Demand for transport services: impact on networks of older persons' travel as the population of New Zealand ages

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Abbreviations and acronyms

ACC:	Accident Compensation Corporation
EEM:	Economic evaluation manual
MoT:	Ministry of Transport
NZTA:	NZ Transport Agency
SGC:	SuperGold Card (a free discount and concession card for free off-peak public transport for all New Zealand residents aged 65 years or over and for those under 65 years receiving New Zealand Superannuation or the Veteran's Pension)
SH:	State Highway
SNZ:	Statistics New Zealand
STS:	special transport service
US:	United States
WTORS:	wheelchair tie-down and occupant restraint system

Contents

Executive summary

As time progresses, New Zealand's population is projected to increase, with a changed age structure. In particular, older age groups are projected to increase much more than younger age groups, which, in some cases, are projected to fall as a percentage of the overall population. As personal travel tends to decrease for those aged 55 years and older, this change in the population's age structure is likely to result in reduced travel compared to the travel of a population of the same size and with the present age structure. It is also likely to result in a road user population with different characteristics and needs from the present population.

This research, undertaken in 2010, has projected both future household travel on the road network and safety levels, based on measures derived from New Zealand Household Travel Survey data and official road safety statistics. The projections have been made using three population projection series from Statistics New Zealand:

- series 1 representing low population growth
- series 5 representing medium growth
- series 9 representing high growth.

The 'mortality' variable underpinning these series has been used as a rough surrogate for health status. Such questions as 'to what extent will women increase their travel in the future relative to men?' and 'to what extent will older persons' per capita travel increase or decrease with changed health status or economic growth?' are addressed qualitatively, rather than in the projections. This is because no population projections are available to shed light on these issues. Time budgets for travel are also treated qualitatively.

The projections prepared as part of this report for household travel on New Zealand roads between 2006 and 2056 suggest that estimates which ignore the changing age structure of a population may overstate the change in travel by around 40%.This is related to large projected increases in the 65+group (273% by 2061), who have a lower propensity to travel relative to younger groups.

Looking at the three New Zealand population projections, differing mainly in regard to mortality assumptions, changes in population health factors make a relatively small difference up to around 2020, but greater variation appears after that time.

The age structure of the workforce is projected to change substantially, with the workforce expected to continue to grow but at a slower rate after the late 2020s. A 190% rise for the 65+ group by 2056 is also indicated, compared with a 26% increase for the population as a whole. The projected changes in the age structure of the workforce are likely to have a noticeable effect on work-related travel, which is projected to increase from current levels by 4.3% in 2031 and by 4.9% in 2056. This increase represents an additional 500 million kilometres' travel per year in 2056. Although substantial in absolute terms, this represents a little over 1% of the 46.18 billion kilometres of total travel projected for 2056.

It is expected that differences in regional age changes and in regions' overall population projections will be substantial. All areas have expected growth greater than 80% for those aged 65 years and older, except for Southland, where the figure is 74.9%. Six regions have a total population growth of under 10%, with two additional regions (West Coast and Southland) having a projected decline. This results in a diversity of expected travel by region by 2031. Some smaller regions will have higher proportions of older people, but relatively low overall older persons' travel in terms of absolute distances; larger regions, a relatively low proportion of older people but relatively high absolute older persons' travel. Thus both the proportion of older people in the population and the absolute numbers need to be used in deciding future action in this area. Each region will require its own approach to providing transport and safety at a level that is appropriate to its particular mix of traffic and age groups in the future.

In cities, the older population already has tended to congregate on the urban periphery. Little indicates that older people will move to the types of accommodation easily served by public transport. Other vehicle safety, vehicle operator and vehicle accessibility issues need to be resolved if public transport and special transport for the disabled modes are to become more acceptable to and used by older people.

Thus public transport is expected to continue to be a minor mode for older people unless town planning and public transport policy changes substantially, with the present reliance on the car, either as driver or passenger, being expected to continue. However, the absolute size of public and special transport will need to increase to cater for the greater older population, if only to keep pace with growth. Based on survey results, the most positive sign for public transport is the SuperGold Card. It may be that substantial percentage increases in public transport use among older people will occur as the population ages.

Surveys have indicated that:

- the present day older population might travel more if travelling was made easier
- older women feel slightly more constrained in their travel choices than do older men
- a healthier aged population in the future might travel more.

With regard to safety and considering time spent travelling, older people are as safe as middle-aged people when using the road network in various capacities. Projections indicate that the future numbers of all road deaths and injuries will be largely unchanged, despite changes in the age structure of the population.

However, because of the increase in the number of older people, road deaths and injuries incurred by older persons aged 65 + years are projected to increase by 42–97% by 2031, depending on the region. These increases will mean that older persons' deaths and injuries as proportion of all deaths and injuries will increase from the present range of 7.6–11.2% to a range of 13–17.4%, depending on the region in question. In other words, older persons' injuries will become a greater proportion of road trauma – a finding which should influence authorities when setting their road safety priorities.

The study found that any projections to be used in planning our transport network need to take the changing age structure of the population into account. It also found that projected network flow changes will differ markedly by region, requiring region-specific policies in future. The interface between public/special transport and the older person needs to be made friendlier if these transport modes are to be used in preference to the private car. In addition, further encouragement is needed for people to take their own transport needs into account when making housing decisions, with urban planners needing to take accessibility of services by public transport and non-motorised modes into account.

