Survey of Airborne Pollens in Seoul, Korea

Hae Sim Park¹, M.D., Duck-Hee Chung², M.D., Yang Ja Joo², M.D.

*Department of Internal Medicine¹, Department of Otolaryngology²
National Medical Center, Seoul, Korea*

*The daily pollen counts in the air of Seoul, Korea were measured using a rotorod sampler from June 1990 to July 1992. Two distinct pollen periods were noted: tree pollens such as alder, poplar, willow, oak and pine appeared in the spring from March to May, and weed pollens, such as *Artemisia* spp., *Ambrosia* spp. and *Hop* japonense appeared in the autumn from August to September. Various kinds of grass pollen appeared from June to September.*

The study indicated that there were two pollen peaks in Seoul composed of tree pollens in spring and weed pollens in autumn.

Key Words: pollen count, Seoul, rotorod sampler

INTRODUCTION

Investigating daily counts of outdoor allergens is an essential procedure for respiratory allergy studies. Up to now, a few aerobiologic studies (Min, 1984; Hong *et al.*, 1986; Kim *et al.*, 1989) using the gravity method have been reported in Korea. The city of Seoul is located in central Korea. Seoul has a temperate climate and four seasons with rainfall during the summer. In Korea, several pollens are known to be important causative allergens (Park, 1991). Thirty percent of respiratory allergy patients showed positive responses to skin-prick tests for pollen antigens (Kang, 1973; Hwang *et al.*, 1974).

In this study, we report the results of a two-year study of pollen counts in the air of Seoul using a rotorod sampler.

MATERIALS AND METHODS

Continuous volumetric sampling was carried out using a rotorod sampler (Sampling Technologies Inc., CA) from June 1990 to July 1992. The sampler

was placed on the top of a hospital building 25 m above ground level. Silicone grease was applied on both I rods. The sampler was in operation for 24 hours but was turned off during the winter (November to February). The I rods were placed in a plastic, grooved stage mount provided by the manufacturer and stained with Calbela's solution. Particles that were recovered were counted microscopically by transmitted light, and results were expressed as "particles recovered/unit volume of sample" by the Ted Brown formula (Muilenberg, 1989). The pollens were classified by the morphology.

RESULTS

Fig. 1 shows the total pollen counts in 1991. The pollen season begins in March, reaches a maximum in May, and ends in late October. Two distinct periods were noted: a major period, which goes from March to May, and a second peak in August-September. The counts markedly decreased during rainfalls and winter.

Table 1 reveals individual tree pollen counts during the spring season for two years. Pine tree pollens were the major contributors. Alder pollens were the major contributors in March. In April, they were poplar and willow pollens, and in May, oak and

Address for correspondence: Hae Sim Park M.D. Ph.D.
Department of Internal Medicine, National Medical Center
Jungku Ulchiro 6-ka 18-79, Seoul, Korea

Table 1. Tree pollen count in Seoul (1991-1992)

	Alnus	Populus	Salix	Quercus	Pine
1991					
March	190	58	7	48	8
April	20	102	386	232	8
May	<5	31	69	70	>2000
1992					
March	183	325	160	134	<5
April	18	78	604	152	37
May	8	10	9	436	>2000

Fig. 1. Total pollen counts in the air of Seoul in 1991

Fig. 2. The single site prevalence data for grass pollens in Seoul from June 1990 to 1991.

pine.

Fig. 2 reveals the total grass pollen counts for two years. Grass pollens of different sizes and shapes were noted. In June 1990, the count of grass pollens was higher than that of 1991. There were two grass pollen periods: the first one was in June (early summer) and the second, in August and September after the rainy season.

Fig. 3 reveals the counts of three major weed pollens for two years. From August to October, the count of *Humulus japonicus* pollen was highest, followed by *Artemisia spp.* and *Ambrosia spp.* pollens. The flowering periods of these three pollens were similar. In 1990, two distinct periods of *Artemisia spp.* pollen were noted: the first was at the end of August and the second, in September.

Fig. 3. The single site prevalence data for *Artemisia* spp. (3a), *Ambrosia* spp. (3b) and *Humulus japonicus* (3c) pollens in Seoul from June 1990 to 1991. Arrows indicate rainy days.

DISCUSSION

In Korea, 30% of respiratory allergy patients participating in a particular study showed positive responses to various pollens on a skin prick test. The sensitization rate to *Artemisia* spp. was highest (18.6%) followed by *Hop japonica* (13.8%), grass pollens (13.2%), tree pollens (11.6%), and ragweed (10%, Yoon *et al.*, 1989). Therefore, pollens are thought to be important causative allergens in Korea.

The results obtained during these two years indicate the presence of different kinds of pollen in the air of Seoul. Comparison of the two years showed similar values and patterns in pollen occurrence. In a temperate climate, three pollen periods have been reported (Mygind, 1986): tree, grass and weed pollen periods. In this study, there were two peaks: tree pollens in spring and weed pollens in autumn, which is a finding similar to other studies using a gravity method (Min, 1984; Hong *et al.*, 1986). There were low counts of grass pollen from June to September.

