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Aeropollinic sampling at three different heights by personal volumetric collector (Partrap FA 52)

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Key words: aeropollinic sampling; volumetric portable pollen traps at different heights.

Background: Aeropollinic sampling is usually performed by volumetric pollen traps located on the top of buildings at a height of 15–20 m. The present study aimed to determine whether pollen concentration is similar, at the same time, at different heights.

Methods: Pollen concentrations were measured at the same time for 3 days each month (March–October 1997), with three Partrap FA 52 devices respectively located at 1.5, 5, and 15 m above the ground. A Burkard sampler was used as control at the 15-m level.

Results: No significant difference in either the total count or the single pollen counts was observed between the Partrap and Burkard samplers at 15 m. The total pollen count did not differ significantly between the Partrap at 1.5 m and 15 m (130 ± 19 and 123 ± 18 , respectively), whereas the sampler at 5 m collected an amount of pollen (84 ± 14) significantly lower than at 1.5 and 15 m ($P < 0.0001$ and $P < 0.001$, respectively). The amount of Urticaceae pollen was significantly higher at 1.5 m (97 ± 17) than at 15 m (80 ± 12) and 5 m (58 ± 11); $P < 0.02$ and $P < 0.001$, respectively. Regarding grass pollen, the collector at 5 m captured significantly less pollen (4.5 ± 0.8) than at 1.5 m (9.5 ± 1.3) and 15 m (7.2 ± 1.3) ($P = 0.002$ and $P = 0.02$, respectively). No significant difference was observed between the data obtained from samplers at 1.5 and 15 m. In addition, the Oleaceae, Cupressaceae, and Corylaceae pollen counts were significantly higher when collected at 15 than at 5 and 1.5 m.

Conclusions: These data show that differences exist in pollen sampling performed at different heights.

Airborne pollen grain sampling is the conventional method to obtain information on the pollination periods of the different allergenic plants.

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Aeropollinic calendars based on the results obtained with pollen sampling in the atmosphere are widely used in the study of allergic respiratory diseases, from the diagnostic, preventive, and therapeutic points of view; once the pollination periods in a geographic area are known, it is possible to establish the correct moment for beginning immunotherapy or preventive pharmacologic treatment of allergic diseases (1, 2).

Pollen detection, which must be representative of the pollen concentrations of a wide area, is usually done with fixed pollen traps, which should be placed on an open site, avoiding obstacles such as buildings, mountains, and hills. Pollen detection for aeropollinic calendars is usually done with volumetric pollen traps located on the top of buildings at a certain height above the ground (3, 4).

In recent years, portable personal samplers such as Partrap FA 52 (Coppa, Biella, Italy) have been available (5–7). Previous studies by our group (8) have demonstrated good efficacy, comparable to that of fixed samplers, in pollen trapping with Partrap FA 52. These devices have been designed to detect aerobiologic particles in the microenvironment of subjects during their daily life. These samplers offer the advantage of a lower cost and easier handling, and may be placed to allow sampling at every place that seems of interest (5–8).

The data obtained with the conventional sampling provide information on pollen concentrations at 15–20 m above the ground; however, in order to define the real exposure of the sensitized subjects, it is also important to determine pollen concentrations at the human level. In past years, comparisons among results obtained from simultaneous samplings at different heights were made; these studies demonstrated that differences in pollen concentrations exist at different elevations above the ground, (9–11, 13, 14). In a study carried out in Córdoba (Spain), for example, Soldevilla et al. reported significantly higher concentrations of Urticaceae pollen at 15 than at 1.5 m, while the concentrations of Oleaceae pollen, in the same study, were higher at 1.5 m than 15 m (12).

In this study, we investigated the possible different concentrations of pollen particles, comparing the simultaneous sampling at 1.5, 5, and 15 m performed in Alassio (Savona) in a typical Mediterranean area in the period from January to October 1997.

Material and methods

The study was carried out at Alassio (Savona, Italy), a town of about 25 000 inhabitants, situated on the coast of the

Ligurian Sea. In this area, there is a typical Mediterranean vegetation, and the highest amounts of allergenic pollens are represented by Urticaceae, Oleaceae, and grass. The sampling was performed on the top of Alassio Hospital at about 100 m from the sea in an open place exposed to the winds and therefore receiving aerobiologic particles from a wide area.

