Lowering Speed Limits around Schools and Health: Evidence Review

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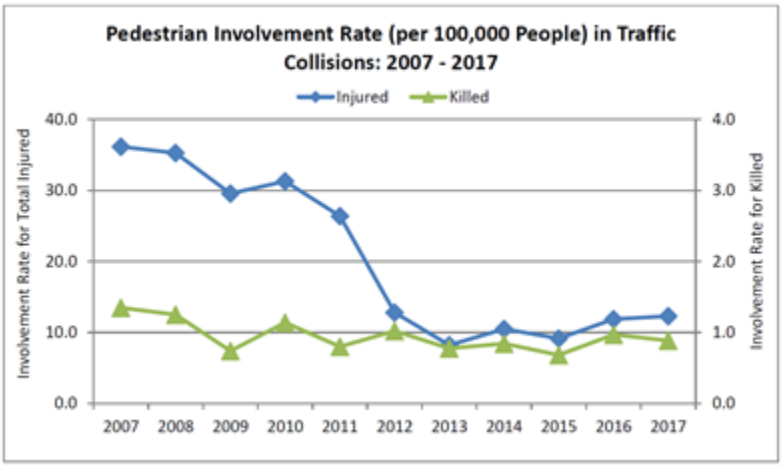
Background:

Road injuries and fatalities continue to be a public health concern, imposing large social and economic burdens on society (Sun et al. 2018). Manitoba Public Insurance (MPI 2017) estimates that between 2012 and 2017, speed accounted for about 18.5 per cent of all fatal collisions and 8.6 per cent of serious injury collisions in Manitoba[1]. There were 132 pedestrians killed and 2788 injured in traffic collisions between 2007 and 2017. In 2017, 12 pedestrians were killed and 22 more were seriously injured; 16% of these victims were children and youth 19 years or younger. While the rate of nonfatal pedestrian injuries declined from 2007 to 2013, since then has it has increased slightly. The rate in 2017 was 17% higher than the previous five-year average. The rate of fatalities has been relatively stable for the last 10 years (Figure 1).

Figure 1. Pedestrian Involvement Rate in Traffic Collisions: 2007-2017



Child pedestrian injuries are a leading cause of injury-related death for Canadian children aged 14 years or younger, accounting for almost 12% of all injury-related deaths in this age range (Parachute 2016). Transport Canada reports that on average, 30 child pedestrians 14 years of age and under are killed and 2412 are injured annually (Transport Canada, National Collision Database, cited in CCMTA 2013).

Older children (preteens and teens), in particular, are at increased risk of pedestrian and cycling fatalities and injuries (Table 1).

Table1. Rate of Cycling and Pedestrian Fatalities and Injuries per million population

Ages	Cyclist		Pedestrian	
	Fatality rate	Injury rate	Fatality rate	Injury rate
5-9	.49	57	.36	10
10-14	1.36	201	.40	25
15-19	2.23	256	1.06	35

Source: NHTSA, 2017a,b

[1] Significant and fatal injury is reportable by law and would be reflected in MPI reports. Minor injuries not reported to police or to MPI would not be included in these data. Injuries not reported to MPI may be captured by hospital data systems. An analysis of the Canadian Hospitals Injury Reporting and Prevention Program (CHIRPP) database was completed in 2012. This database captures injuries treated at the Children's Hospital Emergency Department, so underestimates the total number of injured children and youth (others may visit other emergency departments, urgent care, walk-in clinics and physicians' offices and other healthcare providers). This analysis documented an annual average of 140 pedestrian and cyclist injuries, with 30% of children having moderate to severe injuries. 15% of the child pedestrian victims and 3% of the cyclists required admission to hospital (Impact 2012).

With cities promoting healthier lifestyles and vibrant communities by encouraging active transportation and other outdoor activities, traffic injuries pose a significant challenge to the road safety agenda. Lowering speed limits in residential areas, including school zones, are a key approach to road safety, and intersects with the sustainability and climate change agendas, as well as promoting health and health equity. Pedestrians (people arriving by bus or car, walking, or playing near the school) comprise the majority of vulnerable road users in school zones. Decreasing the speed of cars in urban settings can have positive impacts on the economy, the environment and health (Tranter 2010).