In the safety area, improved provision for older road drivers and older pedestrians is also required. Encouragement to cycle should be sensibly moderated by knowledge of older cyclists' frailty and increased vulnerability to injury in the event of a crash.

Abstract

This research, undertaken in 2010, aimed to provide predictions of older persons' (age 65+) demand for transport until the mid-21st century in New Zealand, and how this will affect our networks.

- Projections which do not take an aging population into account overstate the increase in household travel by ~40%.
- Assumptions about population health factors make a small difference in travel estimates to 2020 but have greater impact thereafter.
- Changes in the age structure of the workforce increased total household travel demand by about 1%.
- Wide regional variations mean that each region will require its own approach to future transport and safety.
- Public transport will be a minor mode without improved public transport for suburban neighbourhoods.
- Vehicle safety, operator and accessibility issues need to be addressed.
- People aged 65–80 years are relatively content with the transport system, but those who are older indicated they would travel more if they could.
- Older women feel more constrained in their travel choices than older men.
- Road deaths and injuries will be similar to those expected for a population without any age structure change. However, older persons' injuries will become a greater proportion of all road trauma.

1 Introduction

This research, undertaken in 2010, will provide practical predictions of older person demand for transport until the mid-21st century[1], and how this and other accompanying demographic changes will affect our networks. Older people, defined as those aged 65 years and over, require safe mobility on a sustainable basis if they are to age positively and productively in line with the government's Safer Journeys Road Safety Strategy (Ministry of Transport (MoT) 2010) and also its Positive Ageing Strategy (Office For Senior Citizens 2001). Information on their demand for transport is therefore urgently needed so that proactive planning can take place to cater for this growing group in a sustainable manner.

This report is not designed to cover all issues related to aging and transport, but only those which can be realistically incorporated into planning for road network travel. These issues can be quantified to various extents. Some are discussed qualitatively in this report; others more quantitatively. Travel projections in this report are based on travel estimates from the MoT's Household Travel Survey, expanded using official Statistics New Zealand (SNZ) population projections as shown in table 1.1.

Table 1.1 SNZ population projection series used in this research

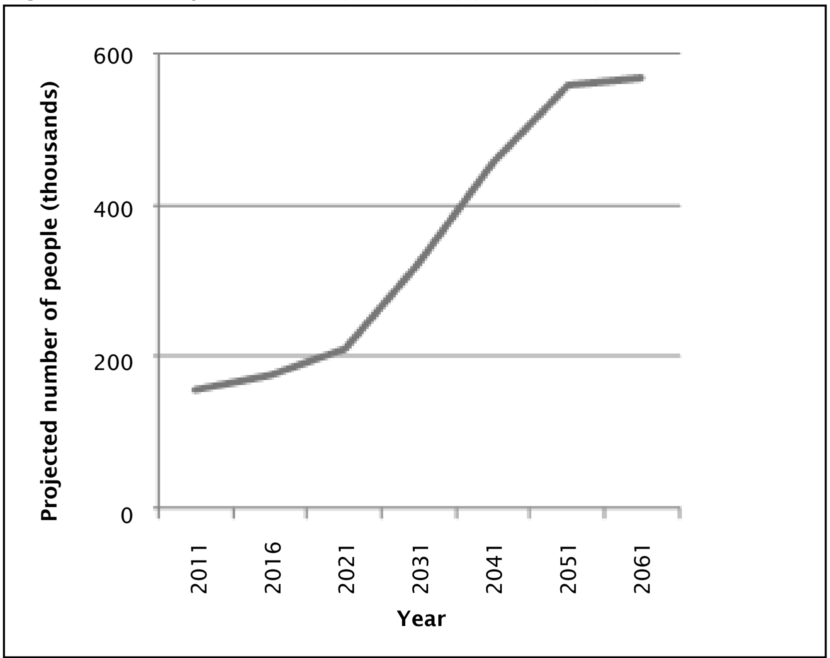
Series	Fertility	Mortality	Long-run annual net migration
1	Low	High	5000
5	Medium	Medium	10,000
9	High	Low	15,000

