

1 'Pedestrian falls' as necessary addition to the current definition of 2 traffic crashes for improved public health policies.

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6 1. Introduction

7 Key to the development of public health policies and strategies is the accurate
8 definition of the problem(s) under review. Accurate problem definition fences off
9 undesirable circumstances, highlighting some aspects and throwing others in the
10 shadow (Weiss, 1989). Widely accepted definitions of traffic crashes focus on vehicle
11 crashes (sometimes further restricted to *motor* vehicle crashes) occurring on public
12 roads. These definitions exclude incidents such as pedestrians slipping, tripping or
13 colliding with objects resulting in falls in public spaces leading to injury or death. Such
14 incidents are hereafter denoted in short as Pedestrian Falls (PFs)

15 The current definition is understandable from a historical perspective, but it
16 may no longer be accurate or justifiable. The exclusion of PFs by definition and,
17 subsequently, in statistics likely leads to biased conclusions in transport and safety
18 policies, not serving public health interests. This paper focuses on the problem
19 regarding definition only and not on reporting issues even though these are important
20 as well as evidenced from frequent missing single-bicycle crashes (which are, unlike
21 PFs, defined traffic crashes in most countries) (Veisten et al., 2007).

22 The current definition of traffic crashes emerged in the early 20th century
23 when motorisation led to increasing numbers of people losing their lives in motor
24 vehicle crashes (Norman, 1962). As a consequence, traffic crashes were defined and
25 measured as (motor) vehicle crashes. Indeed, Norman (1962) describes that in the
26 United States in 1957, deaths following motor vehicle crashes exceeded the
27 combined deaths from all infectious and communicable diseases at all ages. The risk
28 of pedestrian-motor vehicle crashes was particularly high, with pedestrian deaths
29 following motor vehicle crashes in New York City in 1959 amounting to 70% of all
30 officially recorded traffic crash deaths (Norman, 1962). It is likely that, compared to
31 the number of official traffic crash deaths, the number of deaths following PFs was
32 negligible. Nowadays, PFs no longer appear to be a negligible problem, especially in
33 developed countries with their ageing populations as older people have a high risk of
34 serious PFs. Currently in the Netherlands more elderly people are fatally injured from
35 a pedestrian fall in public space than from pedestrian-vehicle collisions (Den Hertog
36 et al., 2013).

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39 2. Recent research on pedestrian falls

40 Although there have been very few, if any, official statistics of PFs until recent times,
41 first studies show the size of the problem. According to Den Hertog et al. (2013) a
42 little more than half of all pedestrian deaths and the vast majority of non-fatal
43 pedestrian casualties in the Netherlands are now as a result of a PF. Table 1, which
44 also includes data from Switzerland and Austria, shows that in the present-day road
45 system, figures based on the current definition of traffic crashes do not provide a
46 comprehensive overview of crash victims on public roads. Also, Mindell et al. (2015)
47 found that of all pedestrian casualties hospitalised in England (2007-2009) with a

48 specified International Classification of Diseases (ICD) coding 23,528 were involved
 49 in a road traffic accident and 76,087 were injured in falls on the public highway,
 50 therefore the number of PF casualties from were, similar to Dutch figures (Den
 51 Hertog et al., 2013), over three times greater than those involving a motorised
 52 vehicle. Both Den Hertog et al. and Furian et al. (2011) found that about three
 53 quarters of the PFs were related to bad or slippery pavement conditions, i.e. lack of
 54 'walkability' as defined by how conducive, friendly and safe the urban environment is
 55 for walking (Abley, 2005). It is however beyond the aims of this paper to discuss the
 56 literature on walkability and factors having an impact on the level of walkability and
 57 related PFs.

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Table 1 The Proportion of SP casualties on public roads in the Netherlands, Switzerland, and Austria.

	the Netherlands 2011(Den Hertog et al., 2013)		Switzerland 2011(BFU, 2014)		Austria 2009 Furian et al., 2011)	
	numbers	%	numbers	%	numbers	%
total number of injured road users	180,000	100	138,000	100	104,000	100
Injured pedestrians	48,000	27	56,700	41	36,500	35
of which traffic crash	5,000	3	2,400	2	4,000	4
of which PFs	43,000	24	55,300	40	32,500	31
total number of hospitalised road users	41,000	100	n.a.	n.a.	n.a.	n.a.
hospitalised pedestrians	11,000	27	n.a.	n.a.	n.a.	n.a.
of which traffic crash	2,000	5	n.a.	n.a.	n.a.	n.a.
of which PFs	8,600	21	n.a.	n.a.	n.a.	n.a.
Total number of fatalities	747	100	n.a.	n.a.	n.a.	n.a.
pedestrian fatalities	160	21	n.a.	n.a.	n.a.	n.a.
of which traffic crash	74	10	n.a.	n.a.	n.a.	n.a.
of which PFs	86	12	n.a.	n.a.	n.a.	n.a.