Although most of the evidence on speed limit reduction pertains to road safety, the health benefits extend beyond this (Jones & Brunt 2017). Speed reduction in school zones can also support active transportation, leading to improved physical activity, and a corresponding reduction in chronic diseases, including obesity. As well, speed limit reduction can improve air quality and noise pollution and promotes mental health and social inclusion.

Evidence Review:

Vehicle Speed and Injury

- The risk of collisions and the subsequent risk of injury and death are significantly influenced by vehicle speed. Evidence suggests that reducing traffic speed significantly lowers the risk of injuries and fatalities for pedestrians and cyclists (Sun et al. 2018).
    - The risk of fatal injury for pedestrians of all ages increases dramatically at speeds greater than 30 km/h. A pedestrian struck at 30 km/h has a 5% of risk of death; this rises to about 13% for speeds of 40 km/h and 29% at speeds of 50 km/h (Hussain et al. 2019) (see Appendix A).
- Children are considered the most vulnerable road users because they are at a higher risk of being involved as well as seriously injured in road collisions. Child pedestrian injuries are more frequent on roads with higher posted speed limits (Wazana et al. 1997).
- Posted speed limits are an important factor in determining vehicle speed; however road design and other factors influence compliance with posted limits and vehicle operating speed (USDT 1999). Lower speed limits are most effective when combined with traffic calming measures (Chriqui et al. 2012).
    - Automated photo enforcement of motor vehicle speed significantly reduced the rate of speeding violations by nearly 50%. The effects of automated photo enforcement were sustained after 1 year of implementation.(Qustberg et al. 2018)
- Structurally disadvantaged populations (e.g., low income, racialized, vulnerable communities) are overrepresented in road traffic collisions, particularly when they involve vulnerable road users (e.g. children, pedestrians and cyclists) (BMA 2012; GBDFT 2011).

Injury and Age – Pedestrians and Cyclists

Students of all ages are at risk of motor vehicle-related injury while travelling to school, not just elementary school children.

- A Canadian study of pedestrians under 18 year of age and motor vehicle crashes near schools showed that the density of collisions, particularly fatal collisions, was highest in school zones and decreased as

distance from schools increased. Most collisions occurred midblock as opposed to intersections. The highest proportion of collisions occurred among 10-14 year old pedestrians (Warsh et al. 2009).

- A seven year study of over 32,000 pedestrian injuries among children and adolescents found that children 5-9 and youth 15-19 years of age had the highest rates of fatal injury, while nonfatal rates of injury peaked at 5-14 years of age (DiMaggio & Durkin 2002).

- A Canadian study of active transportation (AT) to school and injury by children 11-15 years of age showed that as students engaged in AT for longer distances their risk for injury increased irrespective of their mode of transportation. Approximately one injury was reported for every 2900 hours of AT (Gropp, Janssen & Pickett 2013).

  One explanation for these data are that elementary school children are more likely to be driven, ride a school bus or be supervised on the way to school (Schwebel, Davis and O'Neal 2012). As children grow older, parents and caregivers naturally allow more freedoms for unsupervised active transportation despite the child's traffic safety knowledge and skill level. Junior high and high school students are usually not supervised, and may be more likely to be distracted (Schwebel, Davis and O'Neal 2012). Cell phones and music players are a significant source of distraction and can affect cognition, movement, vision and/or hearing. Other sources of distraction include eating, drinking or smoking while crossing the road (CCMTA 2013). Preteens and teens are also at risk because they may have exaggerated beliefs about their abilities and may feel invincible, which can lead to risk taking (CCMTA 2013; LaScala, Gruenwald & Johnson 2004).

Injury and Age - Young Drivers

- Young drivers have a much higher rate of involvement in traffic collisions than older drivers. In 2017, drivers aged 16 to 24 years old have an involvement rate (per 10,000 licensed drivers) in traffic collisions of 1,103.0. This is:
  - 1.2 times that of drivers aged 25 to 34 (rate of 914.3);
  - 1.3 times that of drivers aged 35 to 44 (rate of 842.5);
  - 1.5 times that of drivers aged 45 to 54 (rate of 742.8);
  - 1.9 times that of drivers aged 55 to 64 (rate of 575.4); and
  - More than two-and-a-half times that of drivers aged 65 and older (rate of 432.0) (MPI 2017).