1 This approximates the horizon of Statistics New Zealand projections.

2 Background

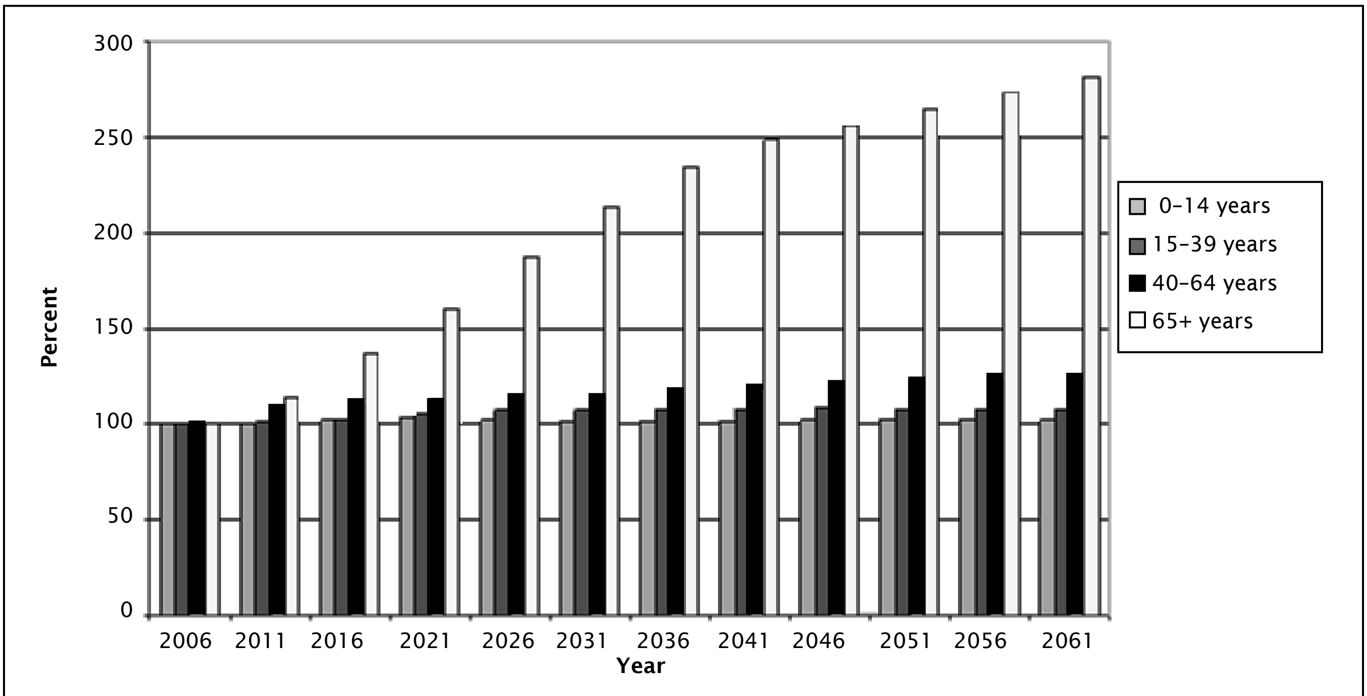
Demographic change will result in a steady increase in people aged 80+ years, both in absolute numbers and as a percentage, with the rate of increase growing rapidly from around 2020 onwards, followed by a levelling out beginning around 2040 (see figure 2.1 and figure 2.2).

Figure 2.1 Projected 80+ population by year (base year 2006*)



*Data courtesy of SNZ, using series 5 projections

Figure 2.2 Projected percentage change in age groups by year (base year 2006*)



*Data courtesy of SNZ, using series 5 projections

This change will be accompanied by smaller increases in the numbers of younger people, who will, however, decrease as a percentage of the total population. The percentage of the population of legal driving age (15+ at the time of writing[2]) will rise from 79% (2006) to 84% in 2061 (figure 2.4), driven by increased longevity and with the rate of increase becoming flatter from around 2040.

Figure 2.3 Age groups as a percentage of the projected New Zealand population by year

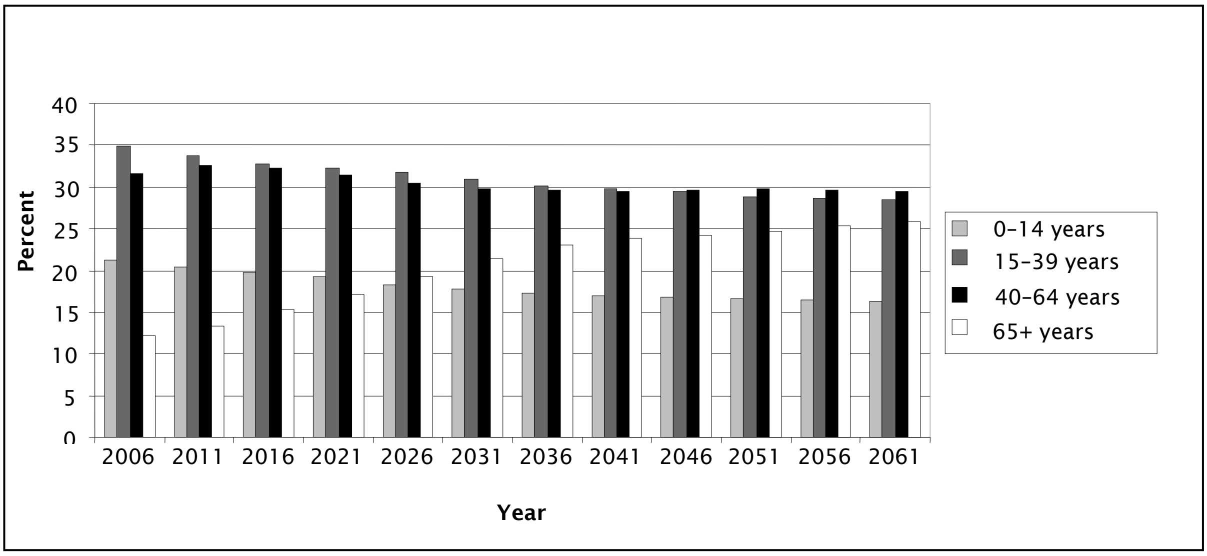
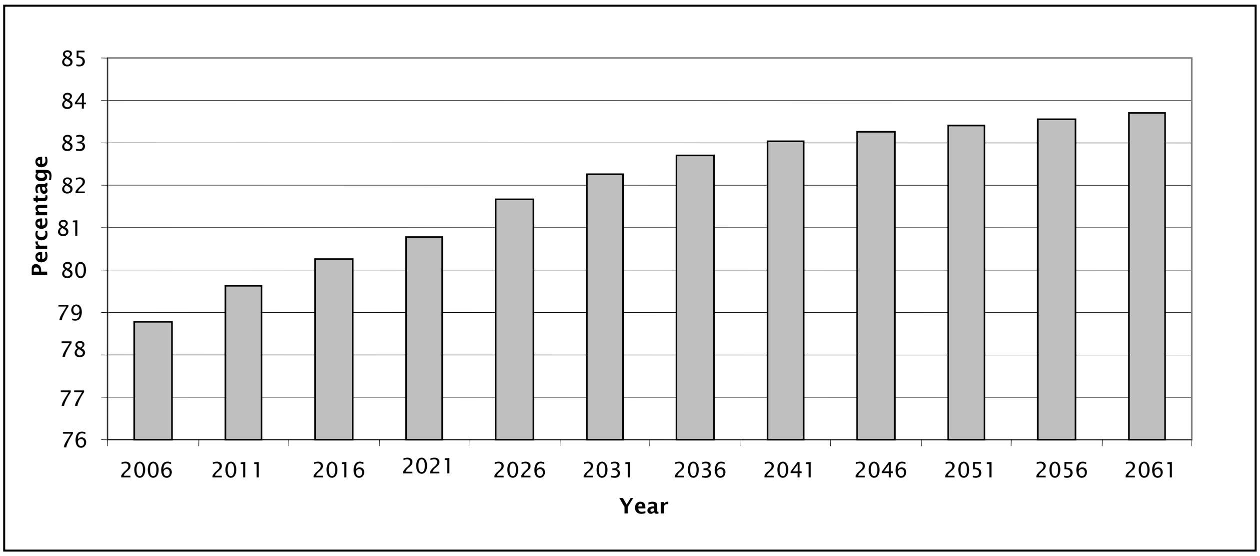


