Scoping paper:
Increasing physical activity levels through active transport – Traffic calming to increase rates of active transport

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1. Background to topic

Traffic calming, either by law through the reduction of speed limits or by physical means through the use of measures such as speed humps, is recognised as an important transport intervention for population health (1). Reducing the speed of motorised travel reduces both the frequency and severity of accidents (2-4). This leads to population health gains, as the burden of injuries from accidents is lessened for motorists, passengers, pedestrians and cyclists.

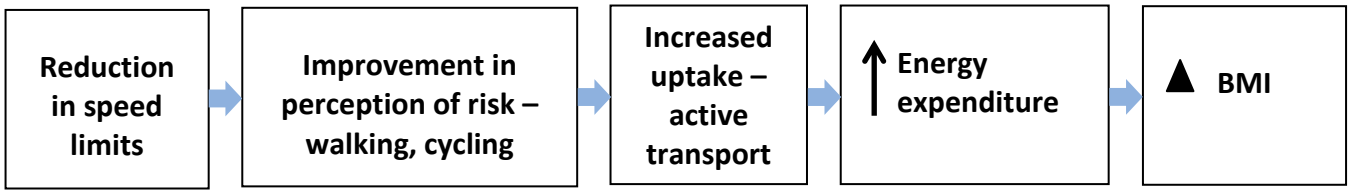
Traffic calming may also lead to population health gains related to an increase in physical activity (5). Evidence suggests that the perception of risk plays a significant role in the decision of whether to engage in walking and cycling for adults (6-8) and children (9-13). The risk of death or injuries has been recognised as the strongest psychological barrier to cycling in particular in high-income, car dependent societies (14). Whilst the primary objective of a reduction in speed limits is to decrease the frequency and severity of transport related accidents there may be potential secondary population health benefits in the form of an uptake in active transport if perceptions of safety improve (15). Slower car travel speeds may also increase the opportunity cost of car travel and potentially reduce its convenience (16).

This scoping paper therefore explores the impact of traffic calming interventions on uptake in active transport. More specifically, the impact of reducing speed limits will be explored due to its potential at the population level and the relative ease with which this intervention could be implemented across areas of Australia.

2. Intended policy impact

Traffic calming may lead to real and perceived improvements to the safety of walking and cycling for transport and leisure. Reduced risk may lead to an uptake in walking and cycling, with a potential BMI effect of an increase in physical activity.

3. Logic pathway



4. Current policy status

a. Australia

State and Territory governments in Australia have direct responsibility for road safety regulation and management (17). Generally agreed default speed limits in Australia are as follows, although these may vary between State/Territory:

Built-up areas	50km/h (60km/h in NT)
Major roads, outside built up areas	100km/h (110km/h in some cases)
School zones	40km/h (25km/h in SA)
Shared zones (e.g. carparks)	10km/h

Australian roads operate under 'Safe System' principles, requiring a holistic view of road safety across all road uses and incorporating all types of road users (17). One of the cornerstones of the 'Safe System' approach is to ensure that speed limits minimise crash impact forces and are appropriate to the road environment. An action of the *National Road Safety Strategy 2011-2020* is to work with local governments to expand the number and scope of projects that implement safe speed limits in areas of high pedestrian and cycling activity (17).

Local governments may apply to reduce default speed limits. A number of local government areas in Australia have instituted reduced speed zones (for example, the City of Yarra has a 40km/h speed limit on all local streets, the City of Melbourne has reduced speeds to 40km/h in some areas, the City of Port Phillip has reduced the speed limit to 40km/h for approximately 40% of all local streets etc).