During the tree pollen period in March, alder pollens were major contributors. Poplar pollens appeared in March and April. Willow pollens were major contributors in April. In May, oak and pine tree pollens were abundant. Although there were rare patients who showed positive responses to pine pollens on a skin prick test (Yoon *et al.*, 1989), counts of pine pollens were very high (from 8 to more than 2000 particles/m³). In addition, low counts of birch and hazel pollens were observed.

From June to October, several kinds of grass pollens were noted. The accurate identification of grass pollens by a light microscope is not possible. During that season, grass pollens of various sizes and shapes were observed. There were two peaks in grass pollen periods. One was in June and the second was in August 1991 and September 1990. The pollen count of June 1991 was lower than that of 1990, which is due to the fact that the rainy season in 1991 began in June. The sensitization rates to grass pollens on skin prick test are not high in Korea (Yoon *et al.*, 1989). Most grass pollen-sensitive patients showed positive responses to five major grass pollens: rye, orchard, Bermuda, timothy, and Kentucky blue grasses which are prevalent in European countries and the United States. All of them are reported in the plant atlas of Korea (Lee, 1985). Among them, *Zoysia japonica* is the most

prevalent one (personal communication, Lee). Sixteen percent of respiratory allergy patients in a particular study in Korea were sensitized to *Zoysia japonica* pollen extract (Lee and Hong, 1991). Further studies are needed to identify the major causative grass pollen in Korea.

Many respiratory allergy patients in Korea have suffered from aggravation of their symptoms in late summer and autumn (Park *et al.*, 1989; Park *et al.*, 1989). In this study, from August to September, the pollens of *Artemisia spp.*, *Ambrosia spp.* and *Humulus japonicus* were abundant in the air of Seoul. The flowering period of these three pollens was the same. Although the pollen counts of *Humulus japonicus* were the highest, the sensitization rate to mugwort was the highest (18.6%) followed by *Humulus japonicus* (14.3%) and ragweed (Yoon *et al.*, 1989).

Mugwort pollens are known to be the most significant allergens among various pollens in Korea (Park *et al.*, 1989). *Artemisia spp.* pollen was reported as one of the important causative allergens in Japan (Usami and Usami, 1988), the United States (Anderson *et al.*, 1978), China (Chen *et al.*, 1988), Iran (Amin and Bokhari, 1977) and Italy (D'Amato *et al.*, 1983) as well as in Korea. In this study, two peaks of *Artemisia spp.* pollens were noted in 1990. In a population study, 26 kinds of *Artemisia spp.* were reported in the plant atlas of Korea (Lee, 1985). Among them, *Artemisia vulgaris* (mugwort) is the most prevalent one (personal communication, Lee). These two pollen peaks of *Artemisia spp.* are caused by the difference in flowering periods of the various *Artemisia spp.*

The pollen counts of *Ambrosia spp.* were not high in this study. Two kinds of *Ambrosia spp.* (*Ambrosia elastior* and *trifida*) were reported in the plant atlas of Korea (Lee, 1985). Brown and Irving (1973) reported that allergic symptoms could be provoked in ragweed-sensitive patients if the pollen count was higher than 20 grain/m³. In Seoul, the maximum count of ragweed pollen observed was 19 grains/m³, which occurred just for one day. But there are appreciable numbers of respiratory allergy patients highly sensitized to ragweed pollens (Yoon *et al.*, 1989; Park *et al.*, 1989). Further studies are needed to evaluate the characteristics of ragweed-sensitive patients in this country.

The flowering period of two major pollens, ragweed and mugwort, were concurrent in this study. Many patients have shown positive responses to

both of these pollens on a skin prick test, RAST and bronchoprovocation test (Park *et al.*, 1989; Song *et al.*, 1992). The possibility of cross-reactivity between these two pollens has been suggested (Weber and Nelson, 1985). But our recent study (Park *et al.*, 1993) using crossed immunoelectrophoresis between these two pollens suggested little evidence of cross-reactivity between them.

The significance of *Humulus japonicus* pollen as a respiratory allergen in Korea is not clear. Respiratory allergy patients sensitized to this pollen have been reported in Japan (Saito, 1980) and Korea (Kim *et al.*, 1987; Hong and Park, 1988). Nam *et al.* (1988) reported that 14% of respiratory allergy patients were sensitized to extracts of this pollen. They also detected its specific IgE antibody by enzyme-linked immunosorbent assay. Further studies are needed to investigate the allergenic significance of this pollen. In addition, a few counts of *Chenopodium spp.* pollens were also observed during this season.

In conclusion, there were two distinct pollen periods in Seoul, Korea: tree pollens from March through May, and weed pollens from August to September. Alder, poplar, willow, oak and pine pollens were the major contributors in spring. The pollens of *Artemisia spp.*, *Ambrosia spp.*, and *Humulus japonicus* were major contributors in autumn. Several kinds of grass pollens appeared from June to October.

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