- Some students attending high schools will drive to school and be young, inexperienced drivers. In the U.S. young drivers make up only 6% of licensed drivers but they account for 13% of drivers involved in a distracted driving crash. Distraction can be from using a cell phone, talking with other passengers, and using the car stereo (Traffic Injury Research Foundation 2019).

Effectiveness of School Zones in Reducing Vehicle Speed

- Sun et al. (2018) summarized the results of previous research on the impacts of school zones with reduced speed limits on vehicular speed and road collisions (see Appendix B). Their study evaluated the effects of reducing school zone speed limits from 50 to 30 km/h in Edmonton, which found that fatal and nonfatal injury collisions were reduced by 45.3% and injuries to vulnerable road users were reduced by 55.3%. For every 1 km/h reduction in average speed, fatal and nonfatal injury crashes were reduced by about 4% (Sun et al. 2018).

- Several Canadian studies have documented poor compliance with school and playground speed limits (Katten et al. 2011). For example in Saskatoon, there was only 23% compliance with 30 km/h zones; however the introduction of school zones reduced speeds by 10km/h, to 45 km/h. School and playground

zones in Calgary had much better compliance, with average speeds very close to the speed limit of 30 km/h, but with 10% of cars traveling at speeds more than 40 km/h.

- There are proven strategies that increase driver compliance and effectiveness of school speed zones. These include: traffic calming road modifications designed to lower speeds (of these, speed humps are the most effective and economical); speed zones that are > 200 m in length; active enforcement; fencing parallel to the zone; specific types of signage (e.g. flashing lights); speed display devices; and the presence of crossing guards (Chriqui et al. 2012).

- A limitation of school speed zones is that vehicle speed is only reduced very close to the school and these zones are often limited to elementary schools and certain time periods and months of the year. The risk to children and youth walking or cycling to school is therefore only reduced once they arrive at the school.

Vehicle Speed and Active Transportation

- Lower speed limits have the potential to impact the behaviour and travel choices of whole communities (Milton et al. 2018). For example, lower traffic speeds in urban areas may contribute to increased rates of physical activity, both for leisure and for transportation (Lee et al. 2011).

    - Children are particularly susceptible to the risks associated with high traffic speeds. The fear of traffic danger is an important factor in the level of children's independent mobility (Tranter 2010).

- Vehicle speed has an important influence on active transportation. Research shows that neighbourhood traffic speeds can either promote or inhibit walking and biking to school (Anderson et al. 1997).

- School speed zones can be an effective strategy to increase the number of students walking or biking to school, but the effectiveness is significantly enhanced with the addition of traffic calming measures and the presence of crossing guards (Martin & Carlson 2005).

- Attitudes about walking and cycling are strongly associated with fear of dangerous traffic (Lorenc et al. 2008).

Vehicle Speed and Air Quality

- Air quality has significant impacts on our health, in particular for children, seniors, pregnant women and individuals with pre-existing heart and lung conditions.

- There is some debate about the optimal speed for reducing vehicle emissions; however, evidence suggests that in real-world conditions driving nearer to 30 km/h produces fewer pollutants than driving at 50 km/h due to smoother driving (Archer et al. 2008).

    - Changes in driver behavior linked with lower speed limits could reduce air emissions, in particular by promoting more constant speeds that can lead to less braking and starting/stopping (Journard et al. 1995; Haworth & Symmons 2001).

    - Although lowered speed limits do not necessarily decrease all forms of air pollution, it is generally accepted that they do not increase air pollution relative to current 50 km/h speed limits (TEAG 2013).

