitis correlated with orchard grass-specific IgE levels but not with Dermatophagoides-specific IgE levels. Similarly in a cohort study of 714 New-Zealand children, Sears *et al.*[5] demonstrated that sensitivity to house dust mites and/or cat dander but not to grass pollen was a highly significant independent risk factor for asthma. Similar findings have been reported in Australian schoolchildren [3]. Verdiani *et al.* [4] showed that perennial rhinitis is a much more important risk factor than seasonal rhinitis for the development of bronchial hyperresponsiveness. Recently, Cookson *et al.* [2], in a group of 143 young subjects, demonstrated that the risk of bronchial hyper-responsiveness was greater in subjects sensitive to house dust and mould than in those reactive to grasses. All these studies, together with ours, suggest that bronchial reactivity and asthma occurrence in atopic individuals depend on the antigens to which they become sensitized.

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