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Joint inquiry into cycling deaths on New Zealand Roads

Introduction

1. My full name is Alexandra Kathryn Macmillan. I am a public health physician and senior lecturer in Environmental Health at the School of Population Health, The University of Auckland. In this capacity I have expertise in policies to improve the health, equity and sustainability outcomes of urban transport systems.
2. In addition to 15 years experience as a clinical and public health doctor, I have spent the past six years undertaking research and service work in transport policy and public health. My skills in this area include epidemiology (the ability to generate and assess best evidence for making public health and policy decisions); and integrated assessment (the ability to bring together disparate pieces of evidence about a wide range of outcomes, and simulate the effects of policies on those outcomes, to support decision-making)
3. I have recently completed a doctoral thesis that included futures modelling of specific policies to increase commuter cycling in Auckland.
4. I am therefore appearing as someone with a general professional interest in cycling safety in New Zealand. I will be providing evidence-based on work specific to Auckland, but which has some generalisable lessons for transport cycling in cities.
5. I will not be providing evidence or recommendations about rural or recreational cycling. Neither will I be commenting on the specific circumstances of the nine deaths included in this Inquiry.
6. Firstly I will summarise our understanding of the integrated benefits and costs of transport cycling. I will then describe some findings from my doctoral thesis that provide a systems understanding of urban transport cycling and injury. I will then use these findings to support some evidence-based recommendations for the prevention of future cycling urban cycling deaths while increasing transport cycling in New Zealand cities.

Cycling for transport and health, equity, and environmental sustainability

7. Cycling for transport is important for human health, social equity and environmental sustainability. Cycling to everyday destinations such as work, school, shopping and social networks can build sustained physical activity back into people's lives; improve urban air quality; increase neighbourhood social connection and reduce road traffic injury overall. Cycling can be a very low cost form of transport, and can therefore provide more equitable access to employment, education, goods and services in cities than designing in car dependence. Increasing transport cycling can therefore contribute significantly to addressing social and health inequities[1]. The increasing expected cost of petrol and diesel in New Zealand means that cycling will become an increasingly important form of socially equitable transport in the future.
8. Furthermore, increasing safe cycling and walking for transport has been identified as a key climate change mitigation strategy that maximises health co-benefits[2].
9. However, the benefits are seen more easily at a population level and individual attribution is difficult. On the other hand cycling injuries and deaths are visible at both population and individual levels, with clear attribution at an individual level between cause and effect. Care is therefore needed in considering the hidden benefits as well as the visible attributable harms.
10. A number of attempts have been made to quantify the integrated social, health and environmental costs and benefits of increasing transport cycling. These studies consistently demonstrate that increasing transport cycling results in benefits that significantly outweigh the harms, in a variety of different cultural and infrastructure contexts[3].
11. My doctoral thesis demonstrated the comparative costs and benefits of a number of different infrastructure scenarios in Auckland. Benefit-cost ratios ranged from 6 to over 20. In other words all scenarios showed a positive benefit (including limited investment in cycling infrastructure). However, there was wide variation in the magnitude of benefits and harms among the scenarios.
12. The conclusion from these studies is that cycling should be supported and encouraged as a mode of transport in cities, and that there is good evidence that we can maximise the benefits while minimising potential future cycling deaths and serious injuries.
13. Recommendations should therefore seek to both encourage more transport cycling **and** reduce future cycle deaths.

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[1] Marmot M, Allen J, Goldblatt P, et al. *Fair Society, Healthy Lives: The Marmot Review*, 2010.
[2] Hosking, J., Mudu, P., Dora, C., Adriazola, C., Welle, B., Herrera, S., et al. (2011). *Health co-benefits of climate change mitigation - Transport Sector*: World Health Organization.
[3] Woodcock, J., Edwards, P., Tonne, C., Armstrong, B., Ashiru, O., Banister, D., et al. (2009). Public health benefits of strategies to reduce greenhouse-gas emissions: urban land transport. *The Lancet, 374*(9705), 1930-1943.
Lindsay, G., Woodward, A., & Macmillan, A. (2008). *Effects on health and the environment of increasing the proportion of short urban trips made by bicycle instead of motor vehicle. Discussion paper Prepared for the Board of the New Zealand Transport Agency*. Auckland: University of Auckland.
Jarrett, J., Woodcock, J., Griffiths, U. K., Chalabi, Z., Edwards, P., Roberts, I., et al. (2012). Effect of increasing active travel in urban England and Wales on costs to the National Health Service. *The Lancet, 379*(9832), 2198-2205.
Macmillan, A. (2012). *Intervening in the trip to work: a system dynamics approach to commuting and public health (PhD, awaiting final examination)*. University of Auckland, Auckland