Pollen was collected during the period from January to October 1997, and the sampling was done on the 10th, 20th, and 30th of each month; for the sampling, four pollen traps were employed: one fixed Burkard sampler located on the terrace of the hospital at about 15 m above the ground level, and three portable Partrap FA 52 devices located respectively at 1.5, 5, and 15 m of elevation. The 15-m Partrap FA 52 was situated close to the fixed Burkard in order to compare the efficacy of the two different devices.

Technical characteristics of Partrap FA 52

This sampler is noiseless, compact, and of small size (18 × 9 × 4 cm) and weight (460 g, rechargeable batteries included), and has technical characteristics comparable to those of the Hirst sampler (Burkard, Lanzoni); it can sample inorganic and organic airborne particles of diameter 1–10 µm (dust, spores, pollen, bacteria) with 10 l/min suction flow and 6000 rpm turbine. This portable pollen trap is provided with a double chamber of collection. Between two successive samplings, the pipes and the single-use double chambers were replaced, while the turbine was dismantled and cleaned with a strong jet of compressed air in order to remove residues of particles that might have been collected in the previous tests.

Sample collection and analysis

Briefly, as previously described (8), the tapes from the different devices were collected at the end of each day of sampling, set with glycerinated gelatin, stained with basic fuchsin, fixed on slides, and analyzed under a light microscope (Olympus CM3 microscope, ×400 magnification) with the reading method of parallel smear with tangential microscope fields. Results are reported as mean ± SEM of both total pollen count and differential count of the different collected kinds of pollens (Urticaceae, Graminaceae, Oleaceae, Cupressaceae, Corylaceae, and Betulaceae) during the collecting period (total of 30 days).

Statistical analysis

For the statistical analysis, Student's *t*-test was employed to compare the results obtained with the different samplers.

Results

Over the entire period of the study, Urticaceae pollen was the most common in each month of sampling, confirming the important role of airborne particles of this family in the pathogenesis of allergic respiratory diseases in this Mediterranean region.

In order to summarize the distribution of pollen concentrations during the study period, the data concerning the pollen detection in the different days of sampling for the various collected pollens are reported in graphic form for the total granule count (Fig. 1), for Urticaceae pollen (Fig. 2), and for Graminaceae pollen (Fig. 3).

It is noteworthy that no significant differences were observed in either the total count or the various types of pollens between Partrap FA 52 and Burkard devices located at the same height of 15 m above the ground (123.7 ± 18 vs 122.1 ± 19), confirming previous studies.

The total pollen count did not significantly differ between the sampling performed at 1.5 m and that done at 15 m (130 ± 19 vs 123 ± 18); the sampler located at a height of 5 m

collected an amount of pollen (84 ± 14) significantly lower than the pollen traps at 1.5 and 15 m ($P=0.0001$ and $P=0.001$, respectively) (Fig. 4).

The number of Urticaceae pollen grains was significantly higher at 1.5 m (97 ± 17) than at 15 m (80 ± 12) and 5 m (58 ± 11): $P=0.02$ and $P=0.001$, respectively. In addition, the number of Urticaceae pollen grains was lower at 5 m than at 15 m ($P=0.001$) (Fig. 5).

Regarding Graminaceae pollens, the sampler located at 5 m trapped an amount of pollen (4.5 ± 0.8) significantly lower than that of the other two collectors at 1.5 m (9.5 ± 1.3) and 15 m (7.2 ± 1.3): $P=0.002$ and $P=0.02$, respectively. For Graminaceae pollens, no significant differences were observed between the collections performed at 1.5 and 15 m (Fig. 6).

For the other families, i.e., Cupressaceae, Oleaceae, and Corylaceae, the amount of captured pollen was significantly higher at 15 than at 5 and 1.5 m (data not shown).

It seems important to note that, in addition to the significant differences observed at different heights that appear from an evaluation of the whole study period, there was an expected and not negligible variability in the number of pollens collected on different sampling days. In addition, important differences among different heights in the same day were observed. In this regard, both the total pollen count (Fig. 1) and the different kinds of pollens (Figs. 2 and 3) were more relevant on some particular days of sampling.

