



# Policies and Interventions to Provide Safety for Pedestrians and Overcome the Systematic Biases Underlying the Failures

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Road transport is failing pedestrians more than other road users. For pedestrians, roads are not safe or improving: Globally pedestrian deaths have increased at nearly twice the rate of other road crash deaths (12.9% increase from 2013 to 2016, vs. a 6.6% increase for other road users). Pedestrians commonly lack safe crossings, safe speeds, and in many locations, footpaths. This paper briefly identifies successes and failures for pedestrian safety, reviews weaknesses, and limitations to actions for pedestrian safety, and identifies barriers to effective action. Barriers include current culture on road usage, victim blaming, under-estimation of the pedestrian crash death problem in particular, and other crash data issues. Advocacy, policies, and actions are recommended to overcome these barriers and to improve pedestrian safety.

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## INTRODUCTION

Road crashes kill 1.35 million people and injure up to another 50 million each year (WHO, 2015, 2018). Over 90% of road crash deaths occur in Low- and Middle-income countries (LMICs) (WHO, 2018). Road safety is recognized in the United Nations (UN) Sustainable Development Goal (SDG) 3.6, with a target of halving road crash deaths by 2020. The UN also designated 2011–2020 as the UN Decade of Road Safety and developed the Global Plan for the Decade (WHO, 2011).

The ambitious targets set for the Decade of Action and the SDG target will not be met [Global Network for Road Safety Legislators, 2018; Job, 2018], except perhaps now through the dramatic reductions in road usage and thus risk exposure created by the coronavirus pandemic, COVID-19 (Carrington, 2020; Job, 2020). Nonetheless, there have been clear successes during the UN Decade including a stemming of the increase in road crash deaths. Pedestrian safety is a key limiting factor in the Decade, demanding more specific attention and funding.

Pedestrian safety and amenity are litmus tests of road transport sustainability in cities. Pedestrians are a vital part of the road transport system: for almost everyone road transport journeys begin and end with walking. Public transport via mass transit increases safety with appropriate buses providing dramatically lower rates of death per million passenger-kilometers than cars and especially motorcycles (Sustainable Mobility for All, 2017). Mass transit reduces greenhouse gas emissions (GHGs), increases transport efficiency, and allows for greater inclusion in the system than do less affordable private vehicles, especially in LMICs. Thus, public transport

is a vital part of the delivery of more sustainable transport (defined as safe, green, inclusive, efficient transport: Sustainable Mobility for All, 2017). Public transport requires more walking than private vehicle transport. Therefore, provision of safe public transport must include provisions of safe pedestrian facilities to allow people to walk at both ends of their public transit journey. In addition, walking is an active form of transport helping to address the epidemics of obesity and cardiovascular disease as well as other health issues. By replacing motorized vehicle travel, walking reduces fossil fuel use, GHGs, noise pollution itself a major cause of mental and physical ill-health (Job, 1996; WHO, 2011), and congestion.

## Global Pedestrian Safety Performance

Despite these visible values of pedestrian movement in sustainable transport, despite the urgent need for improvement based on transport being the only sector not to improve in GHGs (Sustainable Mobility for All, 2017), and despite the worsening global road safety situation (Wambulwa and Job, 2019) and the looming failure to meet the Sustainable Development Goal target of a 50% reduction in deaths (except possibly via the travel restrictions and other impacts of disaster of COVID-19: Job, 2020), safe pedestrian amenity is not being developed as might reasonably be expected. Rather, pedestrian safety is deteriorating at a faster rate than road safety for other road users: Analysis of data from the last two WHO (2015, 2018) reports, reveals that the increase in pedestrian deaths is almost double that of other crash deaths (12.9% increase vs. a 6.6% increase). The latest estimate amounts to 850 pedestrian deaths per day globally, and this is an underestimate (see later analysis). Pedestrians have nine times the risk of death of car occupants on a per km of travel basis (Sustainable Mobility for All, 2017).

