To:	Transport & Health Policy Makers, & Practitioners
From:	Professor Adrian Davis
Date:	2nd September 2024
Subject:	Essential Evidence 4 Scotland No.90 Vehicle front-end height impacts on pedestrian deaths and injuries

Top Line: Taller vehicles tend to be worse for pedestrian injuries, with suggestions that a 72% increase in US pedestrian deaths is plausibly due to the dominance of larger vehicles with higher front ends being bought. A 10 cm increase in the front-end height of a vehicle increases the risk of pedestrian death by 22%.

In the US the number of pedestrians killed in vehicle crashes has risen dramatically. Between 2010 and 2021 the number of pedestrians killed annually in collisions increased by 72%, from 4300 to 7400. Since 2000, over 110,000 pedestrians have died. The increase in pedestrian deaths has occurred during a period when US motorist deaths have fallen. One plausible explanation for the increase in pedestrian deaths is increasing vehicle size. Light trucks, a class of vehicles that includes SUVs, pickups, and vans, have surged in popularity. In 2021, 78% of US new passenger vehicles sold or leased were light trucks rather than cars.[1] An early US study showed that pedestrians struck by an SUV are twice as likely to sustain brain injury as pedestrians struck by passenger cars.[2] The main source of head injuries is the bonnet in SUV collisions, but the windscreen dominates in passenger car collisions. Vehicle front-end height has consistently been linked with poor pedestrian crash outcomes. Research frequently finds that vehicles with higher bonnets leading edges produce worse crash outcomes than vehicles with lower ones.

In the UK vehicle fleet is also getting larger. This is also notably as a result of increased ownership of Sports Utility Vehicles (SUVs) some of which are electric cars, an increase in Light Goods Vehicles, and an overall trend of a general increase in vehicle size. This has been termed 'autobesity'.[3] As in the US, there has been growing concern about the role of increased vehicle size in exacerbating pedestrian injuries when compared with conventional passenger cars. Casualty data have shown that in pedestrian collisions with high-fronted vehicles (SUVs and vans) the risk of pedestrian head injuries from the contact with the ground is higher than with low-fronted vehicles (passenger cars). Impact speed and pedestrian height are considered in these studies.

Consistent with such research, a recent US found that taller vehicles were more dangerous to pedestrians compared with shorter ones, largely because of a tendency to inflict more severe head injuries.[4] However, the inclusion of bumper lead angle provided important nuance to the vehicle height finding: vehicles that were both tall and blunt were particularly dangerous to pedestrians. The elevated risk from tall, blunt vehicles was rooted in their tendency to injure pedestrians' torsos and hips with their front ends directly upon impact rather than rolling them upward onto the hood and inflicting injury there. Relatedly, tall/blunt vehicles were much more likely to injure pedestrians by throwing them forward while tall/sloped vehicles were slightly more likely to briefly roll pedestrians onto the hood before throwing them forward. These effects clarify the long-held finding that tall vehicles pose an out-sized risk to pedestrians and suggest that a blunt front end can magnify the risk from front-end height. New US research finds that a 10 cm increase in the front-end height of a vehicle increases the risk of pedestrian death by 22%. By contrast, it is estimated that a cap on front-end vehicle heights of 1.25 m would reduce annual US pedestrian deaths by 509.[5]

[1] Tyndell, J. 2024 The effect of front-end vehicle height on pedestrian death risk, *Economics in Transportation*, 37: 100324

[2] . Ballesteros, M., Dischinger, P., Langenberg, P. 2004 Pedestrian injuries and vehicle type in Maryland, 1995–1999. *Accident Analysis & Prevention*, 36 (1), 73–81

[3] Autobesity - Wikipedia

[4] Monfort, S., Hu, W., Mueller, B. 2024 Vehicle front-end geometry and in-depth pedestrian injury outcomes, *Traffic Injury Prevention*, 25:4, 631-639.

[5] Tyndell, J. 2024 Op cit.