MOVING TOWARDS A SAFE AND RESILIENT ROAD SYSTEM UNDER UNCERTAINTY

This paper has been peer reviewed

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ABSTRACT

This paper discusses the conference theme from a road safety perspective. Progress under financial constraints requires both strategy and tactics. The tactics must be agile. The strategy must have an excellent evidence base, be practical and shared in a way that encourages bipartisan political uptake. To have an excellent evidence base requires research investment to acquire the evidence, and the evidence needs to be conveyed to decision makers honestly.

Changes happen with every Government Policy Statement (GPS). Programmes that work may have time-limited funding with uncertain renewal. We need to navigate these changes to provide the best possible outcomes now, while ensuring that successful programmes are funded into the future.

Road safety is more complex than reducing the social costs of death and injury. Crashes are associated with road infrastructure damage, travel delays, health sector costs, policing costs, and justice sector costs. International Transport Forum (ITF) analyses show that New Zealand has made stuttering progress during the 21st century while lagging behind most developed countries.

Road safety programmes also should include tackling injury, not involving a motor vehicle, occurring on the road reserve. These include cycle only crashes, pedestrian slips, trips and falls, and other forms of micromobility. We can only move effectively towards a safe system if our strategies and programmes and data gathering include these forms of mobility.

The paper concludes with discussion of our road safety performance and suggests some practical steps for resilient improvement.

INTRODUCTION

Progress towards a safe and resilient road system under uncertainty and financial constraints requires both strategy and tactics. The tactics must be agile. The strategy must have an excellent evidence base, be practical and shared in a way that encourages bipartisan political uptake. To have an excellent evidence base requires research investment to acquire the evidence, and the evidence needs to be conveyed to decision makers honestly.

Road safety is more complex than reducing the social costs of death and injury. Crashes are associated with road infrastructure damage, travel delays, health sector costs, policing costs, and justice sector costs. International Transport Forum (ITF) analyses show that New Zealand has made stuttering progress during the 21st century while lagging behind most developed countries.

Road safety programmes also should include tackling injury not involving a motor vehicle, occurring on the road reserve. This includes injury from cycle only crashes, pedestrian vs cycle crashes, pedestrian slips, trips and falls, and injury involving other forms of micromobility. We can only move effectively towards a safe system if our strategies and programmes and data gathering include these forms of mobility. This means making the data gathered relevant to safety related analysis and available to all relevant players.

ROAD SAFETY PROGRESS UP TO NOW

New Zealand has made stuttering progress in road safety over the last 35 years. As with other high-income countries we have seen an overall reduction in road injury but, with the notable exception of the United States, we have lagged behind the rest of the developed world. This is illustrated in Figure 1.

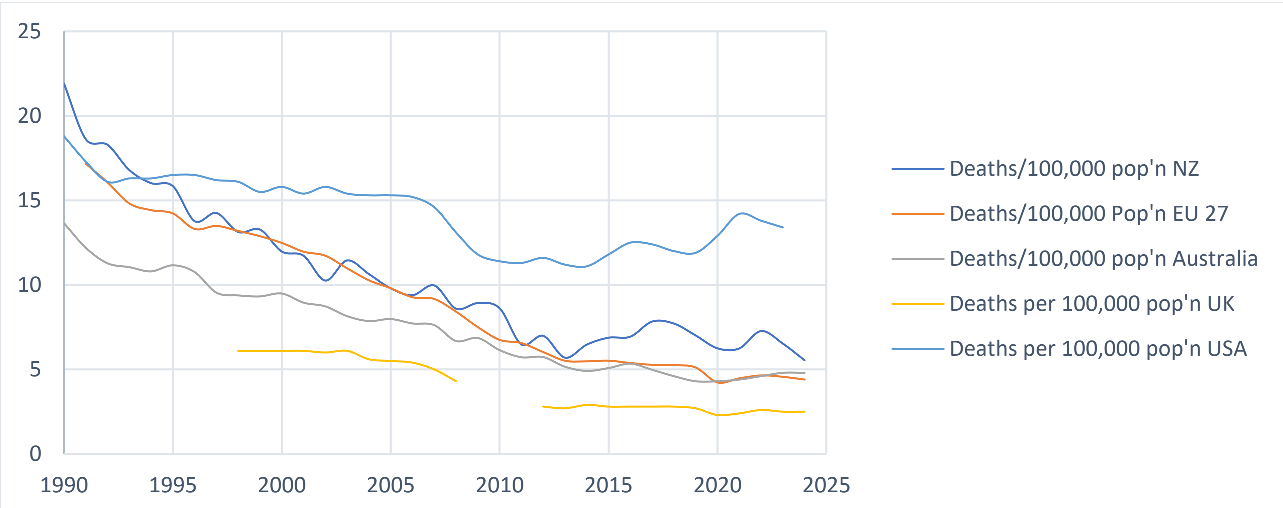

Figure 1:Road deaths per 100,000 population for New Zealand, EU27(EU countries excluding the UK), Australia and the UK (Data from NZ Ministry of Transport, ITF, The EU, the Australian Federal Government, and US Government Agencies)

It is apparent that New Zealand's death rate per 00,000 population has been higher than Australia's since 1990 and has risen above the EU since 2006. It has been considerably above the UK, one of the best performing countries, over the range of the available data. Comparing us with other high-income countries, we see that in 2008 (Figure 2: New Zealand's road) we ranked 20th out of 29 high income countries and by 2023 had regressed to 28th with only the USA having a worse record. This has come about through several previously lower ranked countries experiencing much larger road safety improvements than were experienced in New Zealand. Our neighbour Australia had also dropped from 11th to 19th, a concern, as Australia has at times been considered a role model for New Zealand. All the high-income countries have different sets of internal factors affecting their road safety performance, and some may have higher willingness to spend on safety than New Zealand. However, it is relative performance over time rather than absolute performance that is the concern here.