High-income countries commonly are seeing worsening death rates for pedestrians while deaths for other road user groups decline. In the United States, from 2008 to 2018, pedestrian deaths increased by 41% while deaths for other road users decreased by a modest 7% - a problem which is at least receiving some media and research attention (Chong et al., 2018; Hu and Cicchino, 2018; Baker, 2019). In many high-income countries, pedestrians are an increasing percentage of road crash deaths: In France, pedestrians increased from 12% of road crash deaths in 2010 to 16% in 2016, in Germany the increase was from 13 to 15%, and in Australia 13 to 15% (WHO, 2015, 2018).

## SUCCESS IS POSSIBLE

The failure to reduce pedestrian deaths is not attributable to the absence of effective interventions. Many proven interventions exist, particularly within a safe system context. The safe system approach begins by admitting that humans will inevitably make mistakes and aiming to design, build, and operate a road transport system which accommodates those errors by limiting forces to those which the human body can withstand without causing death or major injury (Belin, 2016; Job, 2018). It has delivered major road safety successes (Carlsson, 2009; Mooren et al., 2011).

For pedestrians the evidence for the need for a safe system approach is compelling. Pedestrians (as well as cyclists and motorcyclists) are less protected than other road users with no surrounding metal shell or airbags, and thus require more accommodation within the safe system. Both drivers and pedestrians inevitably make mistakes which cause deaths and disabilities. Pedestrians include those more likely to make mistakes- children, those with dementia, those who are impaired by alcohol or drugs or distraction, or particular personalities and perhaps even particular socio-economic circumstances (Gorrie et al., 2008; Klaitman et al., 2018; Lucidi et al., 2019). Reliance on improving pedestrian and driver behavior will not deliver a safe system.

Examples of proven successes for pedestrians include basic elements such as provision of footpaths, yet iRAP surveys show that 80% of roads where pedestrians are present do not have usable footpaths (Turner and Smith, 2013). The "Pedestrian Manual" (Bartolomeos et al., 2013, p. 63–65) identifies 18 interventions which are proven to be effective for pedestrian safety, including: signals, footpaths, lighting, speed management through engineering (traffic calming; Job and Sakashita, 2016), and road narrowing (with relevant research in a middle income country showing relevance: Mukherjee and Mitra, 2019), effective laws and enforcement on speeding (Job and Sakashita, 2016), and on drink-driving (Job et al., 1997; Freethy, 2015), improved vehicle standards for pedestrian impacts, and improved post-crash response.

## PEDESTRIANS AND THE UN DECADE

### Effective Actions

The global road safety community and others have advocated strongly for safety of vulnerable road users, and pedestrians in particular [see the International Federation of Pedestrians (2019); Where the walk starts (2019) for advocacy and lists of pedestrian advocacy organizations]. The website of the Pedestrian Council of Australia (2019) begins with a systemic approach couched as: "Safety-Amenity-Access-Health." America Walks (2019) also provides a sound approach with tools for advocacy for systemic change. The International Road Assessment Program, the Global Road Safety Facility, and others have been strong advocates for pedestrian safety, noting the common absence of pedestrian sidewalks where pedestrians are present (iRAP, 2017; Wambulwa and Job, 2019), and the vital role of safe speeds for pedestrians (Job and Sakashita, 2016; Job, 2018). Evaluation of pedestrian risk, provision of footpaths, safe (and specifically speed-managed) crossing facilities, and safe speeds for pedestrians are all integral elements of the guidance for the World Bank's Environmental and Social Framework which recently added requirements covering road safety as part of these "safeguards" (World Bank, 2018, 2019).

Detailed manuals and other documents have been prepared to guide development of safety for pedestrians, including a pedestrian safety manual (Bartolomeos et al., 2013), the National Association of City Transportation Officials (NACTO) (2013) *Urban Street Design Guide*, and the *Safe and Sustainable* guide (Welle et al., 2018).



**FIGURE 1** | Traffic calming: Narrowed lane and speed humps for a 20 km/h limit on a residential road in Switzerland, and speed tables either side of a pedestrian crossing in Senegal (Source: photos by the author).



**FIGURE 2** | Speed humps installed by the community: a dirt speed hump in Africa and a rope speed hump in Latin America (Source: photos by the author).

