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The pollator: a personal pollen sampling device

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Dear Editors,

Background

No reliable data exist on the amount of airborne pollen and fungal spores individuals are actually exposed to in their day to day life.

In past and current trials the exposure is usually extrapolated using pollen measurements from stationary pollen traps on the roof of nearby buildings. These measurements, and to a much lesser degree, such extrapolations, do not reflect actual individual pollen exposure levels [1].

To track individual pollen exposure, the actual air breathed has to be analyzed continuously over several days for the pollen content (type and quantity). Since, for various reasons, a non-invasive measurement of allergenic particles in the air immediately in front of the upper airways (probably 2 dm³ around the mouth) is problematic, the best feasible solution is to measure the particle concentration in close proximity to the upper airways, whilst not hindering or disturbing the individual wearing the device. Even though re-

sults may still differ from what is in the breathable air, the results would be more significant than the current practice of extrapolation remote pollen counts, and it is assumed that they will strongly correlate with the individuals' symptoms.

Besides knowing the pollen exposure itself, it is also vital to evaluate accessible environmental parameters like humidity and temperature, which are known to influence symptoms and the individual's evaluation of the same.

Methods

To get as close as possible to the solution of the problem mentioned above, a personal particle sampler (PPS, Pollator) was developed (Fig. 1). The sampler is a wearable device of approximately 2.4 cm by 2.4 cm by 14.8 cm, weighing 93.0 g and can sample air up to 6 l/min. The sampled air is guided to a particle adhering strip which is located in an exchangeable



Fig. 1 **a** The Pollator with exchangeable cartridge. **b** The position of the Burkard trap and Pollator for comparative measurements

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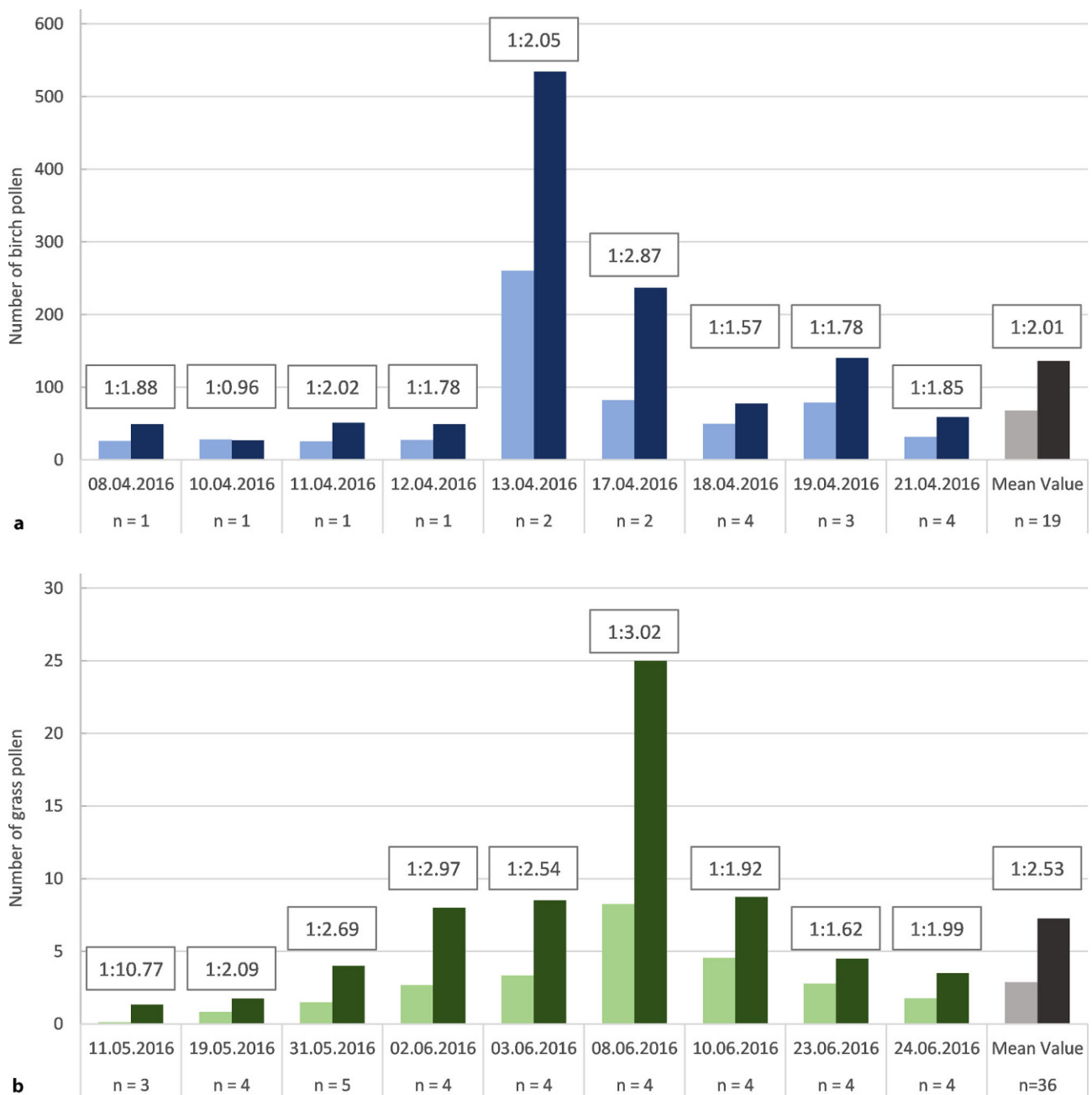


