Lowering Residential Speed Limits and Health: Evidence Review

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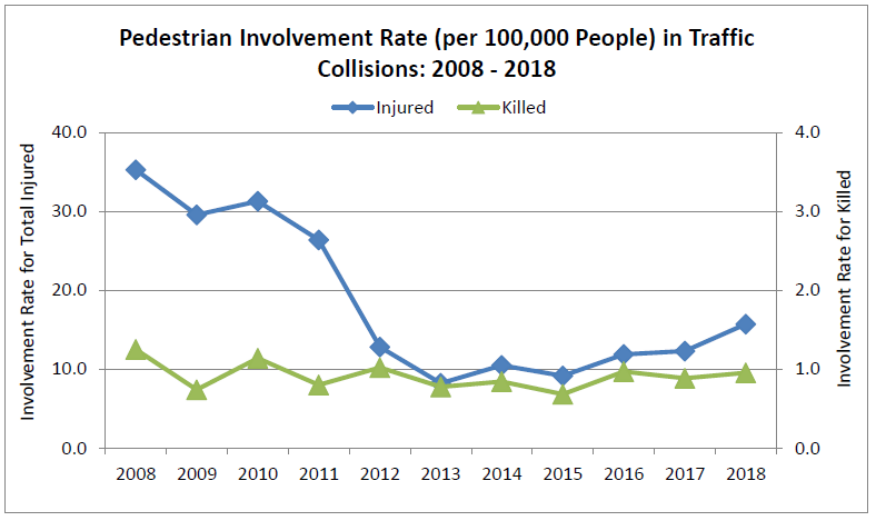
Background:

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 estimates that in 2018, speed accounted for about 23 per cent of all fatal collisions and 5 per cent of injury collisions in Manitoba. There were 129 pedestrians killed and 2564 injured in traffic collisions between 2008 and 2018. In 2018, 13 pedestrians were killed and 36 were seriously injured. (MPI 2019a) Figure 1 shows that the rate of fatalities has been relatively stable for the last 10 years, however, in the first 10 months of 2019 Manitoba has seen a record number of pedestrian deaths for that time period. (MPI 2019b).

Figure 1. Pedestrian Involvement Rate in Traffic Collisions: 2008-2018, Manitoba Public Insurance, Traffic Collision Statistics Report



(MPI 2019a)

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, is a key approach to road safety, and intersects with the sustainability and climate change agendas, as well as promoting health and health equity. Decreasing the speed of cars in urban settings can have positive impacts on the economy, the environment and health. (Tranter 2010)

Safe Speeds is one of the four cornerstones of a Safe Systems approach to road safety, along with Safe Drivers, Safe Roads, and Safe Vehicles. Safe System thinking involves setting speeds with the expectation that crashes will happen and contemplating the injury severities likely to result from such crashes on any given type of road. At higher speeds, the driver's peripheral vision is narrower and reaction time is slower. Safe speeds shorten the time the reaction time of the driver as well as the distance a vehicle needs to stop. (Vision Zero Canada, 2019)

Although most of the evidence on speed limit reduction pertains to road safety, the health benefits extend beyond this. (Jones & Brunt 2017) Speed reduction 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. (Cleland et al. 2019)

Evidence Review:

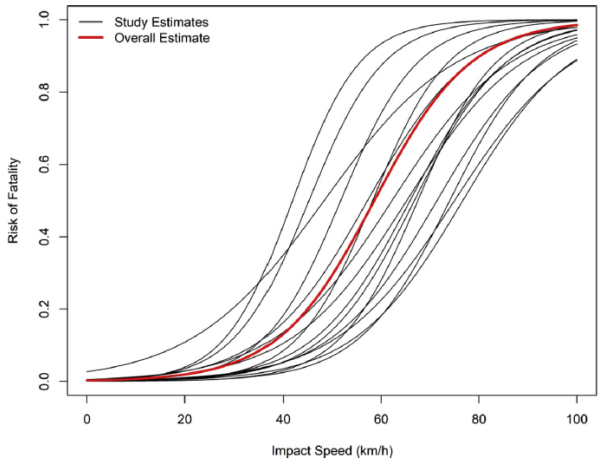
Vehicle Speed and Injury

According to World Health Organization (2004), speed is a key risk factor in road traffic injuries, influencing the risk of a road crash and the severity of injuries. The higher the speed of a vehicle, the less time a driver has to stop and avoid a crash and the higher of the impact when a collision does occur.