Figure 2.4 Projected percentage of the New Zealand population of driving age



2 While this report was being prepared for printing, the legal driving age in New Zealand changed from 15 years to 16 years. The impact of this change on projections would be small, as 15-year-olds typically do not travel very far as drivers.

3 Uncertainties related to projections of future travel

3.1 Background

Few attempts have been made to project the effects of demographic changes in age structure on transport networks systematically. A review of the literature found only one such attempt: Bush (2003) projected travel based on an 'integration of cohort analysis and travel demand modelling' using data from three United States (US) travel surveys and demographic variables, including age.

Regardless of their underlying assumptions and bases, projections are subject to a large number of uncertainties. Some of these uncertainties are discussed in the following section.

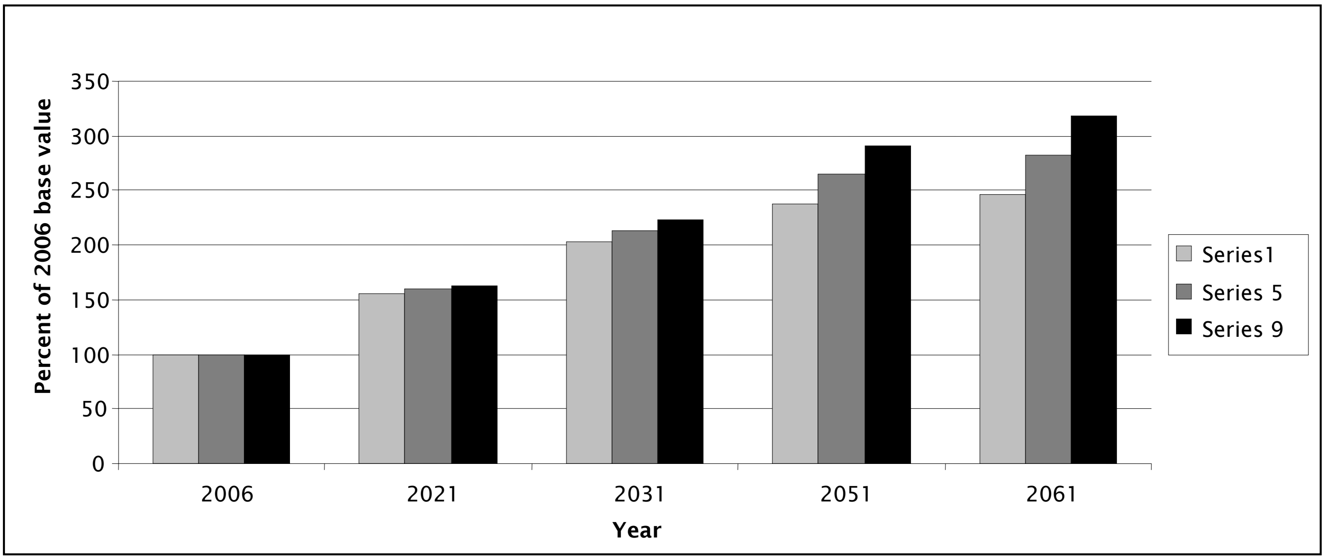
3.2 Uncertainties in terms of future demography

3.2.1 Overall population

SNZ publishes nine population projection series based on different fertility, mortality and migration rates. Projections for New Zealand's population of people aged 65+ years based on three of the projection series are shown in figure 3.1. The assumptions used have been given in table 1.1.