The perception of risk as a barrier to increasing the prevalence of active transport has been recognised in several policy documents within Australia. *The Ministerial Statement on Walking, Riding and Access to Public Transport* (18) acknowledges the impact that traffic volume and speed has on rates of active transport and outlines opportunities for separating pedestrians and cyclists and ensuring appropriate speed levels and road treatments. *The Australian Vision for Active Transport* (19) advocates for a nationally consistent approach to the lowering of speed limits in high pedestrian and cyclist areas. In 2013 the Heart Foundation SA released a Position Statement calling for a reduction of speed limits to 30km/h in residential streets, and 40km/h on other streets with high levels of pedestrians and cyclists (20). The Heart Foundation QLD included a reduction of speed limits to 40km/h in built up areas and 30km/h in heavy pedestrian areas including around schools as part of its 2012-2015 policy proposals (21).

b. Internationally

Australia has relatively high speed limits compared with speed limits on similar road types in most OECD countries (17). Reduced speed limit areas or zones have been introduced in many countries internationally, recognising the balance between safety and mobility (particularly in urban areas).

Evidence suggests that the chances of surviving a crash between a car and a pedestrian decrease rapidly above the 30km/h impact speed (22). Many European countries have 30km/h limit schemes in residential and shopping areas, including in Denmark, Sweden, the Netherlands and Germany. The Department for Transport in the UK has provided guidance on the reduction of speed limit zones from 30mph (48km/h) to 20mph (32km/h) in urban and residential areas or in areas with high numbers of pedestrians and cyclists (23). UK cities that have either introduced or are in the process of introducing reduced speed limit zones include Bristol, Newcastle, Oxford, Glasgow, inner London,

Liverpool, York, Bath and Portsmouth. Edinburgh city council has recently approved speed reduction to approximately 80% of central Edinburgh roads, focused around city centre, shopping and residential areas. Speed limits in residential areas were also reduced from 50km/h to 40km/h in Montreal, Canada in 2009. The speed limit in New York was also recently reduced from 30mph (48km/h) to 25m/hr (40km/h) on most streets (24).

5. Evidence of efficacy/effectiveness

Overview of evidence

Evidence on the obesity effect of a reduction in speed limits specifically is likely to be limited. Within the literature a reduction in speed limits is often examined as a traffic safety, or traffic calming intervention: either on its own or as a suite of measures. Evidence will therefore be presented based on the following exposures:

Traffic speed (perceived or objectively measured)
Traffic safety (perceived or objectively measured)
Traffic calming (perceived or objectively measured)

Evidence will be presented based on the following outcomes:

Obesity effect (BMI, change in weight)
Physical activity effect

Evidence is required in the following areas to model this intervention:

I. Exposure

Exposure to the intervention will be defined as the time spent mode of transport and distance travelled by mode of transport in the population living in areas subject to reduced speed limits. Exposure by age and sex will be required.

II. Impact:

Evidence from systematic reviews or meta-analyses

A search for systematic reviews or meta-analyses that include associations between traffic safety, calming or speed and obesity was undertaken. Sallis et al (25) recently published a non-systematic review of built and social environmental features with potential co-benefits and found insufficient evidence exists on the impact of traffic speed/volume on physical health (defined as chronic disease or obesity). The review found moderate evidence exists for injury prevention and economic co-benefits, and strong evidence exists for environmental co-benefits.

One review was identified for children (26), which found that strong empirical evidence is currently not available on the effect of environmental variables on obesity. However, heavy traffic and parent reported road safety were positively associated with obesity in children aged 10-12 years in studies included in the review. The quality of studies was not systematically assessed however, with methodological issues impacting the quality of the evidence (for instance, most included studies relied on cross-sectional study designs, some included studies relied on self-reported BMI and so on).

Impact on obesity – evidence from scoping review

Given the paucity of evidence found in the search for published reviews a scoping review was undertaken to identify studies reporting an obesity effect of an improvement in traffic safety, calming or a reduction in speed (Table 1). The majority of studies identified examined the association between traffic safety, calming or speed and obesity in children or youth, and most studies used cross-sectional study designs. As we can see from Table 1 however, findings are relatively inconclusive.