Numerous countries have adopted more of the actions identified above for pedestrian safety including safe speed limits for pedestrians, speed managing infrastructure, and safer amenities for pedestrians to cross-roads (but note limitations of breadth in the next section). see **Figure 1** for an example of road narrowing, speed humps, and a 20 km/h speed limits for a residential street in Switzerland, and speed tables on approach to a pedestrian crossing in Senegal.

### Lack of Effective Action

Despite the advances noted above, the extent of adoption of strong safety policies and infrastructure has been quite limited, especially for pedestrian safety. The limited development of pedestrian safety is readily identified on our global road network almost anywhere. High speed road bisecting cities often are not designed for pedestrians to cross at all except at pedestrian bridges which, if they exist at all, are commonly over 2 km apart, forcing long walks to use them, and often only cater for the most able bodied people; Marked crossing are ignored by drivers in many countries; The vast majority of marked pedestrian crossing points are not supported by speed managing infrastructure in HICs or LMICs; Many points where pedestrians often cross do not have marked crossing [for examples, see Bartolomeos et al. (2013)]; in LMICs most locations where pedestrians walk do not have footpaths (Turner and Smith, 2013).

Speed is so inadequately managed that many people appreciate the relevance of speed to pedestrian safety, want speeds managed in their neighborhoods, and have acted directly

to achieve this by installing their own speed humps (for examples see **Figure 2**).

### FACTORS UNDERLYING THE LACK OF ACTION FOR PEDESTRIAN SAFETY

Understanding of the factors behind the global systemic failure to effectively address pedestrian safety and amenity is vital to efforts to overcome the barriers to action and allow better safety improvement.

This systemic failure is, in part, due to many general challenges for road safety, which are only briefly described here, with pedestrian specific issues described in more detail. General challenges for road safety include profoundly the lack of political ownership of the issue. Road safety lacks political salience, which has never been more visible than during the novel coronavirus (COVID-19) outbreak which led to adoption of safer policies such as lower speed limits in order to free up hospital beds for COVID-19 cases. This gives visibility to the acknowledgment that existing speeds are causing serious injuries (and deaths) yet these are not being addressed for themselves until they risk limiting treatment of COVID-19 cases. Related to the lack of political buy-in for road safety, funding is inadequate for the size of the problem, and resources are wasted on ineffective actions (including broad school-based education on road safety and driver training) in place of sound evidence-based opportunities. Perhaps because education and training are recognized as effective in other arenas of life, they are broadly adopted in

road safety despite extensive credible recent and long-standing evidence for lack of effectiveness. A systematic Cochrane Library review of school-based driver training concluded that the results “provide no evidence that driver education reduces road crash involvement and suggest that it may lead to a modest but potentially important increase in the proportion of teenagers involved in traffic crashes.” [Roberts and Kwan (2001); see also O’Neill (2020)]. Similarly, negative results have been shown for post-license driver training (Ker et al., 2003) and even motorcycle rider training (Kardamanidis et al., 2010; Ivers et al., 2016). There is one form of novice driver training which does appear to be effective (see Gregersen et al., 2003) which is being adopted in some HICs countries.

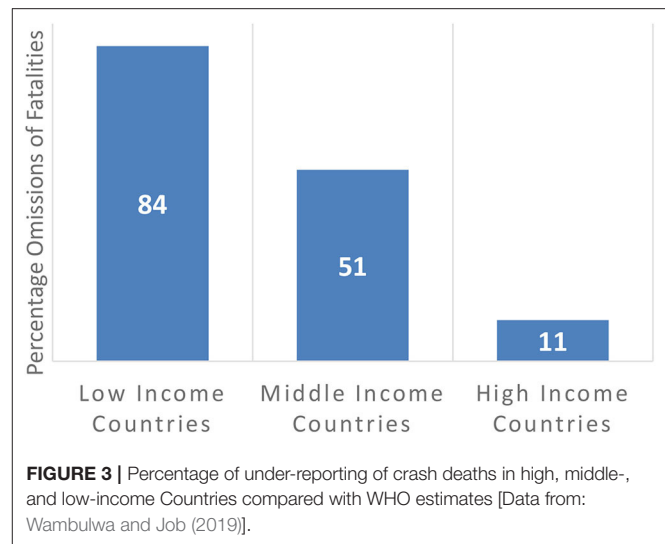
Nine key underlying factors of the failure to deliver safety particularly for pedestrians are described below.