14. Despite the consistent benefits found in studies, New Zealand has a relatively dangerous road environment for cycling, resulting in high rates of serious injury and death compared with less motorized countries[4]. Although it is difficult to compare, our rates of cycling fatality per 100mkm travelled by bicycle are likely to be similar to the United Kingdom and the United States. Countries such as Germany and Denmark have demonstrated that an increase in cycling, accompanied by a decrease in private motor vehicle use for transport, can be achieved with a reduction in the rate of cycling injury and death.

Understanding urban transport cycling from a systems perspective

15. The actual and perceived risk of injury and death from urban transport cycling is closely intertwined with the mode share of trips taken by bicycle. Because perception of cycling safety is a major barrier to increasing transport cycling, these need to be understood together.
16. A number of feedback loops influencing cycling safety emerged from my doctoral research, and these demonstrate the importance of infrastructure investments in improving both actual and perceived cycling safety. The feedback loops were a result of both stakeholder workshops and assessment of the best evidence from the literature. They are shown in Figure 1 below
17. There are four reinforcing loops (R loops in the diagram above) and two balancing loops (B loops in the diagram). It can be seen that almost all the loops are related to the real and perceived risk of injury.
18. The feedback loop diagram suggests that infrastructure and traffic speeds will have the greatest influence on safety and the uptake of transport cycling, while other safety interventions (such as improved education) do not take part in the feedback loops and are likely to have a weaker effect the shape of trends over time.
19. The feedback loops have been used to develop a simulation model incorporating best evidence to compare policy outcomes over time. This enabled the identification of the most likely interventions that would increase the actual and perceived safety of cycling; estimated size of benefits and costs over time; and important uncertainties.

[4] Tin Tin S, Woodward A, Ameratunga S. (2011) Injuries to pedal cyclists on New Zealand roads, 1988-2007. *BMC Public Health* 10:655, http://www.biomedcentral.com/1471-2458/10/655

