



## LETTER TO THE EDITOR

## Will smoking on beaches become a thing of the past? Bibione: The first smoke-free beach in Italy



Dear Editor,

Tobacco consumption has been consistently declared as the main preventable cause of morbidity and mortality in the world. Numerous scientific studies have documented the adverse health effects of second-hand smoke (SHS).<sup>1,2</sup> The dangers of SHS, even for those exposed to it outdoors, are well known,<sup>3,4</sup> but outdoor smoking bans are rare.<sup>5</sup>

In order to protect people and the environment, the Municipality of Bibione, a popular seaside tourist destination near Venice (Italy), introduced a smoking ban for the whole beach, except for specially designated smoking areas. This pioneering initiative in Italy, and one of the few in Europe to ban tobacco on beaches, was acknowledged by the WHO.<sup>6</sup>

Demonstrating a significant improvement in air quality following the introduction of the Bibione beach smoking ban presented significant challenges: to accurately evaluate the air quality before and after the ban, it would have been necessary to install several fixed pollution monitoring stations along kilometers of beach with hundreds of parasols and this was not technically possible. Each monitoring station would have needed an electrical power supply with electrical cables laid all along the beach where people normally walk barefoot presenting an unacceptable safety risk.

Therefore, we engineered an alternative solution: “hunting” for cigarette smoke pollution on beaches using personal portable analyzers. Fixed instruments were deployed on a terrace and on a roundabout for comparison.

The measurement of Black Carbon (BC) was used to detect the level of outdoor SHS pollution because previous studies had demonstrated a very high sensitivity to biomass combustion when measurements are performed at 370 nm, whereas fossil combustion is measured at 950 nm.<sup>7</sup>

The instruments we used were:

- portable aethalometer model AE51 (Aethlab), factory calibrated to measure BC at 370 nm, programmed with 1 s sampling time carried by the researcher at nose level;
- fixed aethalometer model AE31 (Magee Scientific), factory calibrated to measure BC on seven channels from

370 to 950 nm programmed with 2 min sampling time, installed at 10 m height on a terrace at about 50 m from a roundabout at the entrance of the Bibione town, which represents a sort of background.

- fixed sensor for wind direction and velocity model Kestrel 4500 programmed, with 2 min sampling time, battery supplied, installed at the seashore.

The BC measurements on the beach and on the roundabout were performed before and after the ban. After the installation of the fixed instruments (on a terrace and at a roundabout), the researchers equipped with the portable BC analyzer started wandering among the beach parasols, stopping only when they perceived the smell of cigarette smoke, trying to locate the source, and identify the distance and number of smokers. Considering that the cigarettes diffusion plume, with the measured wind speed of  $2.7 \pm 1.0$  m/s is almost horizontal, and that one average cigarette emission rate is about 1.43 mg/min,<sup>8</sup> we estimated that the Black Carbon Ultra Violet (BCUV) measurements would detect SHS even at several meters downwind from smokers.

Averages of BCUV were calculated for the different sites and periods of measurements, and *t*-test was applied to evaluate the differences.