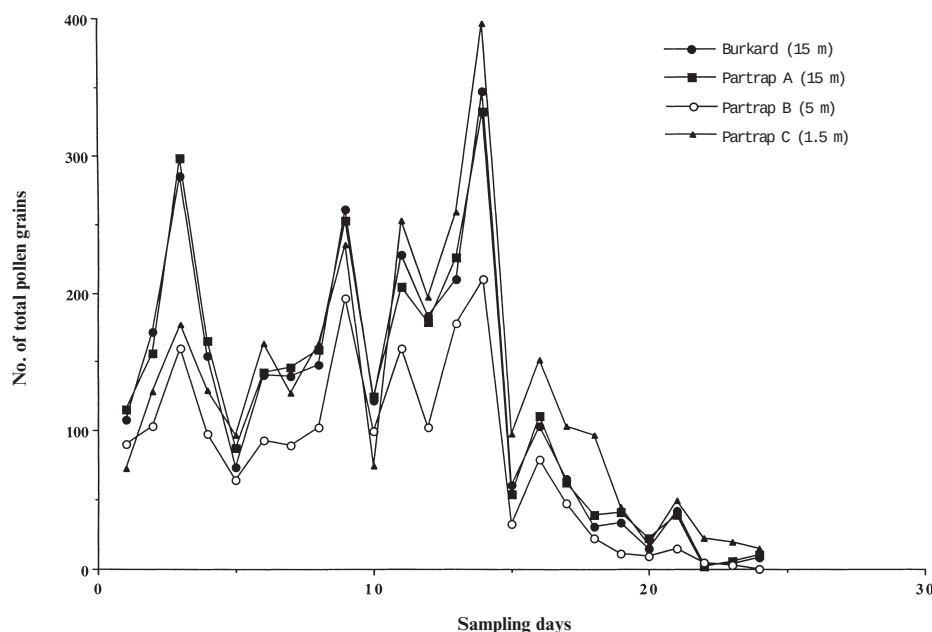


Figure 1. Total pollen count by airborne particle collectors in period March–Oct 1997 on 10th, 20th and 30th days of each month. Pollen traps were located as follows: Burkard at 15 m above ground, Partrap A at 15 m, Partrap B at 5 m, and Partrap C at 1.5 m. Horizontal axis shows sampling days as follows: 1, 2, 3=10, 20, 30 March, respectively; 4, 5, 6=10, 20, 30 April; 7, 8, 9=10, 20, 30 May; 10, 11, 12=10, 20, 30 June; 13, 14, 15=10, 20, 30 July; 16, 17, 18=10, 20, 30 Aug; 19, 20, 21=10, 20, 30 Sept; 22, 23, 24=10, 20, 30 Oct.

