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[Real-Time Measurement of Outdoor Tobacco Smoke Particles](#)

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Abstract:

The current lack of empirical data on outdoor tobacco smoke (OTS) levels impedes OTS exposure and risk assessments. We sought to measure peak and time-averaged OTS concentrations in common outdoor settings near smokers and to explore the determinants of time-varying OTS levels, including the effects of source proximity and wind. Using five types of real-time airborne particle monitoring devices, we obtained more than 8000 min worth of continuous monitoring data, during which there were measurable OTS levels. Measurement intervals ranged from 2 sec to 1 min for the different instruments. We monitored OTS levels during 15 on-site visits to 10 outdoor public places where active cigar and cigarette smokers were present, including parks, sidewalk cafés, and restaurant and pub patios. For three of the visits and during 4 additional days of monitoring outdoors and indoors at a private residence, we controlled smoking activity at precise distances from monitored positions. The overall average OTS respirable particle concentration for the surveys of public places during smoking was approximately $30 \mu\text{g m}^{-3}$. OTS exhibited sharp spikes in particle mass concentration during smoking that sometimes exceeded $1000 \mu\text{g m}^{-3}$ at distances within 0.5 m of the source. Some average concentrations over the duration of a cigarette and within 0.5 m exceeded $200 \mu\text{g m}^{-3}$, with some average downwind levels exceeding $500 \mu\text{g m}^{-3}$. OTS levels in a constant upwind direction from an active cigarette source were nearly zero. OTS levels also approached zero at distances greater than approximately 2 m from a single cigarette. During periods of active smoking, peak and average OTS levels

near smokers rivaled indoor tobacco smoke concentrations. However, OTS levels dropped almost instantly after smoking activity ceased. Based on our results, it is possible for OTS to present a nuisance or hazard under certain conditions of wind and smoker proximity.

Implications:

This article is the first peer-reviewed publication of systematic measurements of OTS concentrations. The main conclusion from these data, that OTS levels can be substantial under certain conditions, is vital to the development of outdoor tobacco control policy. Because adequate information on OTS levels and human exposures has previously been lacking, the estimation of health risks associated with OTS has been hindered, and public discourse concerning OTS has been impaired. The present study also has shown that continuous, portable airborne particle monitors are suitable in OTS investigations across a range of locations and environmental conditions.

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