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Probably owing to definitional bias and lack of accessible data, only a few researchers with a transport and walkability focus (Den Hertog et al., 2013; Furian et al., 2011; Methorst & Schepers, 2010; Öberg, 2011; Mindell et al., 2015, Oxley et al. 2016) have started to estimate the size of the PF problem; however, most research into pedestrian injury/death incidents, is still restricted to pedestrian-motor vehicle crashes (Elvik e.a., 2009). By contrast, the problem of falls is well recognized among researchers in the field of epidemiology. The World Health Organisation estimates that globally approximately 37.3 million falls occur each year that are severe enough to require medical attention, with an estimated 424,000 falls occurring that result in fatal injuries (WHO 2014). This is the second leading cause of unintentional injury death (WHO 2014).

Unfortunately for transport- and public space related researchers, these figures also include falls indoors and in private gardens. As most studies on falls and

76 interventions by epidemiologists combine all falls regardless of location, the
77 outcomes are of limited use for road and public space authorities. It is, however,
78 positive that some researchers recently have started to at least distinguish between
79 indoor and outdoor falls (Kelsey et al. 2010).

82 3. Consequences of excluding pedestrian single crashes

83 The exclusion of PFs from transport research is likely to lead to biased conclusions
84 about the link between road safety and the design of our road transport system. Elvik
85 et al. (2009) described an interesting example based on Norwegian research. The
86 risk of injuries (injuries per kilometre travelled) for bus passengers is about twice as
87 low as that for car occupants. This suggests the number of injuries decreases when
88 people shift from driving to using buses or trains. However, this conclusion only
89 appears to apply to injuries falling within the official definition of road traffic crashes
90 (excluding PFs). According to Elvik et al. (2009: 1064), “The unrecorded injuries from
91 falls will, however, increase so much that no overall gain in safety can be expected if
92 car users start using buses or trains.”

93 Similarly, it is difficult to rule out the possibility that results from studies on
94 pedestrian crossings are biased by the restriction of research to motor vehicle
95 crashes (Elvik e.a., 2009). Nyman et al. (2013) recently found that PFs occurred most
96 frequently while pedestrians were crossing a road. As Den Hertog et al. (2013)
97 suggested, the large majority of non-fatal pedestrian casualties are PF victims. This
98 may also be applicable to pedestrian crossings. This means that walkability factors
99 such as differing kerb heights may have a similar or greater significance in overall
100 safety outcomes than factors relevant to pedestrian-motor vehicle crashes.

101 We expect that the number of severe pedestrian injuries in motor vehicle
102 crashes in developed countries will further decrease in the future. More speed-
103 reducing measures and new mechanical systems such as automated braking and
104 pedestrian airbags on car bonnets have the potential to reduce the risk of fatalities
105 and the severity of pedestrian-motor vehicle crashes. However, our ageing
106 population means that without the introduction of new public health and road safety
107 policies severe injuries from PFs are likely to increase. This increase and related
108 mobility and reduced physical activity problems among the elderly are unacceptable
109 from the perspective of public health. If we are to address the problem of PFs, the
110 first thing we have to do is agree on a comprehensive definition of incidents that
111 includes PFs on an equal basis besides traffic crashes.

114 4. Discussion

115 We recommend to consider changing the definition (for instance in the International
116 Classification of Diseases) to the following: “any vehicle crash and pedestrian fall
117 occurring on the public road spaces.” For the same reasons of usability by authorities
118 we recommend to broaden public roads to public spaces. The inclusion of PFs in the
119 definition would lay the basis for the collection of more comprehensive data on
120 injuries on public roads and public spaces. This would inform more accurate analysis
121 of and research into traffic risks and lead to better input and guidance for road
122 authorities, urban planners, and public health authorities, to enable them to design
123 inclusive and safe public spaces, improve walkability and thereby helping the elderly
124 to stay mobile, independent and (physically) active.

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