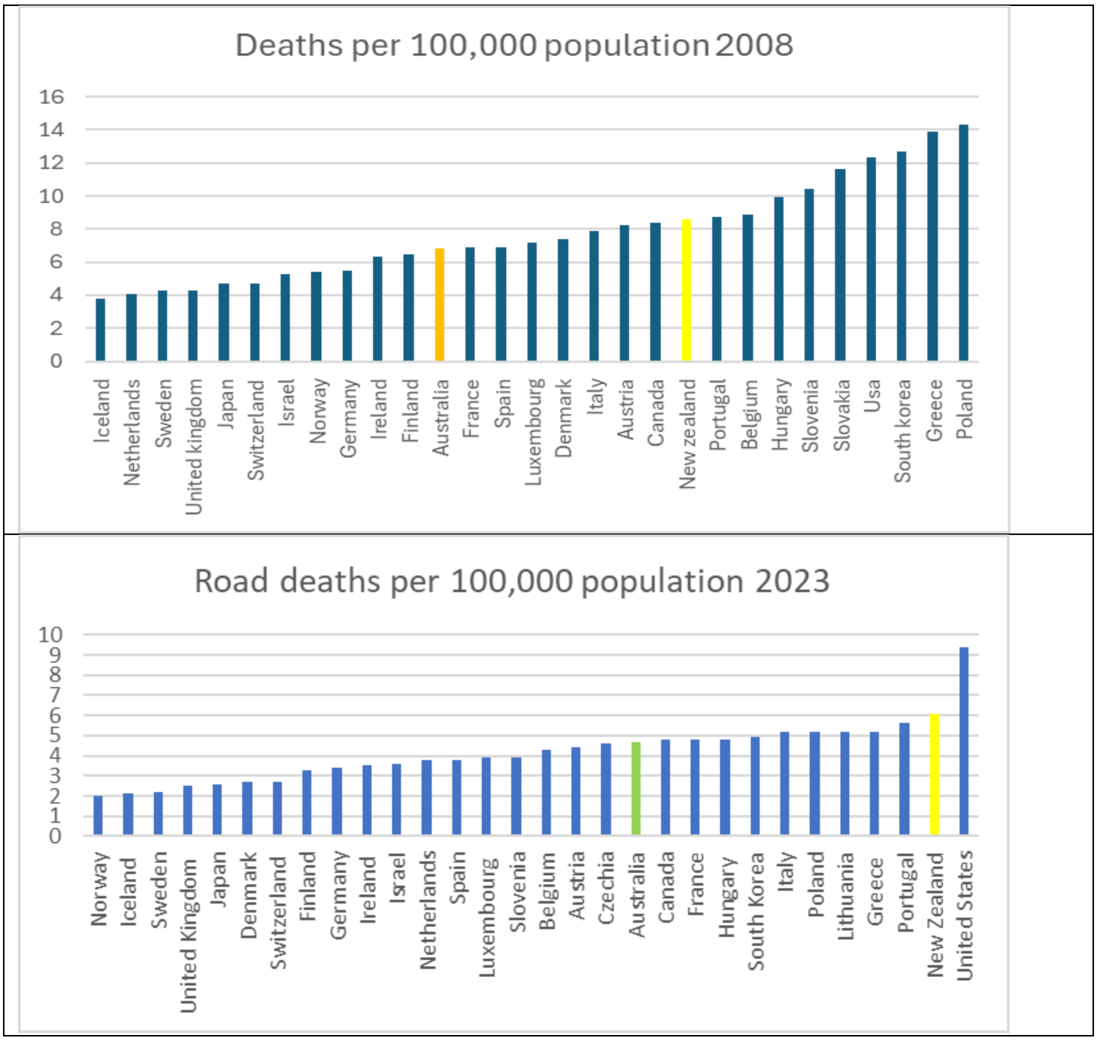

Figure 2: New Zealand's road deaths per 100,000 population for 2008 and 2023 compared to other high-income countries

PROJECTED FUTURE DSI LEVELS

As can be discerned from Figure 1 New Zealand's deaths per 100,000 population has trended upwards since 2014, with the recent 3 year dip from 2023 to 2025, as yet not long enough to constitute a trend. New Zealand's population is projected to increase considerably over the next 4 decades. This will result in a large increase in deaths and serious injuries (DSIs) if the present level of DSIs per 100,000 population continues[1]. Figure 3 depicts median, age-specific, population projections, base June year 2024, up to June year 2063[2] in units of 1000.

[1] The level of DSI's per 100,000 population is used here as a surrogate measure of road safety. Future projections based on its present level represent the continuance of the status quo without further road safety measures taking place.

[2] These projections assume a 30 June 2024 population of 5.290 million, a long-term median period total fertility rate (TFR) of 1.55 births per woman, and life expectancy at birth for males and females increasing from 80.8 and 84.0 years in 2025, to 88.1 and 90.5 years in 2078, respectively. Median annual net migration is assumed to be 25,000 in the June 2025 year and 30,000 in the June 2026 year, gradually rising to 37,500 in the June 2031 year, 42,500 in the June 2051 year, and 49,250 by the June 2078 year respectively. https://www.stats.govt.nz/information-releases/national-population-projections-2024base2078/