Impact on physical activity- evidence from systematic reviews

Given the limited evidence of an obesity effect the search was then expanded to include associations between traffic safety, calming or speed and physical activity. Several reviews or meta-analyses were identified as follows.

The 2013 review by Arango et al. (27) of studies conducted in Latin America found either non-significant associations or insufficient evidence for an association between traffic-related safety and physical activity.

The review by Sugiyama et al. (28) in 2012 examined the association between traffic (defined as speed, volume and noise) and walking for leisure or utilitarian purposes by adults. The authors found that traffic had a limited direct effect on adult utilitarian walking, and that leisure walking was unrelated to traffic in most studies included in their review. Another review in 2012 found no significant associations between traffic safety and PA domains, including active transportation, walking for transport and cycling for transport, in European studies (29).

The review by Ding et al. (30) in 2011 examined the associations between neighbourhood environment and physical activity in children and youth. For children aged 3-12 years, the authors found consistent evidence supporting the association of reported physical activity with objective measures of traffic speed/volume. The review by Fraser and Lock (31) in 2011 found that perceived and objective traffic danger was negatively associated with cycling for transport. The review by McCormack and Shiell (32) in 2011 found insufficient evidence for the association between traffic-related characteristics and physical activity, including only two studies.

In 2009 Casagrande et al. (33) examined the impact of built environment variables on physical activity in African Americans, and included five studies that examined the impact of light traffic. Only one of the included studies found a statistically significant association between light traffic and physical activity (OR=1.53, 95% CI 1.00-2.34) with the remaining studies not reporting significant associations.

Bauman et al. (34) undertook a 2007 review of environmental correlates of physical activity on walking in adults and children for the National Institute of Health and Clinical Excellence (NICE). The authors found reasonably consistent associations between perceived safety and physical activity from studies included in the review.

A 2005 meta-analysis by Duncan et al. (35) found that people that reported that heavy traffic was not a problem were more likely to participate in PA (AOR 1.22, 95% CI 1.08-1.37), with the most common PA outcome variable of included studies being defined as meeting sufficient PA recommendations.

Impact on physical activity – evidence from scoping review

It seems that whilst some of the reviews support at least a notional association between traffic speed/volume/safety and physical activity there is very limited empirical evidence to support these claims. This finding is supported by a report commissioned by the Safe Speed Interest Group (made up of the Heart Foundation, the City of Port Phillip and the City of Yarra) in 2008, that examined the impact of reducing speed limits on active transport prevalence (36). The authors stated that a reduction in speed limits *may* contribute to an uptake in active transport, however noted the limited evidence to support this empirically at that time.

A search of the grey literature was undertaken, for evidence of a physical activity impact from speed reduction schemes that have been implemented either in Australia or internationally. No formal evidence was found for Australia.

Bristol City Council recently undertook a pilot of 20mph areas in its inner areas, with the specific aim to encourage more walking, cycling and independent mobility for children (37). An evaluation of the pilot program cites an increase in walking in the affected areas, ranging from a 1% to 21% increase dependent on area surveyed (inner east or inner south), weekday or weekend travel. Increases in cycling were cited as ranging from a 4% to 22% increase, dependent on the same factors. The data was collected from manual counts, undertaken pre- and post-implementation on both weekdays and weekends and an attempt was made to correct for rainy days.

The UK Department for Transport has commissioned a three-year research project into the effectiveness of 20mph speed zones, with a final report due in 2017. Stage 1 of the project involved a literature review of the effects of reduced speed zones in the UK and Ireland, Barcelona, Belgium, Germany, Switzerland and France (38). Stages 2 and 3 aim to quantify the effect of the 20mph zones in London on cycling propensity, however results are not available at this time.