First, *the growing benefits of passive safety of vehicles are primarily helping vehicle occupants not pedestrians.* Improvements attributable to stronger regulation and market forces driven by the New Car Assessment Program (Global NCAP) have led to great safety for vehicle occupants, whereas the safety improvement from these developments is much smaller for pedestrians. Although vehicle designs which reduce risk for pedestrians in the event of a crash exist and have been refined over many years (Chen et al., 2020), various high-income countries with otherwise strong vehicle standards for road safety have not regulated for vehicle pedestrian protection.

Second, *the benefits of autonomous braking systems rely on detection, and pedestrian detection may be less effective.* Autonomous braking offers the opportunity to save many deaths and injuries. However, the detection systems on which benefits depend can often miss pedestrians and thus the benefits for pedestrians predicted by advocates are an over-estimate (Combs et al., 2019). It is no coincidence that the first fatality involving an automated vehicle was a pedestrian.

Third, *the growth of 4-Wheel Drive and Sports Utility Vehicles (4WD and SUVs) is harmful for pedestrian safety.* In the United States, Australia, and other countries, the growth of these vehicles has outpaced the growth of cars. SUVs and 4WD vehicles have high fronts which cause more serious injuries to pedestrians in the event of a crash. Thus, the growth of these vehicles is a key cause of the lack of progress on pedestrian safety (Hu and Cicchino, 2018; Keall et al., 2018; Su, 2019).

Fourth, *e-mobility is taking footpaths putting pedestrians at risk.* There are challenges which appear to be increasing for the future of pedestrian safety, and the safety value of the smart city concept is questionable (Lytras and Visvizi, 2018). While forms of mobility such as e-scooters and e-bikes may reduce fossil fuel use and greenhouse gas emissions (depending on from which form of transport they draw customers), they are commonly used on footpaths even where this is not legal (Consumer Reports, 2019) and in some locations are allowed on footpaths legally and banned from roads (Haworth and Schramm, 2019). The use of these vehicles on footpaths erodes pedestrian amenity and compromises pedestrian safety, including crashes between these e-mobility devices and pedestrians (Sikka et al., 2019). More extensive consideration of the safety and amenity compromises of these



mobility forms is urgently needed, perhaps including dedicated spaces for e-mobility.

Fifth, *the extent of pedestrian death and injury is systemically under-estimated.* Under-reporting of deaths and injuries is extensive in many LMICs, as shown by the large discrepancies between official data for countries vs. both WHO estimates and Global Burden of Disease estimates of deaths (see **Figure 3**). The under-reporting of pedestrian crashes is a long-recognized problem (Morrison, 1992), and not yet solved. Most relevant to the current issue is that under-reporting of crashes is systematically biased by crash type, with crashes involving vulnerable road users including pedestrians being less likely to be reported than other crashes of similar severity (Dandona et al., 2008; Kira et al., 2016). Thus, not only is the extent of road crash trauma under-estimated in the official data of most countries, but also the contribution of pedestrian trauma is further systematically (though not necessarily deliberately) under-estimated. The real extent of the pedestrian safety problem is not visible to decision makers.

Sixth, *victim blaming at its worst for pedestrians,* often supported flawed crash data and victim-directed advice. Victim blaming, the tendency to blame those involved in crashes rather than the road system, sustains the old-school focus on road user behavior rather than adopting safe system principles to address the problem. Victim-blaming is well-recognized as a problem in road safety (Museru et al., 2002; Girasek, 2007), including for pedestrians in particular (Job, 2012). The tendency to victim-blaming is exacerbated for pedestrians by two factors. First, it is particularly difficult for police to determine fault in pedestrian crashes which results in systematic bias toward finding the pedestrian at fault. Police face an unenviable task when attending fatal or serious injury pedestrian crashes, if there are no uninvolved witnesses. Often, the pedestrian is dead or seriously injured and thus unable to provide their account of events, whereas the driver is likely to be uninjured and able to provide his/her account. The driver is unlikely to admit that he/she was