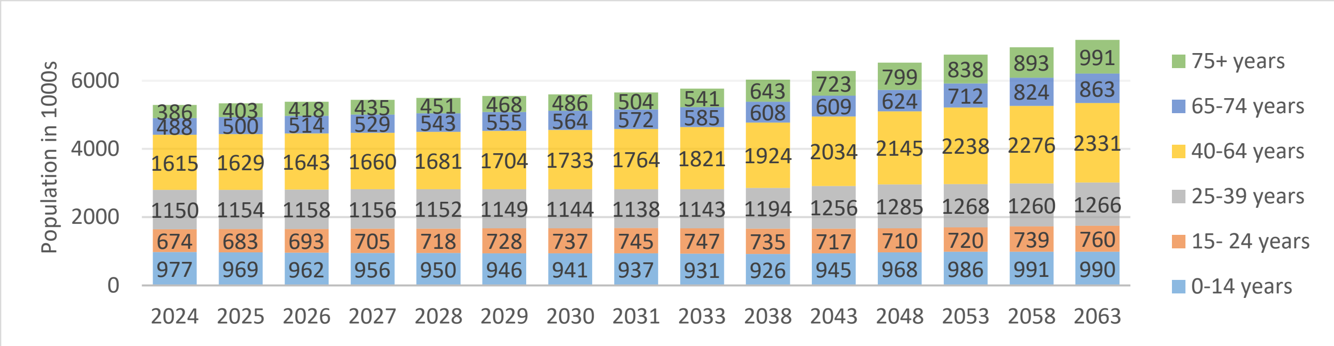

Figure 3:Age specific population projections to 2063-base year to June 2024

Figure 3 indicates that the major changes in population are in the 40+ age-groups and that percentage wise, these changes increase as the age -groups become higher. This has a direct impact on future DSIs. Figure 4 depicts projected age specific DSIs, obtained by applying the average annual age-specific DSIs per 100,000 population for the period June 2021 -June 2024, to the age-specific population projections. It reflects what will happen if we cannot reduce DSIs per 100, 000 population from present day levels in the future.

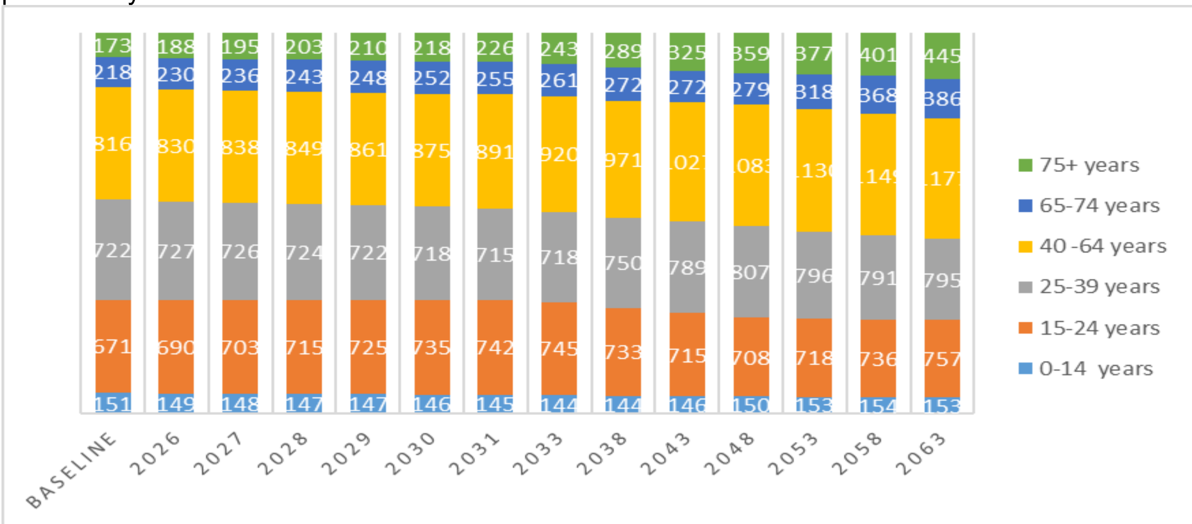

Figure 4; Age-specific DSI projections to 2063-base year to June 2024

The age-specific DSIs/100,000 population express the individual risks of the age-groups and are depicted in Figure 5 which shows that individual risk peaks in the 15-25 age-group and then tapers off with age. The low risk of the 0-14 age-group reflects the absence of drivers in that age-group.

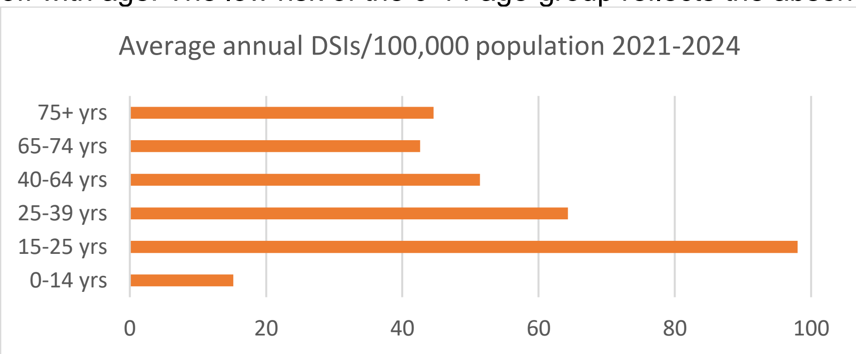

Figure 5:Average annual age-specific DSIs per 100,000 population over the period 2022-2024

Figure 6 summarises projected age-specific increases in DSI levels by 2063 compared to 2026.

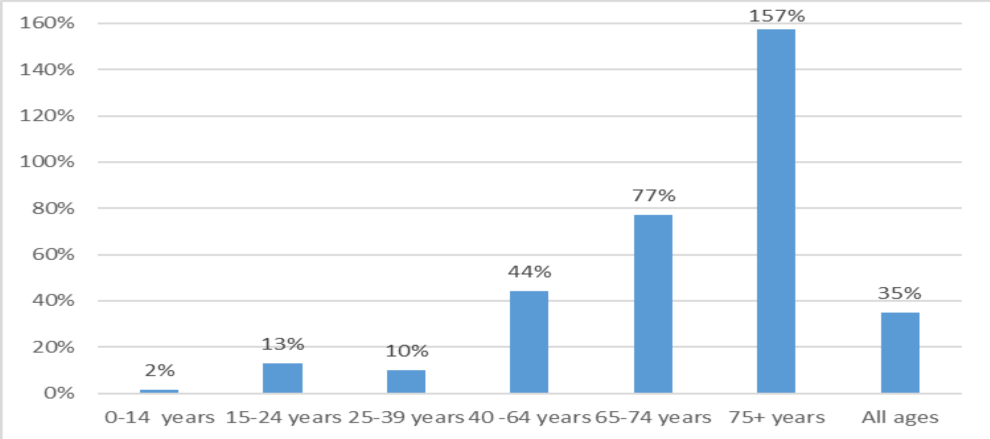

Figure 6:Projected percentage increase in DSI levels by 2063 compared to 2026 levels by age -group