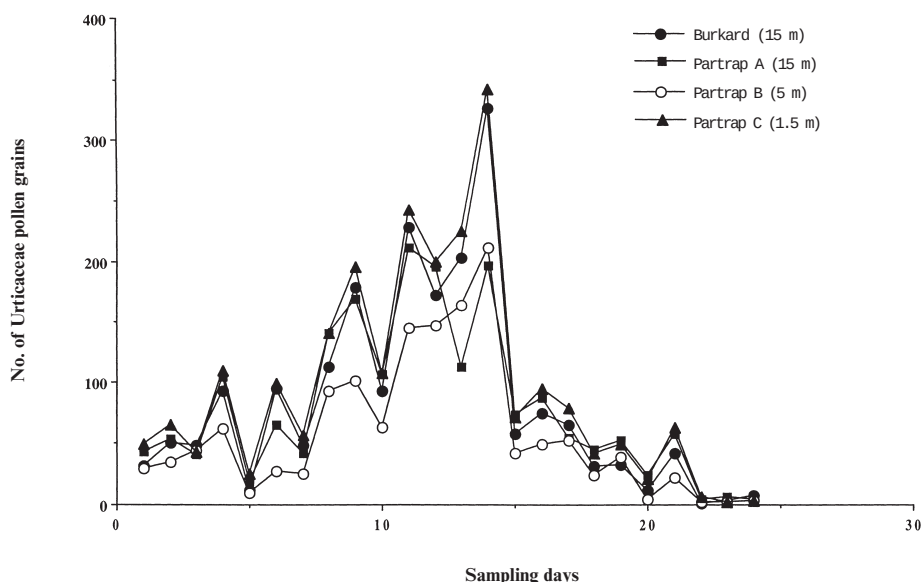


Figure 2. Urticaceae pollen concentrations in atmosphere during pollination season. Pollination spike was observed on 14th day of sampling (20 July). Pollen traps were located as follows: Burkard at 15 m above ground, Partrap A at 15 m, Partrap B at 5 m, and Partrap C at 1.5 m.

Aerobiology is a multidisciplinary science that studies the nature and characteristics of biologic particles dispersed in the atmosphere.

Pollen trapping is usually done with fixed pollen traps located on the top of buildings. This approach to pollen detection has increased our knowledge of pollination periods of allergenic plants in many geographic areas; as a result, the widespread construction of aeropollinic calendars has added

a useful tool to prevention, diagnosis, and therapy in the management of respiratory allergic diseases (1–4).

In recent years, portable pollen traps such as Partrap FA 52 (Coppa Biella, Italy) have been available (5–7). They are characterized by small dimensions and low cost, and can be placed where ever it is important to detect pollen concentrations. They are also easy to carry and to use, although, when used for personal monitoring, they may present some

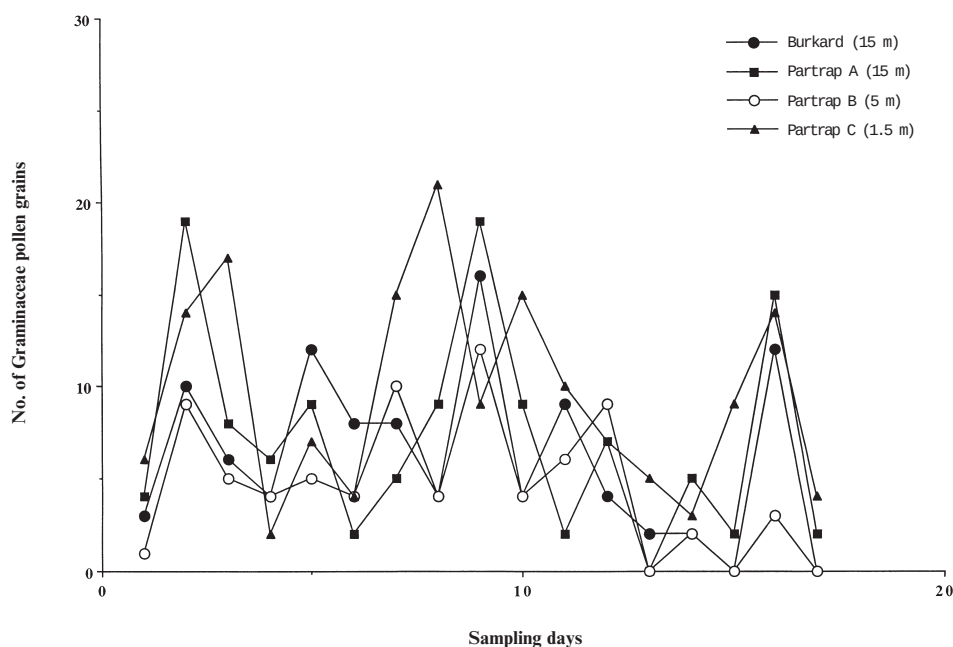


Figure 3. Graminaceae pollen concentrations in atmosphere during pollination season. Pollination spikes were observed on day 2 of sampling (20 March) for Partrap A and day 8 of sampling (20 May) for Partrap C. Pollen traps were located as follows: Burkard at 15 m above ground, Partrap A at 15 m, Partrap B at 5 m, and Partrap C at 1.5 m.