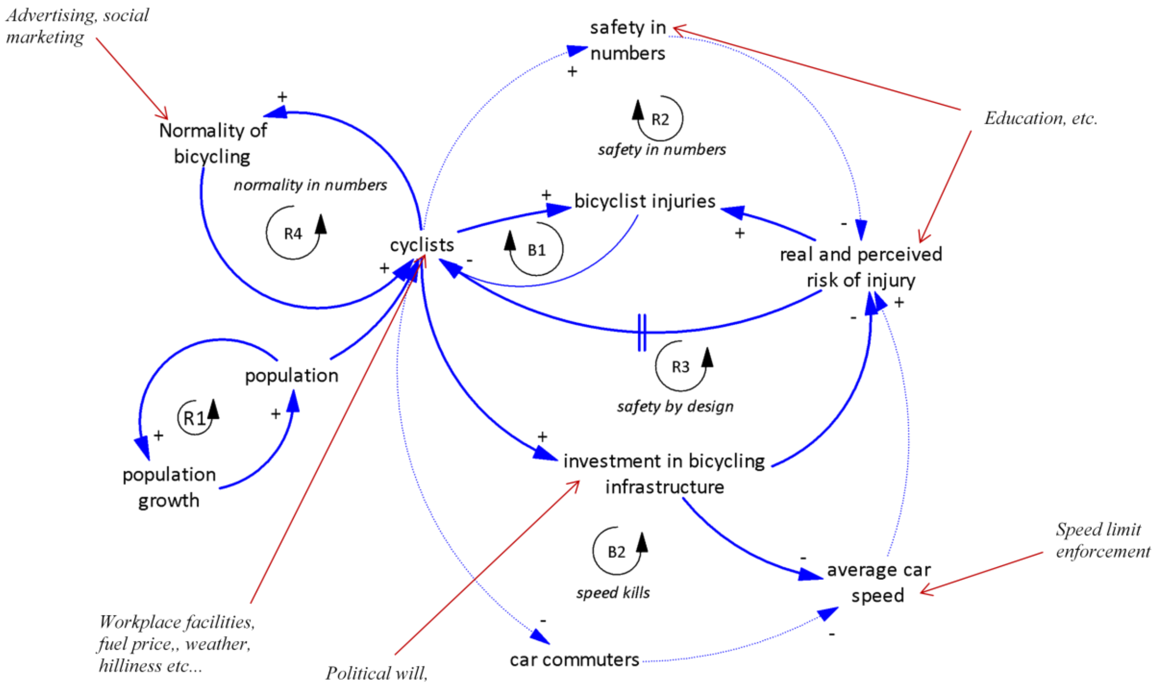

Figure 1 Feedback loops influencing transport cycling in Auckland

20. The infrastructure interventions with the best outcomes were as follows:
    a. best practice segregated arterial lanes (Figure 2) created by **re-allocating the existing road space** (to prevent induced traffic, or a reduction in congestion followed by increasing speeds). These should be elevated between road and pedestrian level with elevation continuing across side roads and leading into marked lanes and advanced bike boxes at intersections and
    b. "home zones" or "self explaining roads" (very low speed zones using endemic features rather than signage and enforcement) on through local roads (Figure 3) that create neighbourhood streets with clear prioritization of pedestrians and cyclists within a shared space[5].

[5] Charlton, S. G., Mackie, H. W., Baas, P. H., Hay, K., Menezes, M., & Dixon, C. (2010). Using endemic road features to create self-explaining roads and reduce vehicle speeds. *Accident Analysis and Prevention, 42*(6), 1989-1998.

Figure 2 Arterial segregated cycle lane in Copenhagen, Denmark (Photo: Streetsblog.org with permission)

Figure 3 “Self explaining” local streets, Pt England, Auckland (Photo: Hamish Mackie 2010, with permission)

21. The evidence from the literature also suggests that certain kinds of cycling infrastructure may make cycling somewhat more attractive while also making it more dangerous. This is likely to include many of the kinds of infrastructure currently being implemented in New Zealand cities, including narrow marked lanes between parked cars and traffic, lanes which end unexpectedly (particularly before the intersection) and off-road shared paths that are not visible from the roadway and intersect with it at “conflict points” (see examples of existing Auckland infrastructure in Figure 4).

Figure 4 Examples of existing cycling infrastructure interventions that may make cycling more dangerous than no infrastructure

22. Lower vehicle speeds over the whole network would also significantly contribute to the safety and attractiveness of cycling as well as having significant other benefits to all road users and the wider community from reduced road traffic injury, air pollution and noise.
23. Table 1 and Figure 5 demonstrates the magnitude of estimated benefits of combining these two best practice principles across the Auckland network by 2050, contrasted with the effects of the Regional Cycle Network as currently planned in the Auckland Regional Land Transport Strategy 2010-2040.

Outcomes by 2050	**Regional Cycle Network**	**Combined best practice**
Cycling mode share by 2051	6%	40%
<u>Cyclist injuries</u>		
Fatal	210	270
Serious	4000	5000
Car crash fatalities	-70	-340
Benefit Cost Ratio (NZTA method, accounting for all quantifiable benefits and costs)	**18**	**24**

Table 1 Modelled mode share, injury and benefit cost ratios (including all quantified outcomes) for the proposed Auckland Regional Cycle Network compared with a universal best practice approach by 2051