Inspection of Figure 6 indicates a 35% overall increase in DSIs by 2063. In line with the age-specific population changes, percentage increases become larger as victim age increases reaching 157% in the 75+ age-group. This is a consequence of an ageing population with DSI growth occurring in proportion to population growth, weighted by the different risk profiles of the different age groups.

WE NEED TO REDUCE DSI RATES PER 100,000 POPULATION

Introduction

The above projections assume the continuance of present-day DSI rates per 100,000 population. To avoid such increases, we need to change the status quo by reducing the DSI rates per 100,000 population. It is worth mentioning that most (84%) of the increase in collective risk (total DSIs) by 2063 lies in the 40+age group, which has a relatively low personal risk (DSIs per 100,000 population) compared to younger age-groups. Any future road safety effort must address this high collective risk which tends to fly under the radar with greater emphasis tending to be placed on the higher personal risks of younger age-groups. A similar situation is the high collective risk of lower-level speeding (Elvik, 2019) where a large percentage of the total risk pertains to the many who break the limit by up to around 10km/h.

We need to work towards a safe system resiliently and sustainably

Resilient in this context means a high ability to stay on course and sustainable adds the dimension of being able to do so in the long term within the resources of the nation. We can learn from history. Road Safety has been bedeviled, like other sectors, with see-sawing approaches depending on the Government of the day. An example is the 1985 upward change in the rural speed limit from 80km/hr to 100km/hr. This followed an oil shortage related downward change in the 1970s[3] (Frith and Toomath,1982). This was a major factor in the reduced speeds and casualties which followed. When the oil shortage diminished, rural speeds increased and this was followed by the 1985 speed limit increase. This change was followed by a further speed increase which was sustained. This increase is documented in Koorey and Frith (2017). Speed increase on rural roads has a well attested relationship to injury increase, with an inverse relationship when speed falls (Elvik et al, 2019). This speed increase was a contributing factor to a worsening road safety situation throughout the 1980s. Other factors operating at the time and in the 1970s are listed in Koorey and Frith (2017).

[3]The open speed limit reduced from 55 mph (88 km/h) and occasionally 55mph, to 50 mph (80 km/hr)

Approaches have sometimes changed even within Governments, when the Minister has changed, or when a Minister's proposal has been overturned by a Cabinet decision. This lack of consistency has arguably impacted on the time line for adopting worthwhile road safety measures. A good example is the 250mcg/litre breath alcohol limit which was adopted in December 2014 after its first presentation to Government by officials in 1991, a gestation period of 23 years. A more bipartisan approach within Parliament is urgently needed. To achieve progress the Government's advisers need a strategy with an excellent evidence base, which is practical and shared in a way that encourages bipartisan political uptake. To have an excellent evidence base requires research investment to acquire the evidence, and the evidence needs to be conveyed to decision makers honestly. Changes happen with every Government Policy Statement (GPS) and work may have time-limited funding with uncertain renewal. Agile tactics to respond to inevitable headwinds are required. We need to navigate these changes to provide the best possible outcomes now, while ensuring future funding for successful programmes.

We need to allocate resources in a less siloed and more nuanced manner

In practice, some measure of Cost Benefit Analysis (CBA) is involved in allocating resources. This is because whatever the rationale for allocating safety resources there will never be enough to meet the demand. Therefore, tools like CBA will always be needed to provide a rational basis for cutting up an always finite pie. However, with CBA, although the areas where costs and benefits accrue may be used in the calculation, they are not part of the final ratio and may not feature prominently in the final slicing of the pie. Therefore, CBA on its own is unsatisfactory. Crashes are associated with road infrastructure damage, travel delays, health sector costs, policing costs, and justice sector costs. Health sector impacts of reducing road injury include reduced load on hospital wards, emergency departments, rehabilitation facilities etc.

An example is speed, where there is much publicity of small, insignificant in terms of real economic impact (Corban et al, 2008) increases in travel time from lowered speed limits and very little about the very real and cumulative healthcare savings. This publicity relates to driver beliefs that they need to drive faster than is actually necessary to achieve a certain travel time. This is based on a tendency to underestimate travel time gains from a given speed increase when the initial speed is relatively low (Elvik, 2009 quoting Svenson, 2008 and Svenson, 2009). Conversely, travel time gains by making relatively high speed faster are overestimated. The European Transport Safety Council (ETSC) has pointed out (ETSC, 1995) that the extra travel time from reducing average speed by 5 km/h. over a 10 km journey ranges from 1 minute 20 seconds when the base speed is 50 km/h to just 11 seconds when it is 130 km/h. There is continuing controversy as to the validity of aggregating small time savings or losses in the valuation of travel time (Frith, 2012).

If we are to maximise sustainability, we need to know public sector costs and benefits on a whole of government basis, rather than just within silos, so that we can better move towards a more effective and sustainable cross-government future, with maximal bipartisan political buy-in. This is discussed in more detail in Mercier (2025).

We need to retain and propagate the Safe System Approach to Road Safety

The Safe System approach is the basis of many of the world's road safety strategies. The Safe System's 5 pillars are Safe Speeds, Safe Roads, Safe Vehicles, Safe People, and Post-Crash Care (Levinson, 2024). The Government's road safety objectives (Ministry of Transport, 2024 pg2) are "focusing on safer roads, safer drivers, safer vehicles and resetting our approach to speed limits". The Safe System approach should be better explained to Transport Professionals and the community, as our experience is that its concepts have not penetrated much further than the ranks of road safety professionals.

