

Characterizing Air Pollution Exposure Profiles During Active Commuting Across Urban Microenvironments

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Abstract

Exposure to traffic-related air pollution (TRAP) may negate the health benefits of active travel, especially when commuting along high-traffic routes—a concern that is particularly relevant for individuals with preexisting chronic diseases such as cardiorespiratory illness. Active commuters are particularly vulnerable to TRAP due to their proximity to vehicle emissions and prolonged exposure times. Our research focuses on the Greater Kuala Lumpur region, which faces challenges from rapid urbanization and increased motorization. We conducted comprehensive analyses of pollutant exposure across different urban settings, including walking routes in two urban cities, a school zone, and a university campus, and examined the associated cardiovascular health effects. The average levels of PM_{2.5} (73.31 µg/m³), black carbon (BC, 6.19 µg/m³), traffic noise (TN, 80.10 dB(A)), and the heat index (27.90 °C) were recorded while walking along the pedestrian zone in Kuala Lumpur. Notably, we observed that pedestrians exposed to high PM_{2.5} concentrations on heavily trafficked walking routes within the university campus (61.6 ± 14.6 µg/m³) experienced increases in systolic blood pressure and lung function, specifically forced vital capacity (FVC). Our findings indicate that the inhalation dose per kilometer traveled (DL, µg/km) is estimated higher for cyclists compared to pedestrians in urban city, school, and university walking routes, largely due to the increased ventilation rate during physical activity. However, pedestrians are also at significant risk from short-term pollution spikes, as they are often unshielded from traffic pollution sources. Our research provides local quantitative evidence that is critical for informing policy on modal shifts, as well as robust scientific data to guide transport policies that promote safer, healthier active travel. Prioritizing the development of cleaner commuting routes can yield significant public health benefits, especially in rapidly developing urban regions.

Early Career Scientist

NO, I am not an early career scientist.