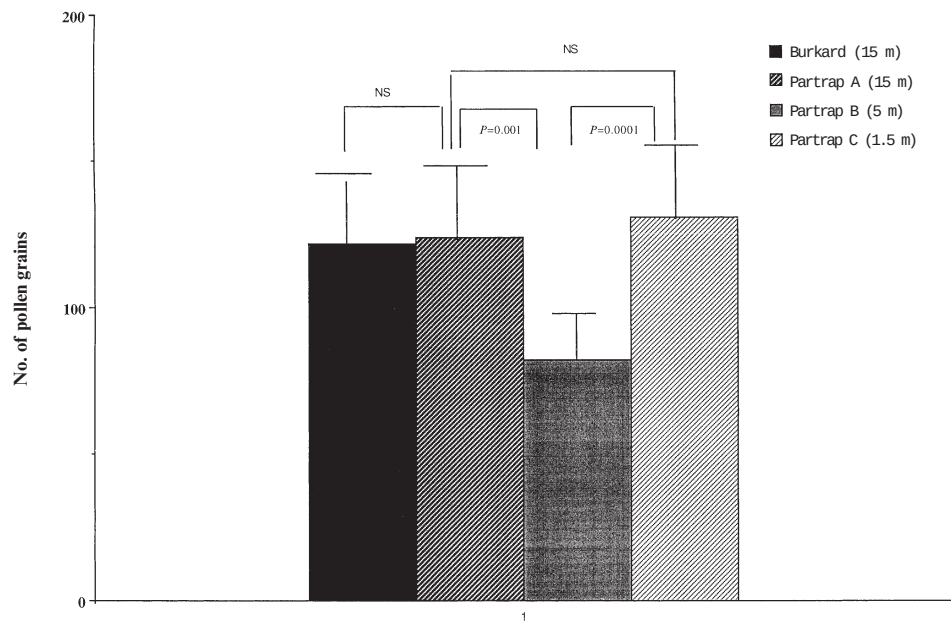


Figure 4. Total pollen count by Burkard at 15 m above ground, Partrap A at 15 m, Partrap B at 5 m, and Partrap C at 1.5 m.

disadvantages such as noise (moderate) during sleeping hours, or a minor obstacle to the practice of particular activities (such as sports).

Detection with fixed pollen traps provides information about pollen concentrations over a wide area at a certain elevation above the ground.

Since it is important to know also the real pollen exposure at the human level, the use of these new portable devices seems to be important for this purpose.

Previous studies have reported that differences exist in pollen concentrations when samplings are performed at the same time at different heights above the ground (9–14).

In this study, we compared the pollen concentrations at different heights with one Burkard fixed trap (15 m) and three Partrap FA 52 devices (at 1.5, 5, and 15 m, respectively). The pollen trap placed at 5 m collected a lower number of pollen grains than the other two, considering