We need to encourage people to use safer modes

Transportation people have little leverage to influence Government population policies but may have more traction regarding modal shift policies. Figure 7 (ITF, 2024 pg 29) depicts motor vehicle deaths per billion vehicle kilometres for high income countries contributing data to IRTAD (International Traffic Safety Data and Analysis Group). IRTAD is a permanent working group of the International Transport Forum (ITF).

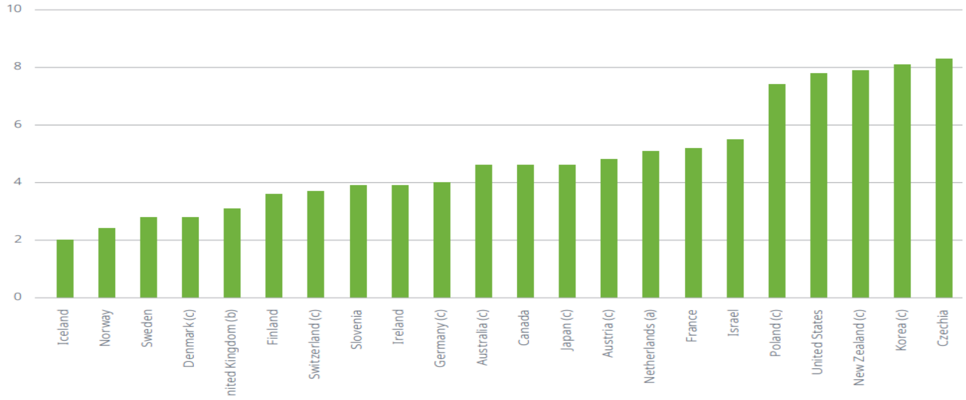

Figure 7:Motor vehicle deaths per billion vehicle kilometres for high income countries contributing data to IRTAD. (c) denotes 2022 data. Otherwise, data is from 2023.

It is obvious from Figure 7 that one tactic to control road injury would be to reduce vehicle kilometres traveled or indeed moderate their increase. Vehicle kilometres of travel have stubbornly increased over time and correlate well with population changes. Prince, Frith and Tate (2022, pg 9) found a linear fit between national resident population and Light Vehicle VKT (Figure 8).
The strength of correlation between national population and Light Vehicle VKT was very strong, having a value of 0.933 using data from the year 2001 to 2020.

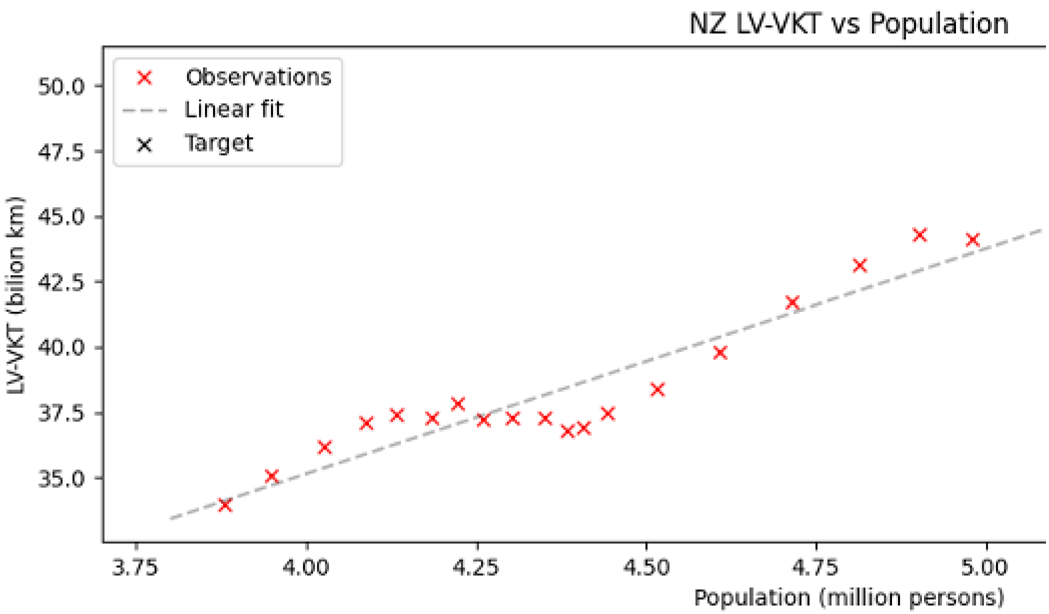

Figure 8:Chart of New Zealand light vehicle VKT against New Zealand population

An obvious consideration is to encourage movement to public transport, which is a safer mode (Figure 9 from Ministry of Transport, 2015 pg 6). Such a move would also reduce greenhouse gas emissions.

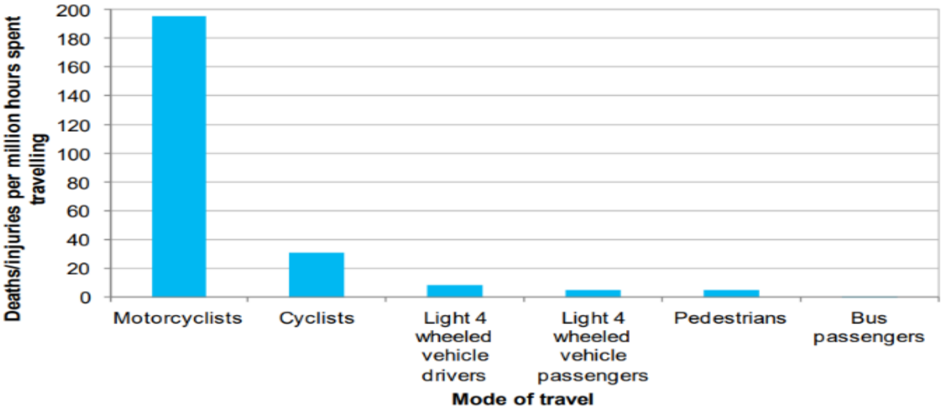

Figure 9:Deaths and injuries in motor vehicle crashes per million hours spent traveling by travel mode