Fig. 2 Comparison of the average bi-hourly concentrations (n/m³) of (a) birch pollen and (b) grass pollen between the Pollator (lighter color) and Burkard trap (darker color) during 9 days

in April or May and June at the Charité station. The framed numbers above each bar represent the ratio of the two methods for the day; n = number of bihourly values for the day

cartridge. The sampler is powered by a battery with a capacity of 1 Ah, enabling the PPS to sample for up to 16 h, with the possibility to adjust sampling intervals. The PPS is equipped with sensors for temperature, relative humidity and barometric pressure and can also incorporate a GPS sensor.

Data can be recorded continuously and downloaded via USB. The corresponding PPS App includes the possibility to download and view the recorded sensor information, see the battery and cartridge status and get notified when the battery has to be recharged or the cartridge needs to be changed.

The App can also be used to record the individual's symptoms as they occur, allowing the post analysis to correlate pollen exposure type and intensity with type and severity of the symptoms and even with the location the exposure spiked.

For comparative measurements we placed one 7-day volumetric spore trap (Burkard) [4] and one Pollator (PPS) at the same site at a height of 23 m (roof top level, 52°31'38.4"N 13°22'40.5"E) in such a way that the orifices of both instruments (distance 25 cm) were always orientated equally against the wind (Fig. 1). On sunny and dry days in April, May

and June 2016 the PPS was operating parallel to the Burkard continuously for a period of 2–10 h. All exposed tapes were stained and examined under a light microscope in bi-hourly segments. Tapes from the Burkard trap were analyzed in four longitudinal lines equal to 7.1% of the exposed surface area (14 mm). The exposed hourly sections of PPS tapes (9 mm) were analyzed completely. For comparison, three pollen types (birch, grass and pine) and one spore type (*Alternaria*) were selected. The airflow was set to 13 l/min for the Burkard trap and 2 l/min for the PPS running in April and to 4 l/min for the PPS running in May and June.

Results

The daily average bi-hourly concentrations (n/m^3) of birch and grass pollen are displayed in Fig. 2 showing appropriate ratios between both samplers, whereby more pollen or spores were normally recorded by the Burkard sampler. The average ratio for birch (*Betula*) pollen between PPS and Burkard is close to 1:2.0 and for grass (Poaceae) pollen close to 1:2.5. The ratios for the different days spread within a range of 1:0.96 to 1:2.87 for birch and of 1:1.62 to 1:10.77 for grass. Burkard trap recoveries of pine (*Pinus*) pollen were 1.16:4.42 times those of the Pollator with an average of around 1.8 and of *Alternaria* spores 0.82:3.81 times those of the PPS with an average of around 1:2.1 (results not shown). Decreasing as well as increasing quantities recorded by one device were in most cases also matched by the other device (with the exception of birch pollen for the 10th–12th of April), especially for maximum concentrations.

Discussion

For evaluation purposes the new particle sampling device (PPS) was compared with a standard Burkard trap under outside conditions to demonstrate the general suitability for the detection of airborne particles in adequate amounts [2, 3]. We conclude that the results of both methods are comparable especially when considering the regularities in increasing and decreasing counts of airborne pollen and *Alternaria* spores.

A certain sampling ratio between these two devices was detected, leading to a possible conversion factor if more data will be obtained. The mean particle concentration/ m^3 recorded by the Burkard was between 1.8 and 2.5 times greater on average than those recorded by the PPS. The different aspiration characteristics (13 l to only 2 or 4 l/min and different orifice designs) may lead to different sampling efficiencies, since weather conditions like wind speed and direction, as well as size, specific weight and aerodynamics of sampled particles influence collection efficiency [5, 6]. In cases of pollen types or spores usually appearing in low numbers, the lower sampling efficiency of the PPS can be addressed by a greater flow rate of e. g. 4 instead of 2 l/min.

The Pollator provides a potential new technology possibly capable of enabling the evaluation of an individual's pollen threshold, thereby permitting an accurate forecast of their symptoms and allowing a better assessment of immunotherapy in field trials.

Conflict of interest T. Sehlinger and E. Goergen are members of Bluestone Technology GmbH. K.-C. Bergmann is working together with Bluestone Technology GmbH. M. Werchan has no conflict of interest.

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