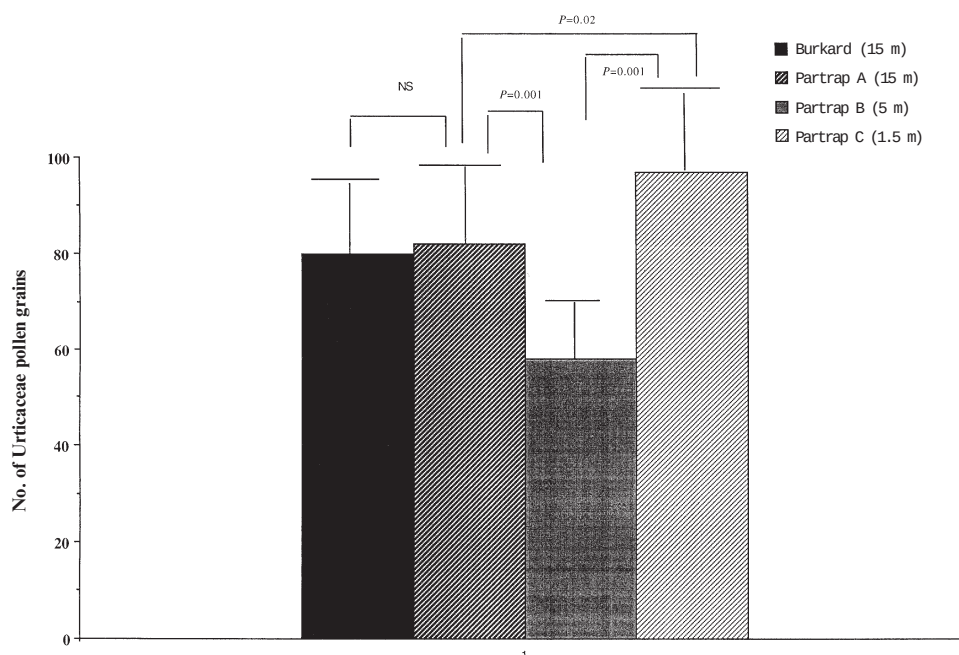


Figure 5. Urticaceae pollen count by Burkard at 15 m above ground, Partrap A at 15 m, Partrap B at 5 m, and Partrap C at 1.5 m.

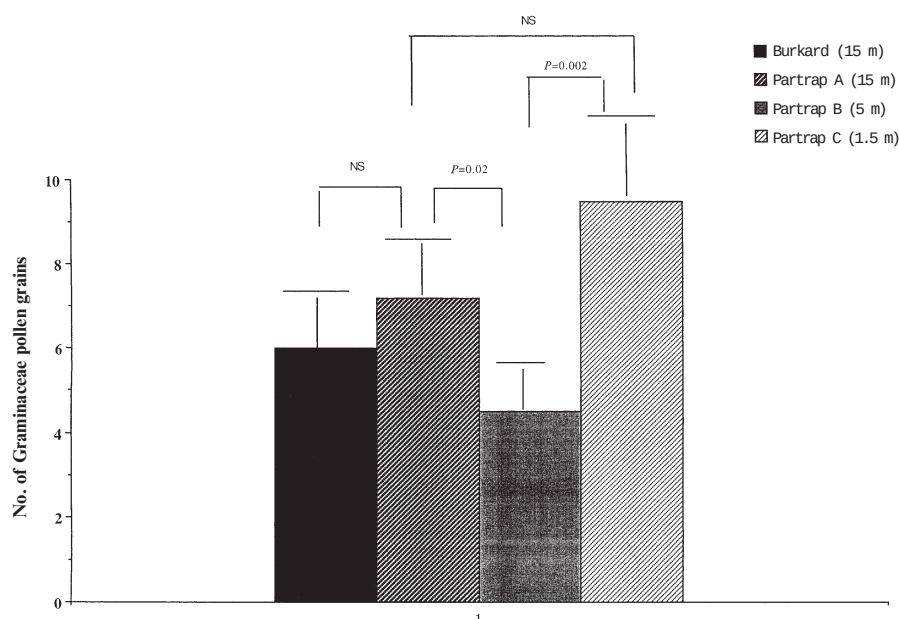


Figure 6. Graminaceae pollen count by Burkard at 15 m above ground, Partrap A at 15 m, Partrap B at 5 m, and Partrap C at 1.5 m.

both the total amount of pollen and the different kinds of aeropollinic granules collected.

The results we obtained demonstrated no significant differences in either the total or differential pollen count between Burkard and Partrap FA 52 located next to each other at 15 m, confirming the reports of previous studies and demonstrating the efficacy of the portable device used.

Concentrations of Urticaceae pollens were significantly higher at 1.5 m than at 15 and 5 m. On the contrary, pollen concentrations of Corylaceae, Oleaceae, and Cupressaceae were higher at 15 than at 1.5 m, while the Graminaceae pollen concentration did not differ significantly between the samplings performed at 15 and 1.5 m.

These data confirm that differences exist between samplings performed at different heights above the ground, particularly between the human level and the

height at which aeropollinic sampling is usually done to compile aeropollinic calendars.

In summary, it is important to note the great utility and the reliability of collection by the stable pollen traps, which remain the reference standard for airborne samplings to obtain data about pollen concentrations in a geographic area. Nevertheless, detection at the human level may provide further information on the real allergenic pressure on sensitized patients. This kind of pollen detection may be of interest for future investigations on the pollens that play the most important role in particular patients and may be used to establish the threshold concentrations for triggering clinical manifestations in different subjects during their daily life.

These observations should be useful in clinical medicine for more precise diagnosis and prophylaxis of respiratory allergies.

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