Using mortality as a surrogate for health status, series 1 relates to lower health status, series 5 to medium health status and series 9 to higher health status.

Figure 3.1 Population projections for people aged 65+ for SNZ's series 1, 5 and 9 (base 2006)



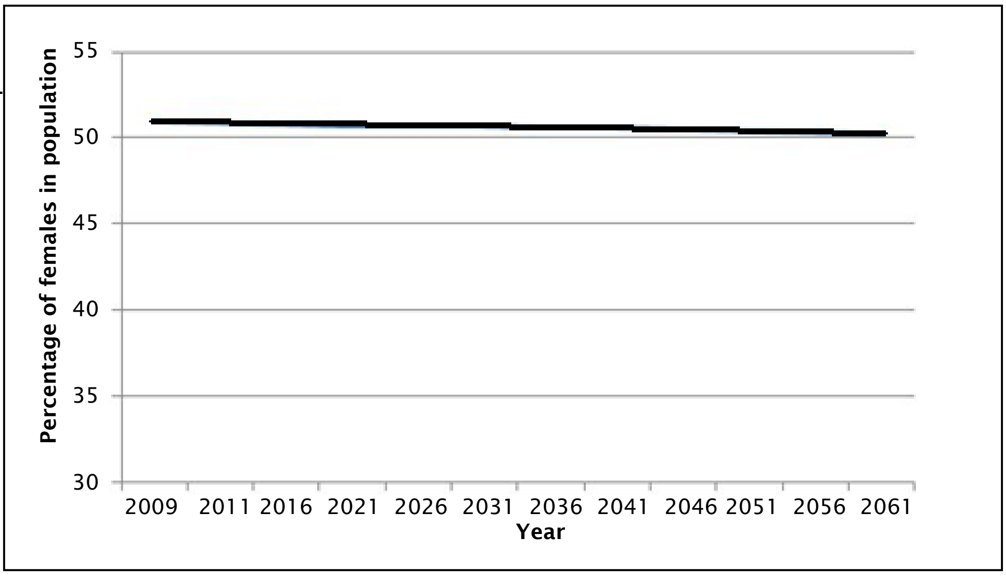
It can be seen that the differences in the projections from the mid-21st century are quite important, and these must be considered when planning network capacity. These differences would be larger were we looking at age groups older than the 65+ group.

3.2.2 Gender balance

As the population ages, the gender balance is likely to change, especially because of the propensity of women to live longer than men. Counterbalancing this tendency is an expected reduction in the difference between male and female life expectancies. Using medium SNZ projections (series 5), in 2009, there were 83 males for every 100 females in the 65+ age group; for ages 85+, there were only 50 males for every 100 females. By 2061, it is projected that for those aged 65+, the proportion of women is not expected to change much, whereas for ages 85+, there will be 69 males to every 100 females. These projections assume some future catch-up in male life expectancy relative to that of females.

Thus, from purely the demographic point of view, women's travel patterns will become proportionately less important for the 85+ age group but not for the 65+ age group. Over the entire population, the percentage of females is expected to drop slightly over time (figure 3.2).

Figure 3.2 Projected percentage of females in the New Zealand population



3.3 Uncertainties related to future older road user behaviour

3.3.1 Population health status

Health status[3] is another factor that affects travel behaviour. This issue, as it relates to older people, is well covered by Bohensky and Langford (2008). If health status improves, by 2030, older people are more likely to be active users of transport networks than today's older people. This change will be related to several factors:

- People have a tendency to retire later and live independently for longer with greater disposable income and, therefore, are likely to have more active lifestyles and greater demands for personal mobility.
- Different travel patterns will result from work-related journeys from older people still in the workforce.
- When these people reach a more dependent stage of life, access to these networks will become more difficult, exacerbated by

3 This report does not consider health-related disasters such as large-scale pandemics.

- smaller, more dispersed families, so that traditional within-family carers and transporters of older people may be less available
- more 'aging in place,' often in outer suburbs, with reasonably dispersed facilities and limited alternative transport options, unless proactive action is taken to provide such services.

However, the health status of future cohorts may not necessarily increase: it may also decrease or remain static. It is usually accepted that baby boomers (those born in the period 1946–1965) are likely to be healthier and more active, suggesting, amongst other things, an improved capacity to cope with the demands of travel. However, baby boomers in North America are in relatively poor health on numerous health status indicators:

> *The increases in physical inactivity and obesity, combined with smoking rates, place Canadian baby boomers at higher risk for chronic health conditions including heart disease, stroke and diabetes. A higher incidence of chronic diseases such as arthritis, diabetes, and heart disease also is reported in the United States for the baby boomer generation.* (Dobbs 2008)

If this worsening scenario came to pass in New Zealand, the subsequent impact on travel would be ambivalent. On the one hand, it would mean more older people (both numerically and proportionally) who may wish to travel, notwithstanding poor health and functional deficits. On the other hand, it would also mean more older people perhaps reducing their travel for those reasons, and almost certainly having greater difficulty in managing their travel. The combined impact of these factors is unknown.

3.3.2 Gender-related behavioural differences

O'Fallon and Sullivan (2009) used data from New Zealand travel surveys to show a consistent association between aging and the number of trips of any travel mode: the older the person, the fewer the trips. Against this overall trend, it was also found that the proportion of all trips undertaken by women as drivers dropped off after the age of 65 and even more markedly after the age of 75. This decline in trips as a driver was also true for older males but to a lesser extent. For example, 69% of the trips of men aged 75+ were as a driver, compared to 42% of trips by women in the same age band.