However, many factors including our spread-out urban fabric, the result of historic land-use policies, limit the penetration of public transport and its perceived and actual cost, so this is a long-term project. Public Transport also needs to be more reliable. Safe shift to vulnerable modes also implies that measures must be made to protect vulnerable road users, not only from motor vehicles but from other vulnerable road users. This includes vulnerable users of facilities separated from motor vehicle traffic, like cycle lanes, footpaths and shared cycle/pedestrian paths. This area is discussed in more detail by Koorey et al (2024).

We need to measure our progress

Up until a decade ago New Zealand was able to report several intermediate road safety measures as a guide to progress, available without waiting for crashes to happen and then react. This included speed (now reinstated), drink driving on the network (now reinstated), seatbelt use, cycle helmet use, cellphone use while driving. There was also much better access to information on hospitalisations from crashes. Progress measurement is an important component of being able to put resources into the most effective places and more work is required to improve the measurement programme. Information on non-motor vehicle road injury is discussed in the next section.

ROAD INJURY NOT ASSOCIATED WITH MOTOR VEHICLES

So far, we have mostly discussed only motor vehicle related injury, often referred to as the road toll. However, roads (the whole road reserve including footpaths, shared paths, cycle lanes and paths etc) are the site of many non-motor vehicle related slips, trips, falls and crashes involving vulnerable road users, namely pedestrians, cyclists, and micromobility vehicle users. These injuries will increase as population increases, but probably more steeply than motor vehicle related injury unless more is done to reduce their number. This is because as these are injuries to vulnerable road users, the increasing numbers of fragile older people will be more vulnerable than members of the same demographic traveling in a motor vehicle. Injury from these sources is very costly but tends to fly under the radar as it is not included in motor vehicle crash statistics but in the Public Health and ACC statistics. These are rather less accessible and less specific in terms of location and circumstances than Police motor vehicle crash statistics. It is less likely for such incidents to be included in CBA as they are not routinely shared with Police or the NZTA. Frith and Thomas (2010) found that around 700 pedestrians were admitted to hospital each year due to slips, trips and stumbles in the road environment. This is similar to the 738 pedestrians admitted for injuries caused by motor-vehicle collisions in the 2008 calendar year. Methorst et al (2017) found that in the Netherlands 4–9 times as many pedestrians are injured in falls than in pedestrian-vehicle collisions. Sweden includes these types of injury in its national database for the road transport injuries (Skyving, 2025), and New Zealand would have a much better picture of total road injury if we took steps to follow suit.

SOME CRASH IMPLICATIONS OF AN AGING POPULATION

As the population ages the types and locations of crashes involving drivers from the different age groups change. So, when we look at crash involvement (NZTA Crash Analysis System, 21/01/2026) whereas roughly 50% of all drivers involved in high severity (DSI crashes) are in rural environs, for those drivers 75 years and older, only 41% are involved in rural high severity crashes. Of these rural crashes on average 51% are single vehicle crashes whereas for older drivers (those 75 years and older) only 36% of rural crashes are single vehicle. At the other end of the scale the majority of crashes for older drivers are multi-vehicle crashes in urban areas. This is related to a tendency for older drivers to carry out shorter journeys and thus do less rural driving than their younger counterparts.

It is a common misconception that older drivers are riskier than their younger counterparts. In reality, older drivers are involved in proportionally fewer crashes than middle-aged drivers (AA Research Foundation, 2023). However, due to increased fragility, when they do crash they're more likely to get hurt than younger drivers. As public crash statistics pertain only to injury crashes, older driver crashes are more likely recorded in the database than if the driver was younger and therefore survived uninjured. The same applies to older passengers. This underlines the importance of having our vehicles as crash-worthy as possible and containing advanced driver assistance systems appropriate to older drivers. The most helpful of these systems for older drivers include lateral position control systems, headway control systems and automatic high beam activation (AA Research Foundation, 2023).

As the majority of urban crashes occur at priority intersections, ability of drivers to identify and assess safe gaps in traffic is important. A review of factors impacting driver gap acceptance (Tate 2003) found older drivers are characterised by reduced physical ability, specifically neck articulation, which impacts on visual scanning (Isler et al, 1997). Poorer visual performance and slower lane clearance times when negotiating intersections require older drivers to generally accept larger gaps (Parsonson et al, 1994). Drivers' gap acceptance becomes increasingly conservative with age (Darzentas et al, 1980) and age-related changes in perception and cognition lead to more variable gap acceptance decisions (Staplin et al, 1997).

A strong correlation between the mean critical gap and the variance of critical gap has also been found (Bottom and Ashworth, 1978). This supports the observation that older drivers, who typically have a more conservative gap acceptance, are more likely to have a larger variance in acceptable gaps. Within each age group, female drivers are more cautious than male drivers (Darzentas et al, 1980; Staplin, 1995; Staplin et al, 1997).

Although unable to correct for the effect of different rates of exposure in different driving environments, a study (McKenna et al, 1998), has shown that as age increases the crash risk at junctions, expressed as a proportion of all accidents increases, and is higher across all age groups for women drivers Using a simulation experiment the study found older subjects, and in particular older women, were more likely to accept so called "risky gaps" even though the mean gap acceptance for this group is typically more conservative.

