

Distinguishing Indoor- and Outdoor-Generated Components of Residential Exposure to Air Pollutants for Improved Health Metrics

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Abstract

In recent decades, the proliferation of measurement technologies has expanded our capacity to gather environmental data from diverse sources, both indoors and outdoors. Despite these advances, innovative analytical techniques are essential to fully exploit the potential of low-cost sensor measurements and extract maximum information to avoid “exposure misclassification”. In this study, we develop a novel methodological framework involving a mass balance model to distinguish between the indoor- and outdoor-generated components of indoor air pollution. This methodology is applied to data collected from 60 portable air quality sensor platforms deployed among 250 participants during the winter and summer seasons as part of the AIRLESS (“Effects of AIR pollution on cardiopuLmonary disEaSe in urban and peri-urban reSidents in Beijing”) study in Beijing, China. Our analysis reveals that while outdoor-generated pollutants typically dominate indoor exposure, indoor sources also contribute significantly. Notably, during winter, approximately half of CO concentrations originated indoors, likely attributed to indoor combustion for heating in peri-urban areas and insufficient ventilation. Similarly, NO₂ and PM_{2.5} exhibited substantial contributions from indoor sources (30-40%), possibly originating from cooking activities. These highlight the fact that using outdoor (ambient) measurements in health studies may not deliver accurate public health associations. These findings underscore the importance of understanding the relative contributions of indoor and outdoor sources to air pollution exposure and thus health. By elucidating the limitations of ambient measurements in air pollutant epidemiology studies, our research underscores the need for detailed exposure metrics to comprehend the health implications of diverse pollutant sources in various microenvironments. Such insights can inform evidence-based public health policies aimed at mitigating both indoor and outdoor sources of air pollutants.

Early Career Scientist

YES, I am an early career scientist.

IGAC Activities

MAP-AQ: Monitoring, Analysis and Prediction of Air Quality, Allin-Wayra: Small Sensors for Atmospheric Science

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