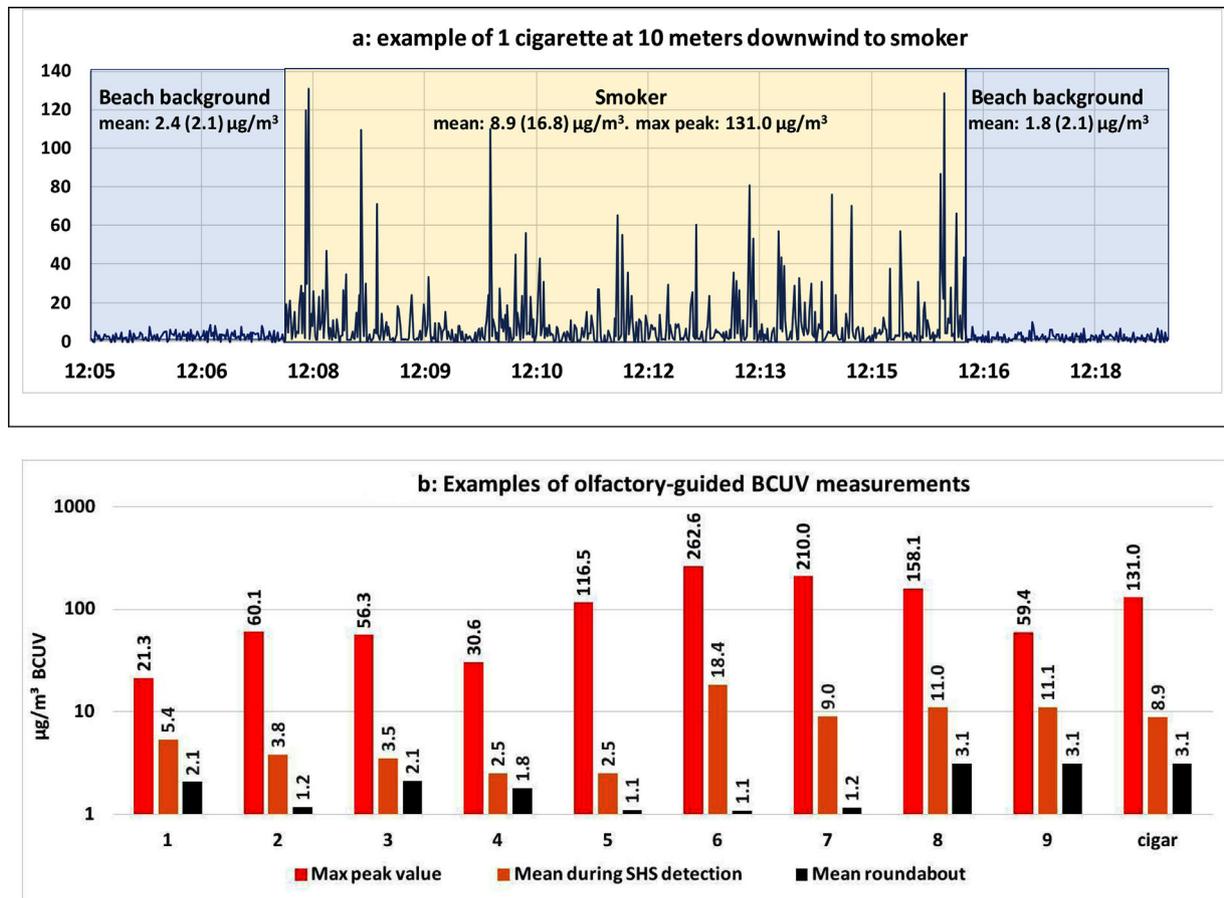
**Before the ban** SHS concentrations generated by smokers under parasols were detected at variable distances between 3 and up to 4–15 m downwind and were characterized by short, frequent, and also some extremely high BCUV peaks, detected simultaneously with the SHS odour. Fig. 1a shows an example of the BCUV measurement where it is possible to count the smoker puffs (each peak corresponds to one puff).

Since the distance between umbrellas is four meters, all those under three to four umbrellas located downwind are exposed to SHS. As can be seen in Fig. 1b, in all tests the mean BCUV concentration levels measured downwind of the smokers is higher than those measured at the traffic crossing site within the same time window ( $8.1 \pm 5.4$  vs  $2.0 \pm 2.0$   $\mu\text{g}/\text{m}^3$ , *p*-value = 0.02).

**After the ban** no SHS was detected by the BCUV and by olfactory sensation during the wandering of the researchers on the beach, with the exception of downwind to the four special smoking sites located far away from the umbrellas zone, and therefore there are no data to report.

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**Fig. 1** (a) Examples of one cigarette at ten meters downwind to smoker. (b) Examples of olfactory-guided BCUV measurements. Despite the limited number of BCUV measurements, the results of our study demonstrate that, a significant improvement in the air quality was achieved on the beach after the introduction of the smoking ban.

## Conflicts of interest

The authors have no conflicts of interest to declare.

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- C. De Marco<sup>a</sup>, A.A. Ruprecht<sup>b</sup>, A. Borgini<sup>b,c,\*</sup>, P. Contiero<sup>c</sup>, A. Di Paco<sup>d</sup>, C. Veronese<sup>e</sup>, P. Paredi<sup>f</sup>, A. Tittarelli<sup>g</sup>, R. Boffi<sup>e</sup>
- <sup>a</sup> *Diagnostics and Molecular Research Unit, Fondazione IRCCS Istituto Nazionale dei Tumori, 20133 Milan, Italy*  
<sup>b</sup> *International Society of Doctors for Environment (ISDE), 52100 Arezzo, Italy*  
<sup>c</sup> *Environmental Epidemiology Unit, Fondazione IRCCS Istituto Nazionale dei Tumori, 20133 Milan, Italy*  
<sup>d</sup> *Respiratory Pathophysiology, Casa di Cura San Rossore, 56122 Pisa, Italy*  
<sup>e</sup> *Respiratory Diseases Unit, Fondazione IRCCS Istituto Nazionale dei Tumori, 20133 Milan, Italy*  
<sup>f</sup> *Airway Disease Section, National Heart and Lung Institute, Imperial College, London, UK*

<sup>§</sup> *Cancer Registry Unit, Fondazione IRCCS Istituto Nazionale dei Tumori, 20133 Milan, Italy*

\* Corresponding author at: Environmental Epidemiology Unit, Fondazione IRCCS Istituto Nazionale dei Tumori, via Venezian 1, 20133 Milan, Italy.

*E-mail address:* [alessandro.borgini@istitutotumori.mi.it](mailto:alessandro.borgini@istitutotumori.mi.it) (A. Borgini).

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