Ocular deterioration in older drivers makes driving at night more difficult as drivers age. Factors like these mean that older drivers tend to self-regulate choosing routes that avoid high speed intersections and driving at night (Frith, 2002). It also implies that road markings and signage, which are usually calculated based on the needs of younger people may become increasingly inadequate as the driving population ages. Figure 10 from AA Research Foundation (2023, pg12) quoting Van Bommel (2015) illustrates the difference in night vision between a 25-year-old and a

65-year-old. This difference is corrected by cataract operations, where they are available.

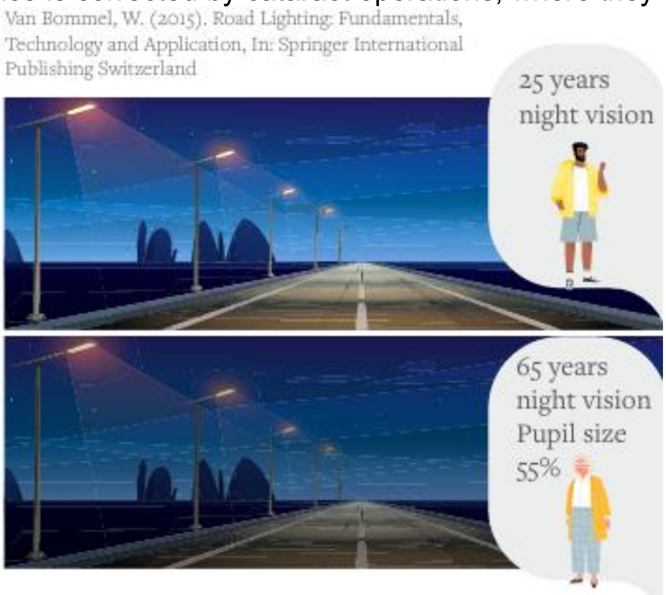

Figure 10: Comparison of the night vision of a 25 year old and a 65 year old. From AA Research Foundation (2023) pg 12, quoting Van Bommel (2015)

Retroreflectivity of existing signs is based on performance in New Zealand as assessed visually by mobile inspectors. Having inspectors of over 60 years of age as in some US states could improve recognition of the requirements of older drivers (AA Research Foundation, 2023, pg12)

To develop a more resilient road safety approach to road safety against a background of an aging population requires decision makers to understand the issues faced by older drivers and to develop customized improvement programs.

IMPACT ON ROAD SAFETY INFRASTRUCTURE

Issues such as those identified above should see more emphasis on preventing and ameliorating crashes at urban junctions and in particular those involving higher speed and higher volume intersections. This may see a greater emphasis on explicit control such as traffic signals or the extension of lower speed environments. Already some local authorities with higher proportions of retired residents are undertaking more in-depth analysis of their crash situation and remedial measures. Without increased funding, this increased emphasis may require some reallocation of resources. While the above focused on the majority, older drivers, one recent investigation at Kapiti Coast District Council (Minnema, Ron, 2025) has identified an increasing issue with older cyclists.

CONCLUSIONS

- Our past road safety performance does not compare favourably with that of other high-income countries, and our relative position has deteriorated over time.
- If we continue with the same motor vehicle- related deaths per capita as at present, we are looking at an overall 35% increase in DSIs by 2063
- Eighty-four percent of that increase is projected to occur in the 40+ age group. This group has a relatively low personal risk but is expected to be responsible for the bulk of the population increase and consequently the bulk of the DSI increase.

- Similarly, injuries from non-motor vehicle related slips, trips, falls and crashes involving vulnerable road users (pedestrians, cyclists, and micromobility vehicle users) will increase, as population increases. The increase will likely be steeper than for motor vehicle related injury because the increasing numbers of more fragile older people will be more vulnerable than members of the same demographic traveling in a motor vehicle.

- To improve we should:

  - Retain and propagate the safe system approach to road safety so the culture of New Zealand becomes better attuned to its precepts

  - Work towards a safe system resiliently and sustainably. Resilient in this context means a high ability to stay on course and sustainable adds the dimension of being able to do so in the long term within the resources of the nation. This implies a high level of political bipartisanship, with a willingness to accept free and frank evidence-based policy advice.

  - Allocate resources in a less siloed and more nuanced manner. If we are to maximise sustainability, we need to know public sector costs and benefits on a whole of government basis, rather than just within silos, so that we can better move towards a more effective and sustainable cross government future, with maximal bipartisan political buy-in.

  - Encourage people to use safer modes. Public Transport is a very safe mode, and its availability and reliability need to increase. Safe shift to vulnerable modes implies that measures must be made to protect vulnerable road users, not only from motor vehicles but from other vulnerable road users.

  - Measure progress. Progress measurement is an important component of being able to put resources into the most effective places and more work is required to improve the measurement programme.

  - Carry out research to provide evidence where existing evidence is inadequate.

  - Take specific account of the needs of the aging population when developing programs for road safety improvement

REFERENCES

AA Research Foundation (2023) Insights into older driver safety and mobility *AA Research Foundation Report* *Infographics-Insights-into-older-driver-safety-mobility-AA-Research-Foundation-2023.pdf* Viewed 20/1/2023

Darzentas, J., McDowell, M.R.C., Cooper, D.F. (1980). Minimum acceptable gaps and conflict involvement in a simple crossing manoeuvre. *Traffic Engineering and Control*, 21 58-61.

Elvik, R. (2009). The Power model of the relationship between speed and road safety. Update and new analyses.. *Institute of Transport Economics* Report 1034, Oslo getfile.php Viewed 28/01/2026

Elvik, R (2019) A comprehensive and unified framework for analysing the effects on injuries of measures influencing speed. *Accident Analysis & Prevention* 125: 63–69

Elvik R, Vadeby A, Hels T, van Schagen I. (2019) Updated estimates of the relationship between speed and road safety at the aggregate and individual levels *Accident Analysis & Prevention* 123:114-122

ETSC (1995) Reducing traffic injuries resulting from excess and inappropriate speed. European Transport Safety Council, Brussels.