While this data shows that older women were more prone to reducing their driving as a preferred transport mode than men, the study did not determine the reasons for the greater decline. Oxley et al (2010) surveyed both former and current older women drivers about driving issues, transport needs and crash involvement. Almost all (98%) older women who were married or lived with a partner reported they were not the primary driver in their household. This supports the suggestion that older women in relationships drive less frequently and provides a possible reason for females' decline in driving after retirement. As new and culturally different cohorts of people reach the older age groups, with possibly different propensities to drive and to take part in activities which require transport (such as working), only time will reveal the future extent of this male predominance in older persons' driving.

Set against this is the increase in total driving of women of all ages relative to that of men over the period 1989/90 to 2004/07 , with the increase being much greater between 1989/90 and 1997/98 than between 1997/98 and 2004/07 (O'Fallon and Sullivan, 2009). These results are shown in table 3.1.

Table 3.1 Driver trips and total distance driven, by gender of driver: 1989/90, 1997/98, and 2004/07 (source: O'Fallon and Sullivan 2009)

	Total	Male	Female
Total driver trips (in millions)			
1989/90	174.5	121.2	53.3
1997/98	270	165	105
2004–07	364	214	150
Annual distance driven (in 100 million km)			
1989/90	10.4	7.9	2.5
1997/98	18.7	12.7	6.2
2004–07	25.0	15.8	9.2

This increase was associated with increases in women's licensing relative to men. Thus women are increasing both their driving and licence holding but, after the age of 65, are decreasing their driving distances more than men. The changes in driving and licensing seem to be flattening out. How these present-day tendencies will continue into the future is uncertain. Many extraneous factors, including economic factors, will intrude. Given older women's greater propensity to use other modes than driving, this may indicate that population-based estimates of driving may be a realistic upper bound.

Kostyniuk and Molnar (2008) interviewed older drivers about their extent of driving. The authors used hypothetical scenarios to identify any differences based on physical mobility, visual ability and gender. Overall, gender had the greatest self-reported effect on driving both by modifying driving behaviour and by not driving, with women being more likely than men to show such behaviours. The authors suggest this relationship could also be caused, to some extent, by female drivers having lower driving confidence overall, as this has previously been shown to influence the extent of driving.

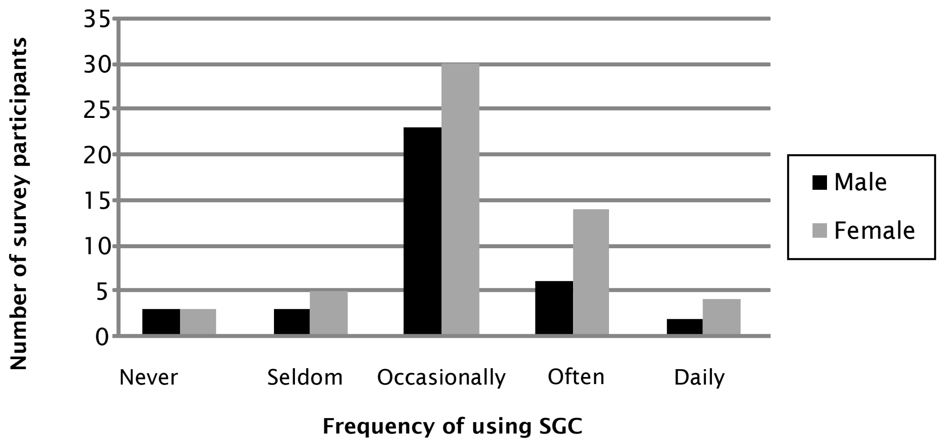
Bauer et al (2003) also found that older women were more likely to regulate their driving, particularly in relation to driving less, reducing night-time and freeway driving, and avoiding long trips and bad weather. However, when looking at reasons for giving up driving altogether, Hakamies-Blomqvist and Siren (2003) found that it was the driving habits of women prior to giving up their licence that had the biggest effect on this decision, rather than their gender *per se*. Those women with more driving experience were more likely to retain their licence longer than those with less experience. Women aged 75+ made 32% of their trips as a passenger in 2004–07 compared with 9% of men at the same age (O'Fallon and Sullivan 2009).

Self-report surveys[4] were conducted as part of this research with a sample of people who were all eligible for the SuperGold Card (SCG)[5] to gain understanding of the use of public transport by older people. Regarding gender, as shown in figure 3.3, female respondents were higher users of the SGC, with 33% using it more than occasionally compared to 20% of men. This, in combination with our other findings for passengers, confirms that older women are greater users of non-driver modes than men.

4 A home interview survey of 100 New Zealanders aged 65+ residing in the Hutt Valley, a part of the greater Wellington urban area, was carried out in August–September 2010. The survey was carried out by the 'snowball' method where members of a peer group who were interviewed were asked to nominate other members of the peer group who might be approached. These people were then approached and interviewed until the required number was reached.

5 New Zealand residents aged 65 years or over and those under 65 years receiving New Zealand Superannuation or the Veteran's Pension are eligible for an SGC. The SGC is a free discount and concession card available that includes free off-peak bus travel, which is discussed in more detail in section 3.2.3.