Vehicle Speed and Noise

- Noise increases with traffic speed. It causes annoyance, reduces people's quality of life and has been linked with health problems associated with sleep deprivation and stress (BMA 2012).
    - In relation to the effect of noise on health, the British Medical Association (2012, p26) concludes that "The cheapest intervention, and the one with large co-benefits, is speed reduction".
    - There is strong evidence that excessive traffic noise is associated with poorer mental health among adults and children, relating in part to the chronic nature of traffic noise (BC Children's Hospital 2019).

Vehicle Speed and Mental Health, Social Connectedness and Community Wellbeing

- Faster traffic acts as a barrier to people traveling within and between communities, especially for those on foot or on bicycle, those with mobility impairments, older people and young children (Transport Research Laboratory 2012).
- Neighbourhoods with streets with low traffic speeds and volumes have been found to have better quality of life indicators (Tranter 2010).

Vehicle Speed and Health Equity

- Reducing vehicle speeds can enhance social inclusion by removing barriers to local mobility and increasing active modes of transport such as walking and cycling.
- Neighbourhoods with structurally disadvantaged populations are likely to experience the greatest community and health benefits from a speed limit reduction. For example, low income neighborhoods are far more likely to suffer poor air quality and increased noise, and be in closer proximity to high traffic flow and speeds (Lawton et al. 2012; BMA 2012).

Evidence- Informed Actions for Consideration:

- Maintaining speed limits at 30 km/h in school zones is an important countermeasure to children's increased crash and severe injury risk.
- Evidence suggests that reduction of speed limits in school zones should be combined with other strategies (e.g. traffic calming road modifications, surface treatments, active enforcement, flashing lights, speed display devices, use of crossing guards) to improve driver compliance and effectiveness of school speed zones.
- Consideration should be given to extending the length of time that the school zone speed limit is in effect, as well as extending the school zone speed limit to all schools (including middle and high schools) in Winnipeg, in order to further protect children, youth and other community residents.
- Further policy action to extend the school speed zone to streets surrounding the school (i.e. reduced residential speed limits), as well as around playgrounds and major pedestrian areas, would maximize the health impacts described in this document.

- School division policy in Winnipeg maintains the provision of transportation to school for students that live more than 1.6 km away from the school. It is therefore important to provide safe school travel options for the children/youth that live within what is considered a walkable/bikeable distance to school.

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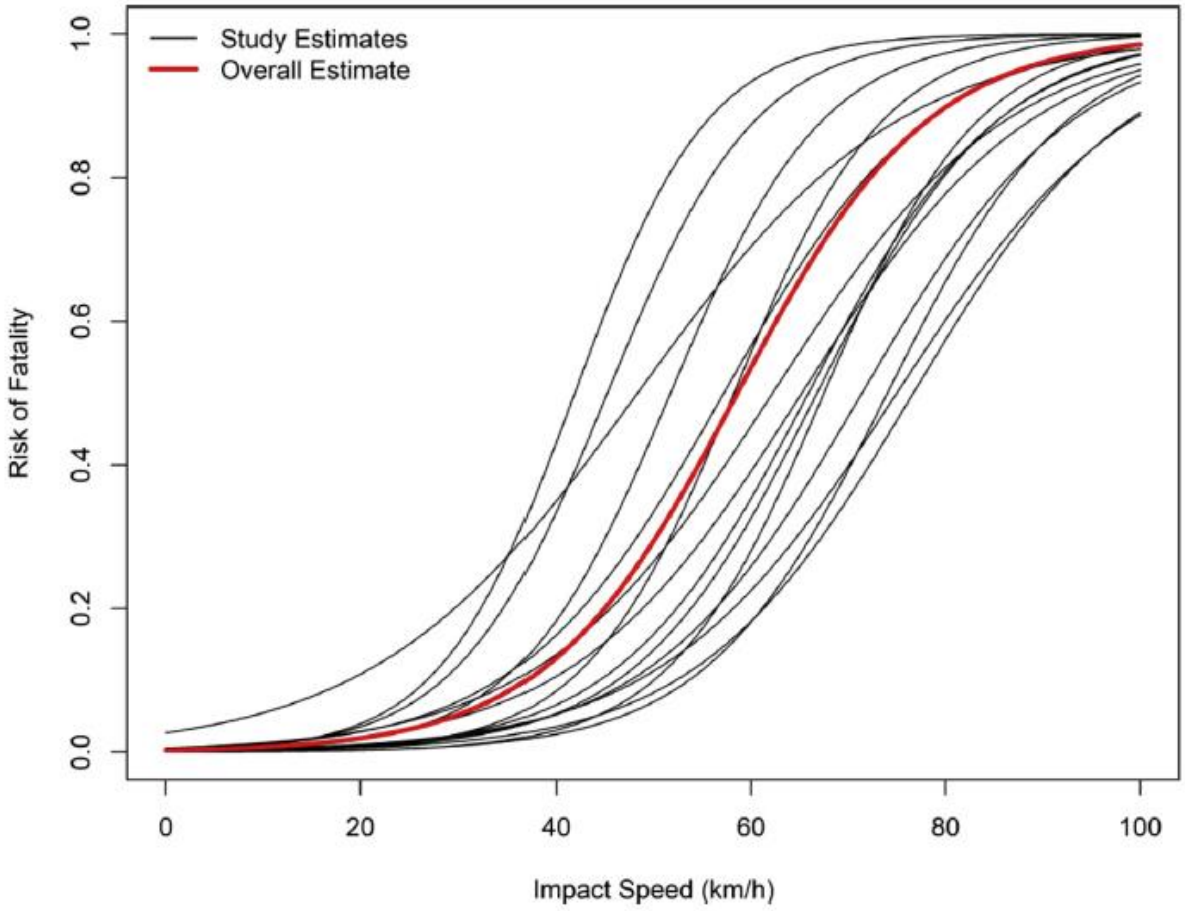
Appendix A: Plot for S-shaped curves for pedestrian fatality risk by impact speed