Frith, W J. and Toomath, J B (1982) The New Zealand open road speed limit, Accident Analysis & Prevention, Volume 14, Issue 3, Pages 209-218

Frith, W J (2002) Engineering for safe mobility for older transport users *Conference on Mobility and Safety of Older People,* Melbourne, Australia pp *193-223*

Frith, W., Thomas J. (2010). The mechanisms and types of non-motor vehicle injuries to pedestrians in the transport system and indicated infrastructure implications. *NZ Transport Agency research report* 431. 104pp. Research Report 431 The mechanisms and types of non-motor vehicle injuries to pedestrians in the transport system and indicated infrastructure implications Viewed 29/01/2026

Frith, W J (2012) Economic evaluation of the impact of safe speeds: literature review. NZ Transport Agency research report 505. 38pp. RR 505 Economic evaluation of the impact of safe speeds: literature review Viewed 28/01/2026

Isler, R.B., Parsonson B.S., Hansson G.J. (1997). Age related effects of restricted head movements on the useful field of view of drivers Accident Analysis and Prevention (29) 6 pp. 793-801.

ITF(2024) *IRTAD Road Safety Annual Report 2024* Road Safety Annual Report 2024 Viewed 28/10/2025

Koorey, Glen, Frith, William (2017) Changing rural speed limits – learning from the past *IPENZ Transportation Group Conference*, Hamilton, 29 – 31 March 2017 (PDF) Changing Rural Speed Limits - Learning from the past Viewed 28/10/2025

Koorey, G., Lieswyn, J., Gregory, M., van den Top, P., Reid, N., Azzizi, A., & Ware, L. (2024). Mode-shift impact on safety (NZ Transport Agency Waka Kotahi research report 728) Research Report 728 – Mode-shift impacts on safety – October 2024 Viewed 28/01/2026

Levinson, David M (2024) Safe System Approach to Traffic Management *Module 7-1 The Safe System Approach.* Austroads https://austroads.gov.au/__data/assets/pdf_file/0027/392067/Module_7-1_The_Safe_System_Approach.pdf Viewed 28/10/2025

McKenna, F.P., Waylen, A.E., and Burkes, M.E. (1998) Male and Female drivers: how different are they? 66 pp *Report by University of Reading for AA Foundation for Road Safety Research* Basingstoke

Mercier, Kali (2025) Ageproofing Aotearoa Rethinking our infrastructure for an ageing population Helen Clark Foundation/WSP Report https://www.wsp.com/-/media/campaign/new-zealand/documents/hcf-25-two-age-proofing/age-proofing-aotearoa-by-wsp-and-the-helen-clark-foundation.pdf Viewed 5/11/2025

Methorst, Rob, Schepers, Paul, Christie, Nicola et al (2017) 'Pedestrian falls' as necessary addition to the current definition of traffic crashes for improved public health policies, *Journal of*

Transport & Health, Volume 6, 2017, Pages 10-12

Ministry of Transport(2015) Risk on the road: Introduction and mode comparison Wellington New Zealand https://www.transport.govt.nz/assets/Uploads/Report/Risk-2015-intro-overview-final.pdf Viewed 24/10/2025

Ministry of Transport (2024) New Zealand's road safety objectives 2024 24-EX-087-Road-Safety-Objectives-document_v2.4.pdf Viewed 28/10/2025

Minnema, Ron (2025) Employee of Kapiti District Council. Personal Communication

Parsonson, B. S., Isler, R. B. and Hansson, G. J (1996). Driver Behaviour at Rural T-Intersections. *Transit New Zealand Research Report No 56*, 73 pp Wellington NZ. https://www.nzta.govt.nz/assets/resources/research/reports/056/056-Driver-behaviour-at-rural-t-intersections.pdf Viewed 28/01/2026

Prince, Thomas, Frith, William and Tate, Fergus (2022) Household travel in our major urban areas-Initial Investigations on Light Vehicle Kilometres Travelled *Briefing paper for NZTA* Household travel in our major urban areas Viewed 12/01/2026

Prince, Thomas (2023) Reducing Light Vehicle Kilometres Traveled *PowerPoint Presentation, ENZ Transportation Conference*, Household travel in our major urban areas Viewed 28/10/2025

Skyving, Marie (2025) Serious Injury Data Collection in Sweden Linking police and hospital data – a national approach *Road Safety Analyst PIN Talk – Reducing serious injuries in Europe*, Online, ETSC Marie-Skyving-PIN-talk-Serious-Injuries-The-STRADA-database-and-serious-injury-reporting-Nov-2025.pdf Viewed 12/01/2026

Staplin, Loren. (1995). Simulator and Field Measurements of Driver Age Differences in Left-turn Gap Judgments *Transportation Research Record No 1485 Safety and Human Performance: Human Performance and Safety in Highway, Traffic and ITS Systems*. Transportation Research Board. Transportation Research Record No. 1485, Human Performance and Safety in Highway, Traffic, and ITS Systems Viewed 28/01/2026

Staplin, L., Harkey, D.L., Lococo, K. H. and Tarawneh, M.S. (1997). *Intersection Geometric Design and Operational Guidelines for Older Drivers and Pedestrians Volume I: Final Report*. FHWA-RD-96-132 US Department of Transportation, Federal Highway Administration McLean VA.

Svenson, O. (2008). Decisions among time saving options: When intuition is strong and wrong. *Acta Psychologica, 127*(2), 501–509.

Svenson, O. (2009). Driving speed changes and subjective estimates of time savings, accident risks and braking. *Applied Cognitive Psychology, 23*(4), 543–560

Tate, F. N. (2003). JAWS: The Safety Impact of a Junction Action Warning System. (PhD), University of Leeds (Institute for Transport Studies).

Van Bommel, W. (2015) *Road Lighting: Fundamentals, Technology and Application* Springer International Publishing Switzerland