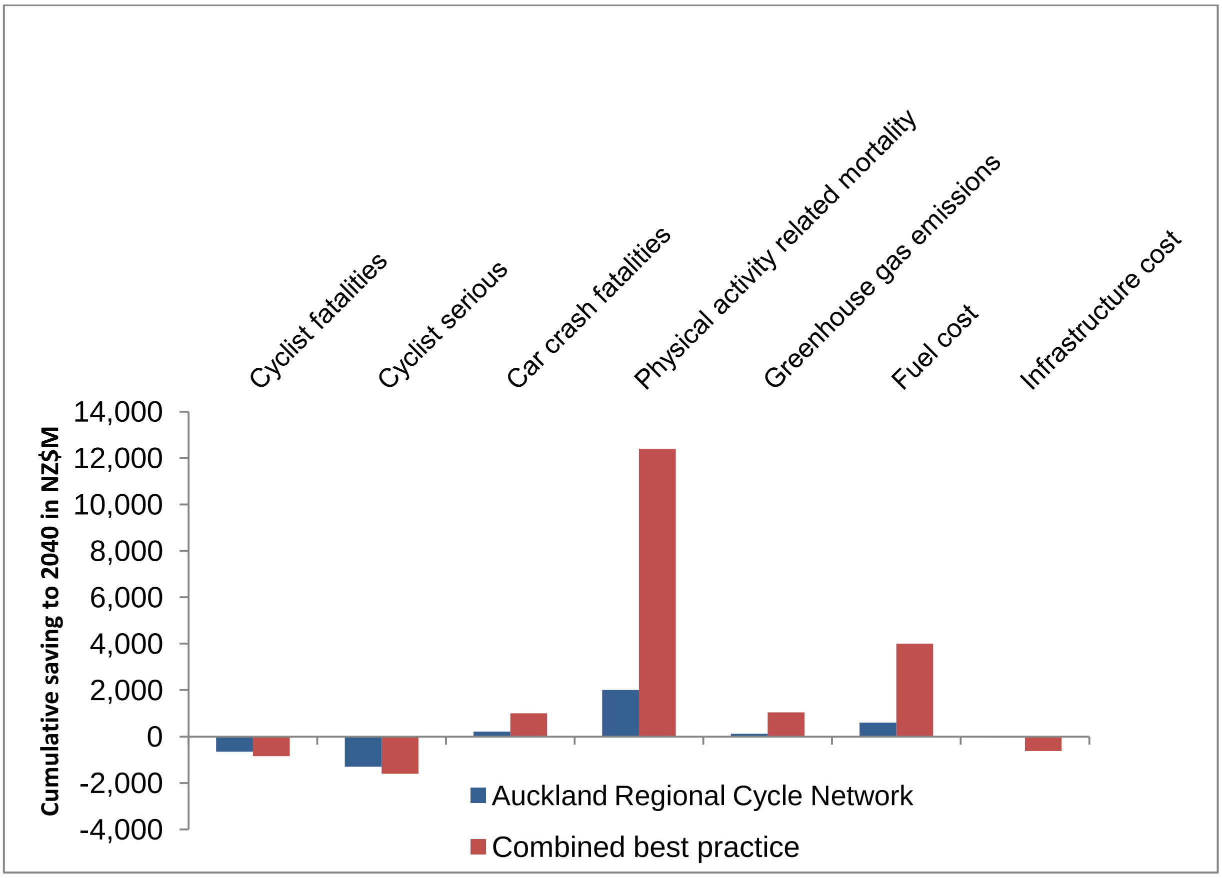

Figure 5 Monetised impact of a regional cycle network compared with best practice (physical segregation on all arterial roads & self explaning local through roads)

Uncertainties in our knowledge about what improves cycling safety

24. Assessing the effectiveness of different infrastructure types from the literature is made difficult by the limited number of high quality studies and heterogeneous implementation of infrastructure within and between studies. Bringing together the best published studies, I have developed a set of indicative uncertainty limits that overlap across the different infrastructure types; with the best point estimate also demonstrated (Figure 6).

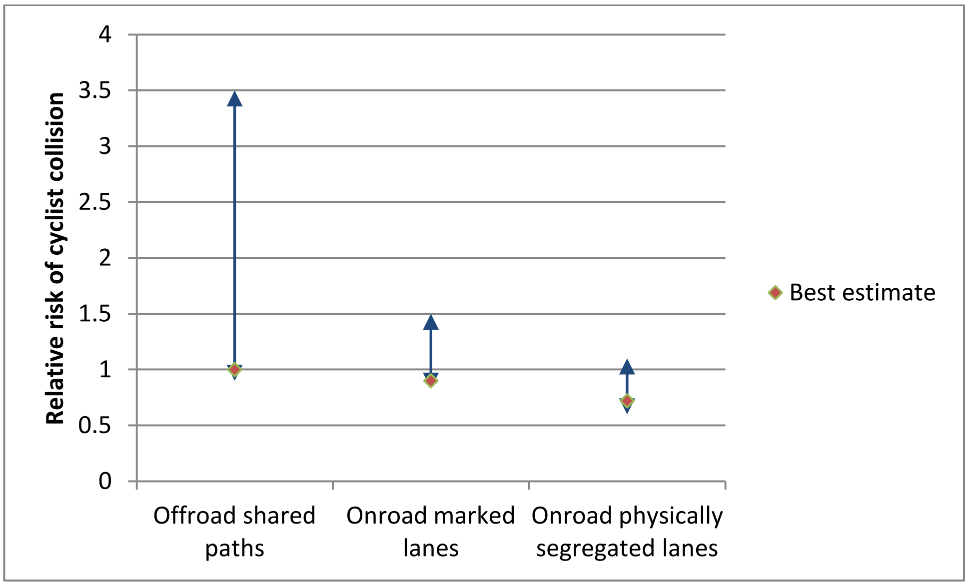

Figure 6 Range of relative risk estimates in the most robustly designed studies of infrastructure effects on cycling risk of collision, with best estimates of relative risk from the studies