Table 1 ***Associations between traffic safety, calming, speed and obesity***

Study	Location / Population	Aim	Exposure (outcome)	Method	Results / Effect size	Quality
Boehmer, et al. 2006 (39)	13 rural US communities n=2,210	To identify perceived indicators of the built environment associated with obesity in US rural communities	Perceived safety from traffic (obesity)	Cross-sectional, survey Adjusted for age, gender, education	Lack of perceived safety from traffic correlated with obesity (obese vs normal weight, AOR 1.65, 95% CI 1.2-2.27).	Cross-sectional, self-reported BMI, not representative of population due to sampling, unable to control for other potential confounders in analysis (e.g. PA).
Crawford et al. 2010 (40)	Families of **children aged 10-12 years**, Melbourne n=301	To determine the contribution of home and neighbourhood environments on BMI and physical activity in children.	Traffic exposure, perceptions of road safety (physical activity, obesity)	Longitudinal	Perceived road safety concerns were not associated with BMI z-score. Perceived road safety concerns were not associated with MVPA. Perception of heavy traffic was associated with PA, for boys only.	BMI not self-report, accelerometers used for PA, GIS for traffic.
De Bourdeaudhuij, et al. 2015 (41)	17 cities across 12 countries Australia (Adl), Belgium, Brazil, China, Colombia, Czech Republic, Denmark, Mexico, New Zealand, Spain, the UK and USA) n=14,222 aged 18-66 years	To examine associations between perceived neighbourhood environmental characteristics and BMI.	Safety from traffic (BMI)	Cross-sectional, surveys or interviews	Safety from traffic was the only environmental attribute that was associated in the expected direction both with lower odds of being overweight/obese (OR 0.92, 95% CI 0.86-0.97, p=0.005) and lower BMI (exp(b) 0.99, 95% CI 0.99-1.00, p=0.002).	Height and weight self-report in 8 countries, measured in 4. Adjusted for age, gender, marital status, educational level.
Evenson et al. 2007 (42)	USA **Sixth grade girls** n=1,554	To examine the association between perceived neighbourhood environmental factors and PA, sedentary behaviour and BMI in girls.	Safety (BMI)	Cross-sectional, survey.	Perception that traffic did not make walking difficult was associated with lower BMI (mean difference in BMI -0.5, p-value=0.01).	Accelerometer measured PA. BMI measured by study staff. Data used was baseline data of a related randomised trial so data collection methods were better than for some cross-sectional studies using secondary data.

Grafova 2008 (43)	USA, n=2,482 **children aged 5-18 years** and their primary care-givers	To examine the relationship between the built environment and overweight status in children	Pedestrian danger – fatalities from motor vehicle crashes (Overweight)	Cross-sectional, survey Logistic regression	Pedestrian danger not statistically significantly associated with the probability of being overweight (AOR 1.01, 95% CI 0.9-1.1).	Adjusted for age, gender, race, ethnicity, total family wealth and income to needs ratio, mothers BMI, education, no. children in household, whether household female-headed, mothers annual work hours, region of residence.
Lee et al. 2012 (44)	USA N=410 ethnic minority women aged 25-60 years defined as physically inactive (less than 30 mins PA per day on 3 or more days per week)	To examine the associations between street scale elements and cardiometabolic risk factors amongst inactive ethnic minority women	Street scale environment measures included posted speed limit, crossing aids, traffic buffers, connectivity, amenity, safety and attractiveness of environment (BMI, blood pressure)	Cross-sectional, survey Logistic regression	Complex relationship most likely between street-scale elements and cardiometabolic risk factors. Positive association between presence of pedestrian crossing aids and BMI ($p<.05$) may suggest a relationship between traffic speed/volume and BMI, as aids more likely to be in areas with more and faster traffic.	Results not generalisable, as study population inactive ethnic minority. Small sample size.
Lovasi et al. 2011 (45)	New York City, USA n=428 **pre-school children** from low income families	To investigate associations of environmental characteristics with adiposity.	Pedestrian auto injury rate used as indicator of traffic safety issues(adiposity)	Cross-sectional, survey Regression	Pedestrian auto injury rate significantly associated with adiposity (1.0mm greater skinfold thickness per standard deviation increase in pedestrian auto injuries, 95% CI 0.2-1.7, p=0.018). Not statistically significantly associated with BMI z-score however (0.00, 95% CI-0.18-0.19). Authors note skinfold measures may be more sensitive to influence of built environment variables.	Adiposity measures measured. Adjusted for age, sex, race/ethnicity of mother and child, no. rooms in the home

