



To: Place Directorate

From: Adrian Davis

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Subject: Essential Evidence on a Page 162: Air pollution exposure among motor vehicle occupants

Top line: A key concern for air pollution scientists and the broader clinical and public health community is a lack of awareness amongst the public and decision makers as to the potential high air pollution exposure levels for motor vehicle occupants. High pollutant exposure levels in urban areas, particularly under typical commute driving conditions, exposes vehicle occupants to health risks that are often significantly greater than that for those travelling by other modes.

Transport microenvironments tend to have higher air pollutant concentrations than other settings most people encounter in their daily lives. The choice of travel modes may affect individuals' exposure significantly. The literature on exposure to air pollutants by mode has reported evidence for over two decades and more researchers have studied aspects of this topic in more recent years. There are many variables to consider when assessing exposure to motor traffic generated air pollutants. Variables range widely and include types of pollutants, motorised traffic volumes, speed, occupational exposure (e.g. taxi drivers, street cleaners) and specific environmental conditions, and specific locations such as intersections. Nonetheless, past studies have repeatedly found that driving a car (or being a passenger) often provide less protection than travel by other modes.ⁱ ⁱⁱ It has been described that vehicle occupants are, in fact, driving in a 'tunnel' of pollutants.ⁱⁱⁱ

In 2017 researchers reviewed the literature on air pollution exposures in travel microenvironments in Europe.^{iv} Ten studies which measured various travel modes were selected which met the inclusion criteria. This review provided average ratios of exposures between travel modes. Studies measuring fine particulate matter (PM_{2.5}), black carbon (BC), ultrafine particles (UFP), and/or carbon monoxide (CO) in the walk, bicycle, car and/or bus modes were included in the analysis. Pedestrians were shown to be the most consistently least exposed of all across studies, with the bus, bicycle and car modes on average 1.3 to 1.5 times higher for PM_{2.5}; 1.1 to 1.7 times higher for UFP; and 1.3 to 2.9 times higher for CO. Car occupants tended to be the most exposed (from 2.9 times higher than pedestrians for BC down to similar exposures to cyclists for UFP on average). Bus exposures tended to be similar to that of cyclists, except for UFP where they were lower.

The difficulty of communicating this air pollution risk to vehicle occupants is that dangerous conditions are not necessarily visible, but are known to have many health impacts. In addition, there may be assumptions that air quality will be better inside a sealed vehicle (windows closed) than outside and that air conditioning may provide sufficient additional protection from poor air quality.

ⁱ Morabia, A., et al, 2009 Air pollution and activity during transportation by car, subway, and walking, *American Journal of Preventive Medicine*, 37(1): 72-77.

ⁱⁱ Dons, E., et al, 2012 Personal exposure to black carbon in transport microenvironments, *Atmospheric Environments*, 55: 392-398

ⁱⁱⁱ Jefferis, P., Rowell, A., Fergusson, M. 1992 *The exposure of car drivers and passengers to vehicle emissions: Comparative pollutant levels inside and outside vehicles*. London: Earth Resources Research.

^{iv} De Nazelle, A., Bode, O., Orjuela, J. 2017 Comparison of air pollution exposure in active vs. passive travel; modes in European cities: A quantitative review, *Environment International*, 99: 151-160.