25. There is also significant uncertainty about the existence of a "safety in numbers" effect (Reinforcing loop R2 in Figure 1). Much of the effect seen in simple comparisons between cities with different cycling rates at a single time point is likely to be due to a "numbers in safety" effect – as these kinds of studies are not designed to determine a causal relationship between cyclist numbers and rates of injury and death. In other words, it may be that improved infrastructure leads to improved safety and therefore more cycling. It is likely that some degree of safety in numbers does occur at high rates of cycling, but that there is a threshold below which no effect is observed. This theory is supported by historical data in Auckland, has seen little significant change in infrastructure over time. Despite fluctuations in the rate of cycling in Auckland over time, the rates of cycling injury and death have remained stable[6]. The threshold for a safety in numbers effect is not known, but is likely to be somewhere between 5 and 10% of the mode share of all trips.
26. These uncertainties do not detract from the need to make the best decisions based on our current knowledge. The evidence we have before us about what makes cycling both safer and more attractive is sufficient to demand changes in the way that cycling is provided for in New Zealand cities to reduce the likelihood of future cycling deaths and serious injuries while reaping the significant health, social and environmental benefits of an increase in transport cycling.

[6] Author's own analysis of Crash Analysis System (CAS) and census data

Other context specific factors influencing cycling safety in New Zealand

27. New Zealand currently has poor systems in place to measure cycle trips and cycling injury. Recent evidence suggests that even serious cycling injury is undercounted, with little overlap between different systems, including police reports, hospital admissions and ACC data[7].
28. Despite the significant potential for cycling to contribute positively to health, social and environmental outcomes, and the high rates of cycling injury and death in New Zealand, the National Land Transport Programme currently contributes little more than 0.5% of the total transport budget to walking and cycling combined[8].
29. The New Zealand Transport Agency (NZTA) has a set of guidelines for councils implementing cycling infrastructure that only partially reflect current best evidence and do not require a minimum standard for infrastructure[9]. This has not been updated since 2004. Given the wide range of safety effects reported in studies, including that infrastructure can increase the risk of injury and death when poorly or inconsistently implemented, the lack of minimum standards represents an ongoing risk for councils.

Recommendations

Based on the evidence described above, I make the following four recommendations to the coroner:

1. That national and regional walking and cycling targets and budgets be separated to increase the accountability of the agencies responsible for cycling safety
2. That the NZTA cycling infrastructure guidelines be replaced by a set of consistent best practice standards to provide clearer direction to local government and planners, and increase accountability for cycling safety
3. Improving transport cycling safety in cities requires a significant investment in best practice infrastructure. This investment needs to include both specific projects and consistent opportunistic investment as part of road maintenance and improvements.
4. Best practice infrastructure should include the following components
    a. Reallocation of existing road space
    b. Physical segregation (including by curb separation, elevation, and protection by parking) on arterial roads, accompanied by intersection and side road treatments
    c. Where there is room in the existing road space for both parking and cycling, the cycle lane should be between parking and the footpath
    d. Creation of “self explaining” or “home zone” local streets with endemic road features that lower average vehicle speeds to well below 30km per hour, allowing for safe sharing of the road space between pedestrians, cyclists and vehicular traffic.

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[7] Turner, S., Roozenburg, A. B., & Francis, T. (2006). *Predicting accident rates for cyclists and pedestrians*. Wellington: Land Transport New Zealand.
[8] NZ Transport Agency, &. (2011). *National Land Transport Fund expenditure by class* Wellington: NZ Transport Agency
[9] Land Transport Safety Authority (2004). *Cycle network and route planning guide*. http://www.nzta.govt.nz/resources/cycle-network-and-route-planning/docs/cycle-network-and-route-planning.pdf