Figure 3.3 Percentage of eligible men and women using the SGC to various extents



Survey results reported in chapter 8 also indicate older females feel more transport constraint than older males.

3.3.3 Reaction to changes in fuel prices and public transport fares

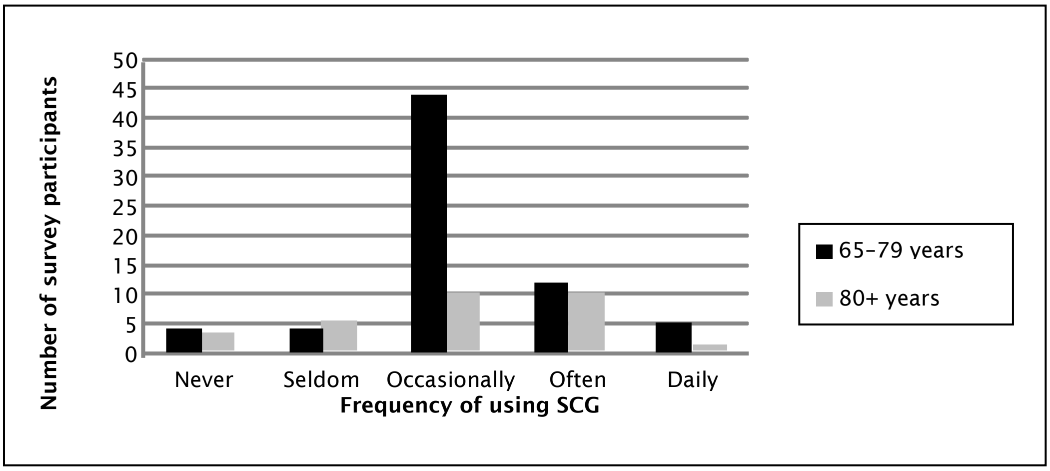
3.2.3.1 Prior research

Kennedy and Wallis (2007) looked at the effect of fuel prices on future New Zealand travel. This study did not take demographic change into account and neither were any of its references quoted as taking demographic change into account. From this, it has been taken that little information is available on how demographic change will affect the impact of fuel price rises on network flows. However, Kennedy and Wallis indicated that any fuel price changes would happen swiftly and would be relatively small. This would indicate that within these changes, demographically-led differences would also be relatively small. This report does not go into this area any further than this, but this does highlight a need for future research in this area. Were the SGC to continue, this would provide a level of insulation of people aged 65+ to increased travel costs from this source and one could conjecture some degree of modal shift from private to public transport for this group.

3.2.3.2 Frequency of using the SGC

To gain a greater depth of knowledge regarding the influence of the SGC, a sample of older people were surveyed to look at the impact of the SGC on their travel. Responses were disaggregated into a younger group (65–79 years) and an older group (80+ years). Figure 3.4 indicates that for the younger group, around 63% use it occasionally and a little over 20% use it more than occasionally. Generally speaking, the 80+ age group uses the card more than younger people, with more than 35% using it more than occasionally. In both groups, daily use is relatively small.

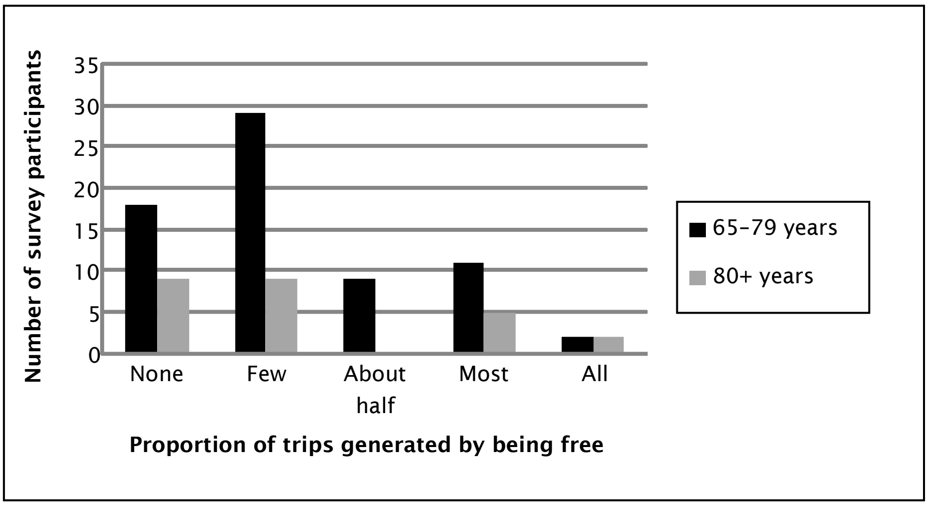
Figure 3.4 Frequency of SGC use by user age



