

Abstract

During commuting, passengers are significantly exposed to pollutants, which constitute a significant fraction of daily personal exposures. For the past two decades, numerous studies on commuter exposure were conducted on city roads, but exposure studies on national highways are limited. This forms the basis for the research. The major objective of the research is the assessment of passengers' exposure to pollutants in different travel modes on national highways (NH) in India. During monsoon and winter long-haul studies, we assessed concentrations of PM_{2.5} and CO inside the open window public bus (Bus), open-window car (Car) and car with recirculation mode of air conditioning (Car RC) on an NH 30 and 65. Mean PM_{2.5} concentrations were highest in the Car, followed by the Bus, and lowest in the Car RC. In contrast, mean CO concentrations were highest in the Car RC (2 ± 0.9 ppm). Mean concentrations in different seating positions in Bus followed the trend: middle > rear > front. Travel mode for PM_{2.5} and in-city/out-city segments for CO explained the highest variability for pollutant concentrations. PM_{2.5} consists of soot, mineral and fly ash, which are proxies for fresh exhaust emissions, re-suspended road dust, and industrial emissions, respectively. During the summer short-haul journeys, PM_{2.5} concentrations showed the following trend: Bus > Car FA (fresh air mode of air conditioning) > Bus AC (air-conditioned bus) > Car > Car RC (recirculation mode of air condition). The concentrations were highest at the rear seats during the Bus AC journeys. In Car FA, the contribution of PM₁ to total concentrations was dominant (61%). Respiratory Deposition Doses of passengers were as high as 3.22 µg of PM₁₀ for Bus journeys.

Overall, traveling by Car RC results in the lowest PM exposures on NH, although it exposes the passenger to a high CO level. Avoiding national highways passing through cities can reduce up to 25% of PM_{2.5} and 50% of CO mass exposures. Highway authorities should focus on early completion of construction and repairing activities to reduce exposures to passengers.