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Appendix B: Literature Summaries of School Zones' Effects on Vehicular Speed and Road Collisions

Table 1. Literature summary of school zones' effects on vehicular speed.

Study	Country	Data sample	Result summary
Young and Dixon (2003)	US	4 school zones	School zone signage had no general impact on reducing vehicular speed.
Zhao et al. (2015)	China	20 school zones	Effectiveness of school zones in changing speed varied greatly depending on road geometric conditions.
Strawderman et al. (2015)	US	4 school zones	Marking school zones was ineffective in improving safety, while a high saturation of signage had a more positive effect in changing driver behavior.
Vis et al. (1992)	Netherlands	15 areas with 30 km/h zones	30 km/h zones led to a significant reduction in traffic volumes and speeds, receiving support from residents.
Lazic (2003)	Canada	15 school zones	85th percentile speed was reduced by 10 km/h, after reducing speed limit from 50 to 30 km/h in school zones.
Tay (2009)	Canada	20 spots around schools and playgrounds	Mean speed and 85th percentile speed at 30 km/h school zones were significantly lower than on other 50 km/h streets.

Note: (1) Mixed findings on the effectiveness on speed reduction. (2) A relatively small sample size was used in most previous studies.

Table 2. Literature summary of school zones' effects on road collisions.

Study	Country	Data sample	Result summary
Engel and Thomsen (1992)	Denmark	44 experimental streets	Road casualties were reduced by 72% by reducing speed limits.
Lindenmann (2005)	Switzerland	30 residential zones	Collisions were reduced significantly on 30 km/h residential zones.
Grundy et al. (2009)	UK	20 mph zones around London	20 mph zones are effective in reducing road casualties, particularly for young children.
Graham and Sparkes (2010)	Australia	820 school zones	Crashes, especially pedestrian casualties, were significantly reduced by implementing 40 km/h school zones.
Hazzard and Hildebrand (2015)	Canada	31 urban and 24 rural school zones	Delineated school zones are statistically safer than comparable streets outside school areas.
Li and Graham (2016)	UK	20 mph zones around London	Minor road injuries were reduced by 10% and serious road casualties were reduced by 24% in 20 mph zones.

Note: (1) Most studies used a simplistic study design. (2) Most studies were conducted on residential streets, with limited studies being carried out in school zones, where children are the predominant vulnerable road users.

Sun et al. 2018