speeding or distracted, and likely to claim that the pedestrian darted out. While police may doubt the account, proving it wrong is deeply challenging, especially in countries which do not undertake detailed crash reconstruction. Without a detailed crash reconstruction which may uncover factors such as speeding the driver is unlikely to be charged (Job and Sakashita, 2016). Such crash reconstructions are rare in LMICs which suffer 93% of deaths globally. In these circumstances, pedestrian crash victims are systematically more likely to be seen as at fault. The crash data then invite a second problem: once the pedestrian is seen as mostly at fault, there is a tendency to jump to fix the pedestrians as a solution which drives advocacy for what pedestrians should do as the primary solution. For example, the NHTSA website on pedestrian safety starts with tips for pedestrians on how to be safe, then for drivers on how to drive safely for pedestrians but does not address how to advocate for systemic change, safe pedestrian amenities or lower speed limits (NHTSA, 2019) and a similarly problematic approach is adopted on the US (National Safety Council, 2020) website. These communications, of unknown value in behavior change, are deeply counter-productive to a safe system approach to pedestrian safety, by promoting views which facilitate political obfuscation of responsibility for providing a safe road system.

Seventh, *the focus on increased speed for economic improvement is misleading and costly especially to pedestrians*. Speed is a major determiner of road crashes, injuries, and deaths, with small changes in speed creating large changes in numbers of deaths and injuries (Job and Sakashita, 2016). Speeds can be effectively managed (Howard et al., 2008; Job and Sakashita, 2016). Critically, speeds of impact are a vital determiner of survivability for pedestrians, with risk elevating dramatically even at lower speeds. For example, a recent synthesis identified of a 5% risk of death at 30 km/h, increases to 13% for an impact speed of 40 km/h and 29% for 50 km/h (Hussain et al., 2019). Lower speeds are identified to protect pedestrians from serious injury (Jurewicz et al., 2016). However, commonly speed limit increases are sought on the basis of anticipated economic improvement through reduced costs of travel, and in cities on the basis of anticipated reductions in congestion. Both these expectations are refuted by the data: Increasing speeds increases other costs often not considered, including the costs of crashes, greenhouse gas emissions, vehicle maintenance, and air pollution. When all costs of speed are considered, economically ideal speeds even on open highways are typically substantially lower than the speed limits set and increasing speed limits harms the economy (Cameron, 2003; Elvik, 2009; Hosseinlou et al., 2015). Increases in speeds are shown not to help with congestion and may even make it worse (OECD, 2006), due to the longer headway drivers must leave as speeds increase. Some of the best road safety performing countries are applying 20 km/h speed limits in various residential streets (see **Figure 1** for an example from Switzerland).

Eight, *the road system is not designed to accommodate visibility challenges for pedestrians*. Pedestrians are inherently less visible than other road users because the human body is smaller than the human body plus any vehicle, even a bicycle. Thus, the angle subtended on the retina is smaller. This lower visibility of

pedestrians is further compounded by two further factors. First, young child pedestrians are much smaller and especially shorter than adults meaning that they may not be as tall as a typical vehicle or other obstacles on the edge of the road which may obscure a driver's view of them. Second, pedestrians may be less likely to be seen by motorcycle riders moving faster than the rest of the traffic by lane filtering or lane splitting (riding between other vehicles in adjacent lanes), and the motorcycle may be less visible to pedestrians, especially small pedestrians.

Ninth, *pedestrians are not fully considered as part of the road transport system*. In many cities and countries roads are still considered to be for cars, with a prevailing view that pedestrians simply should not be on the roads. Direct evidence for the lack of consideration comes from the inclusion of driver waiting time in economic modeling for road policies and specific decisions such as signal phasing at intersections yet the absence of consideration of waiting time for pedestrians (Job, 2012). Thus, road policy in many high-income countries is determined with the astounding inconsistency that the time of a person waiting in a car has economic value, yet the time of the very same person waiting to cross the road has no economic value.