- 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)

- As seen in Figure 2, 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)

  Figure 2: Plot for S-shaped curves for pedestrian fatality risk by impact speed



(Hussain et al. 2019)

- 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)

- 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 A). They found that reducing school zone speed limits from 50 to 30 km/h in Edmonton reduced fatal and nonfatal injury collisions by 45.3% and reduced injuries to vulnerable road users by 55.3%. For every 1 km/h reduction in average speed, fatal and nonfatal injury crashes were reduced by about 4%.

Vehicle Speed and Active Transportation

Increasing active transportation through healthy community design including speed reduction and traffic calming has many benefits. (CLASP Healthy Canada by Design 2012), These include improving health by promoting physical activity, reducing obesity, improving cardiovascular health and promoting mental health. Increasing active transportation also benefits the environment by improving air quality and addressing action on climate change. Active transportation also has the benefit of improving community livability. (Brown et al. 2016)

- 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)

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

- 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)

- Streets with lower speed limits can be used to enhance cycling infrastructure, shortening the length of routes by not relying on arterial streets. (Streetfilms 2007)

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 behaviour 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. (Jourmard 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

Traffic noise causes annoyance, reduces people's quality of life and has been linked with health problems associated with sleep deprivation and stress. (BMA 2012) 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). For example, a prospective cohort study of school children in Germany found that exposure to noise at home is associated with mental health problems, including emotional symptoms, conduct problems and hyperactivity. (Dreger et al. 2015) There is also an association between traffic noise exposure and risk of depression. (Seidler et al. 2017; Rautio et al. 2018)

- The volume of noise caused by traffic is affected by speed, traffic volume, traffic mix, and acceleration. (National Collaborating Centre for Public Policy 2012), All considered, in urban areas with speeds between 30 and 50 km/h, a reduction in speed of 10 km/h reduces noise levels by 40%. (Mitchell 2009)

- The British Medical Association (2012) states that speed reduction is the cheapest intervention that addresses noise, and has the largest co-benefits for health.

Vehicle Speed and Mental Health, Social Connectedness and Community Wellbeing

Traffic speed and volume can deter people from walking and crossing roads on foot, and so interfere with individuals' ability to access the goods, services, and people they need for a healthy life. (Mindell 2017). This is often called 'community severance', and can adversely impact health and reduce social contacts. Reducing vehicle speeds can enhance social inclusion by removing barriers to local mobility and increasing active modes of transport such as walking and cycling. (Mindell 2012)

- Faster traffic acts as a barrier to people traveling within and between communities, especially for pedestrians or cyclists, those with mobility impairments, older people and young children. (Lawton et al. 2012)

- Neighbourhoods with streets with low traffic speeds and volumes have been found to have better quality of life indicators. (Tranter 2010)

- Cleland (2019) identified several studies that measured liveability outcomes. Perceptions of safety and the pleasantness of walking or cycling improved in several cities following the introduction of 20 mph zones.

Vehicle Speed and Health Equity

Health equity means that all people can reach their full health potential and should not be disadvantaged from attaining it because of social and economic status, social class, racism, ethnicity, religion, age, disability, gender, gender identity, sexual orientation or other socially determined circumstance. (WRHA 2013) Point Douglas is the lowest-income area of Winnipeg. People who live in Point Douglas, have higher rates of hospitalization from road traffic injuries than higher income areas.
In Point Douglas:

- occupant-related injuries are 1.85 times higher than the lowest rate observed in the St. Boniface community area
- pedal-cyclist related injuries are 3.05 times higher than the lowest rates observed in the Inkster and Seven Oaks community areas
- pedestrian-related injuries are 7.12 times higher than the lowest rate observed in the Fort Gary community area for (WRHA 2014)

- 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)

- 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)

- London has found that implementing a 20 mph (30kph) zones in the most deprived areas has reduced the gap in the number of casualties between the most and least deprived quintiles of deprivation by approximately 14%. (Steinbach, 2011)

Evidence- Informed Actions for Consideration:

- Reducing the overall speed limits on residential streets has health benefits beyond decreasing the incidence of injuries. Many cities in North America have implemented this strategy. is a strategy being implemented in many cities in North America to address pedestrian and cyclist safety.

- When determining which streets should have lower speeds it is important to consider road history (injury/collision data) and active travel routes. Health equity is also an important consideration- structurally disadvantaged neighbourhoods should be prioritized for road safety improvements, including vehicle speed limit reductions

- Evidence suggests that reduction of speed limits should be combined with other strategies (e.g. traffic calming road modifications, surface treatments, active enforcement, flashing lights, speed display devices) to improve driver compliance.

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Appendix A: 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