Timperio et al. 2005 (46)	Melbourne, Australia. n= 291 families of **5-6 year old children**, 919 families of **10-12 year old** children from high and low SES areas.	To examine associations between parent and child perceptions of local neighbourhoods and overweight/obesity.	Safety (BMI)	Cross-sectional, regression	No significant associations for 5-6 year old children. Parents of 10-12yr olds who agreed that road safety a concern more likely to be obese (OR=3.9, 95% CI-1.0-15.2) compared to those whose parents disagreed.	Height and weight measured. Adjusted for sex, SES and car ownership.

Notes: AOR = adjusted odds ratio, PA= physical activity, MVPA= moderate to vigorous physical activity, Adl= Adelaide.

6. Economic evaluations of reduced speed limits from the literature

Several economic evaluations of reduced speed zones have been undertaken, however have only included health impacts related to injuries (for example, (47, 48)).

James et al (49) undertook a health impact assessment of a proposed bill to decrease speed limits in Massachusetts, USA. Pathways for the health impacts of a reduction in speed limits were identified as: (i) change in serious and fatal injuries through improved safety, (ii) change in emissions; and (iii) change in chronic disease through an increase in physical activity due to improved perception of safety. However, the analysis only included a qualitative assessment of the literature for potential physical activity effects, finding general support for a positive impact of traffic calming overall on perceptions of safety and on active transport.

7. Feasibility of intervention's implementation in Australian context

Introducing "sign-only" speed reductions is relatively simple, although public compliance would need to be encouraged through measures such as policing and the use of speed cameras (50). Evidence suggests that higher rates of compliance and more public acceptability may also be achieved through an educational or social media campaign to communicate and 'normalise' speed reductions (37, 51). In the UK, 68% of respondents to the 2013 British Social Attitudes Survey were in favour of 20mph speed limits in residential streets (52).

8. Stakeholders

a. Policy makers/regulators

- All levels of government, federal, state, local
- Treasury and Finance
- Department of Transport
- BITRE
- Department of Planning
- National Transport Commission
- Transport Accident Commission

b. Industry

- Australian Transport Council
- Motoring organisations
- RACV and other motoring bodies
- Metro and other providers of public transport
- Public Transport Users Association

c. Academics

- The Institute of Transport and Logistics Studies, University of Sydney.
- Monash University Accident Research Centre

9. Issues specific to this intervention

a. Modelling

Access to transport demand modelling may help to validate or strengthen the effect estimate. Enquiries are being made with the Department of Transport in relation to accessing transport demand models, however these are likely to be capital city or state specific (e.g. the Statewide Victorian Integrated Transport Model, the Melbourne Integrated Transport Model (MITM)) and may not include all active modes, which would severely limit their usefulness for our purposes.

b. Other issues

No significantly negative equity impact is expected. Traffic calming may in fact reduce horizontal equity, as it may reduce the external costs imposed by motor vehicles and improve the balance between different types of public roads (53). Evidence suggests that safety concerns particularly discourage women, children and the elderly from engaging in active transport (8, 54). Therefore reduction in speed limits may reduce health inequalities in these groups if improved perceptions of safety lead to more active transport. From an injury prevention perspective, evidence from an analysis of 20mph zones in London suggests that the reduction in injuries was similar across SEP quintiles (55) and that the relative difference in the number of casualties between the most deprived and the least deprived areas of London was reduced by 15%(56).