## DISCUSSION AND RECOMMENDATIONS

Pedestrians are at high risk of death and debilitating injury in road crashes. This paper identifies the neglect of pedestrian safety in the road transport system, despite clear evidence-based solutions, and proffers reasons for this. Strong progress for pedestrian safety depends not only on addressing the broad limiting factors of road safety delivery visible during the decade of action notably including inadequate funding and low political salience, but also depends on countering the identified specific barriers to effective delivery of pedestrian safety. Improvement may be facilitated by bold advocacy for fundamental culture change as well as incremental change. Seven areas of opportunity for change to improve pedestrian safety are suggested to both address the barriers to action and improve safety.

First, as an integral part of the safe system approach applied for pedestrians, managing speeds down is a vital safety intervention for pedestrians as well as all other road users. Speed managing infrastructure, such as speed humps, raised pedestrian crossings which deliver a 20-fold increase in the chance of drivers yielding for pedestrians (Torres et al., 2020), and well-designed roundabouts are the best systemic (and most sustainable) method for managing speeds in urban areas. The narrative for lower speeds must include correcting the mistaken impression that these will increase congestion and will increase total travel costs, as well as advocacy for safe system and demand for political accountability for road safety.

Second, improved data are required to overcome the systematic (though not deliberate) biases in crash reporting and thus data collection. Even if the deeper cultural and economic issues which may underlie under-reporting of pedestrian crashes in particular cannot be overcome, other interim solutions may improve the situation. For example, a dedicated field study in a specific area could determine the level of under-reporting (or the

real ratio of pedestrian to other crashes) and this could be applied as a correction factor to estimate the real extent of pedestrian deaths, injuries, and costs.

Third, strong advocacy and resistance to victim blaming is essential to generating appreciation of the need for safe infrastructure for pedestrians. This may usefully include correcting impressions of pedestrian error as the fundamental cause of pedestrian crashes and highlighting problems with police data on pedestrian crashes, while noting that this is not an attack on police but a recognition of the challenges they face with pedestrian crashes. Advocacy for the safe system approach is also valuable, including the promotion of a focus on the causes of injuries and how to avoid them, rather than a continuing often ineffective focus on causes of crashes *per se*. It is also important that advocacy for pedestrian safety and the roles of NGOs are not reduced to educating pedestrians to be safe, thus facilitating the victim blaming mentality. Instead, the strong promotion of safe system principles for pedestrian safety is required. Many system design interventions exist to improve pedestrian safety, as identified earlier.

Fourth, crash data may also be improved to address the systematic tendency to assign responsibility for a crash to the pedestrian. Stronger allowance for the cause of a crash being recorded as unknown combined with appropriate training may assist to reduce this data bias, allowing for better informed (less mis-informed) advocacy and safety solutions.

Fifth, provision of safe separate amenities for micro-mobility (e-scooters and e-bikes) rather forcing them to share roads with cars or footpaths with pedestrians will avoid the current trend to reduced amenity for pedestrians.

Sixth, road design and roadside furniture might valuably accommodate the visibility challenges of pedestrians, especially the young. Standards which improve visibility include the provision of raised platform crossings which raise the height of crossing pedestrians, curb extensions at crossings, removal of and

prevention of roadside furniture such as signs and vegetation which may obscure a pedestrian from the view of an approaching driver, and prevention of parking on the approach side close to pedestrians crossing points.

Seventh, stronger inclusion of pedestrians as acknowledged legitimate road users is required. The old-school roads-are-for-cars mentality must be overcome; pedestrian waiting time must be considered in road design and operation decisions such as signal phasing; and usable pedestrian facilities such as footpaths and safe convenient crossing facilities must be a required standard for roads where pedestrians are present. Strong advocacy for this culture change by NGOs is vital.

With these changes we will move more effectively to address pedestrian safety and thus reap more of the ancillary sustainability benefits of walking and mass transit, including reducing obesity, greenhouse gases, air pollution, noise pollution, fossil fuel use, and improved inclusion.

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