Impact on industry

Whilst there may be a perception that slower travel speeds will lead to loss of productivity through increased travel times, evidence suggests that the impact of a reduction in speed limits on urban journey times may be negligible (17, 57). This is partly due to the fact that the major sources of travel time delays, including congestion, intersections and negotiating corners, will remain unchanged and that journey speed is often less than posted speed limits. The relationship between speed limits and travel time is complex (57), however it may be reasonable to assume no increased travel time burden due to the reduction in speed limits for the purpose of our analysis (perhaps, with sensitivity testing around this assumption, Archer et al. 2008 provides some estimates of extra travel times on a journey of 10km under reduced speed limits that may be useful, otherwise input could be received from TAP members). A reduction in speed may however impact on vehicle operating costs (for instance, fuel consumption, tyre costs)(57). The extent to which these effects would be included would be subject to TAP review.

Impact on injuries and environmental effects

The primary motivation for reducing speed limits is to reduce the risk and severity of injuries. A reduction in speed limits is likely to have greatest effect in terms of a reduction in injuries in areas of low to medium traffic density where traffic is periodically able to travel at or near the speed limit (57). A reduction in injuries in very heavily congested areas may not necessarily be observed, as vehicles may travel at lower average speeds in these areas due to the congestion. A reduction in speed limits may also have environmental effects, due to a change in the level of vehicle emissions (57).

The effects of injuries and emissions as a result of the shift from motorised to more active forms of transport is being explored for incorporation into the modeling. Other effects (such

as a reduction in severity of injuries sustained in motor vehicles due to reduced speed) are out of scope of this project and therefore will not be included.

10. Intervention's potential to meet intervention selection criteria

a. Potential impact of addressing the problem of obesity

The intervention is likely to have a relatively small impact on addressing the problem of obesity (if any). The intervention is potentially most effective as part of a range of measures to increase rates of active transport.

b. Relevance to current policy decision-making

Speed reduction has been implemented internationally, primarily to reduce the risk and severity of transport accidents. A secondary benefit of an uptake in active transport may be achieved if speed reduction leads to an improvement in risk (or perception of risk).

c. Availability of evidence of efficacy/effectiveness to support the analyses (using a broad definition of evidence)

Limited evidence exists for obesity or physical activity effect.

11. Potential for intervention

Overall, whilst the perceptions of walking and cycling as dangerous are commonly recognised as an important barrier to active transport (9, 58), there is limited empirical evidence to support an uptake in active transport from interventions that improve safety. This does not necessarily mean that no effect exists, but rather that the evidence does not exist to date. In other words, it may be a product of other factors including the well-established difficulties of collecting rigorous evidence for transport interventions and the relative infancy of research into the physical activity effects of transport policy.

Input is required on whether this intervention should be modeled.

12. Preliminary intervention specification

Given the limited evidence base, the intervention would be modeled using a number of assumptions (somewhere between an economic evaluation and a health impact assessment in terms of its reliance on assumptions, less rigorous evidence). The intervention could be specified as a reduction in speed limits for residential roads using TAP guidance on the magnitude of the speed reduction. Precedence exists internationally for a reduction to 30km/h however TAP guidance would need to be sought on feasibility of a reduction to either 30km/h or 40km/h on residential streets (which some local governments have implemented in Australia). The intervention should be area-wide (rather than in isolated areas), so that faster traffic are displaced onto arterial routes (59).

The intervention could consist of a “signs only” approach – whereby physical traffic calming measures are not utilised. Costs of implementation could be ascertained from local councils who have implemented speed reductions in Australia and extrapolated. Staff from relevant Council/s should be approached for TAP membership should the intervention proceed to modeling.

Intervention effect could be based on conservative estimates from the Bristol City Council pilot evaluation {Bristol City Council, 2012 #1081} along with expert guidance from the TAP and a thorough sensitivity analysis. In the absence of more rigorous evidence, the alternative would be to not model the intervention.

Health impacts relating to risk of injury and emissions would be limited to the intervention effect on time spent per mode of transport (exposure).

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