3.2.3.3 Travel generated by the card

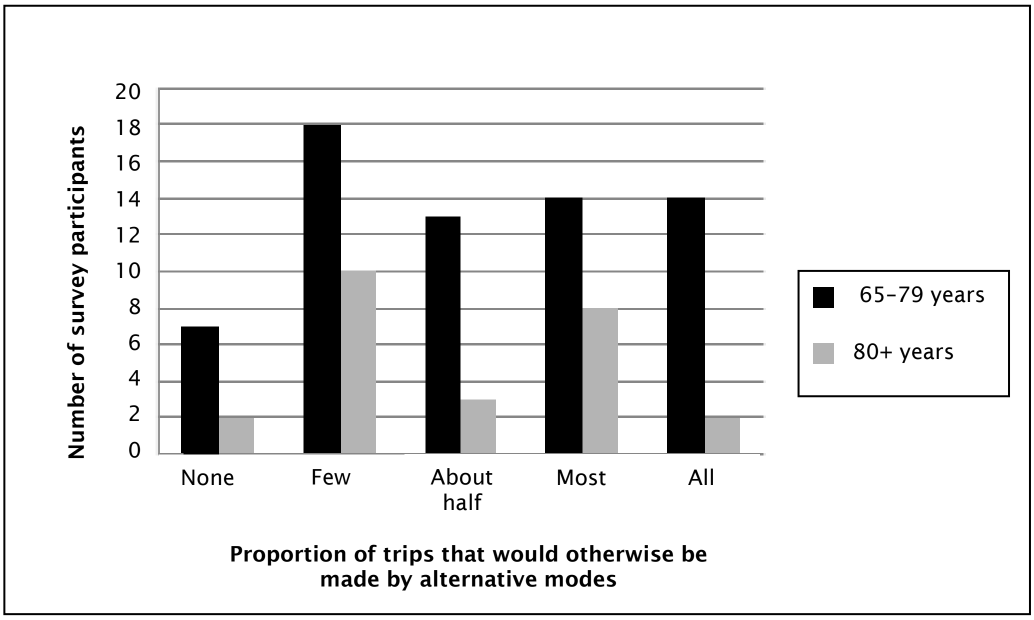
Figure 3.5 illustrates, by age, the perceived proportion of public transport trips made by respondents only because the SGC is free. This shows that for both age groups, most trips they take are perceived not to be generated by the card being free. However, in the older age group, a greater proportion of participants (27% compared to 11%) perceived that most or all of their trips were generated by the card being free. Overall, about 31% of all the respondents indicated that about half or more of their public transport travel was generated by the SGC being free.

Figure 3.5 Perceived proportion of public transport travel generated by the SGC being free



Another way of looking at this issue is to consider users' perceptions of how they would use transport if no card was available. As can be seen in figure 3.6, the distribution for the 80+ age group was bimodal, with about 48% responding 'few' or 'none', and about 40% responding 'most' or 'all'. For the younger group, the distribution throughout the alternatives was more even with a small number of responses under 'none'.

Figure 3.6 Respondents' perceived use of transport if no free card was available



McDermott Miller (2010) conducted another SGC user survey. The survey was carried out by telephoning households and yielded 388 responses.

Around 58% of respondents perceived that their most recent journey would not have been affected if the SGC scheme did not exist. About 800,000 'induced travel'[6] trips (out of the 7.4 million total) were made under the scheme in its first year. This translates to a 12% increase in public transport usage in the target age group. Slightly more than quarter (27%) of journeys under the scheme were journeys that would have been made by another mode if the card did not exist.

3.2.3.4 Summary of results

Combining the results of both the McDermott Miller (2010) study and our own survey of SGC users produces the following summary:

- Most card use is occasional and increases with age, with the card seldom being used daily.
- In terms of respondents' perceived use of transport if there was no free card available
  - The distribution for the 80+ age group was bimodal, with about 48% responding 'few' or 'none', and about 40% responding 'most' or 'all'. This could be related to availability of other transport options. The percentage of drivers in the sample dropped off steeply with age.
  - For the younger group, the distribution across the different usage categories was more even, with a small number of responses under 'none'. This could be related to the generally higher disposable income levels of the households from which younger members of the sample were drawn and their higher driving levels.
  - Around 27% of journeys under the scheme were journeys that would have been made by another mode if the card did not exist
  - A 2% increase in public transport usage in the target age group seemed to be indicated

[6] These are trips which would not have been made at all if the scheme had not existed.

- If the SGC did not exist, for around 58% of users, their most recent journey would not have been affected (McDermott Miller 2010).

3.2.3.5 Conclusions

The SGC has apparently generated a 12% increase in public transport usage for its target group. If the scope and free nature of the scheme continue, usage should continue to grow as numbers in the target group increase, and future planning should allow for this. An estimated 8 million SGC trips were taken in the year October 2008 to September 2009 (NZ Transport Agency 2010a). Were these to increase in line with medium SNZ population projections, around 16 million trips will be taken per year by 2031. Greater growth is also possible if the costs of other forms of transport increase by any means or if the higher projection options of SNZ prove more accurate than the medium ones. Conversely, lower growth is also possible if, for the sake of argument, the present rate of usage has an element of novelty and tails off over time.

3.3.4 Technological influences on travel

In coming years, technology is certain to affect travel, but not necessarily equally on different age groups' travel. Thus the aging of the population is likely to influence the effects that occur. Technologies that are likely to increase the amount of older persons' travel include:

- technologies which make the safe driving of a motor vehicle easier, eg vehicle stability control and proximity warning devices
- technologies to improve access to public transport and special transport, eg more widespread use of vehicle kneeling systems, global positioning systems to improve the reliability of paratransit and more user-friendly means of paying for public transport (eg easily used stored value cards)
- technologies to reduce the cost of travel eg, more economical vehicles and electronic integrated public transport ticketing systems.

Also, some technologies related to 'bringing the world to the home', eg responsive internet-based television, could reduce the travel needs of the whole population.

4 Changes in travel with age of the traveller

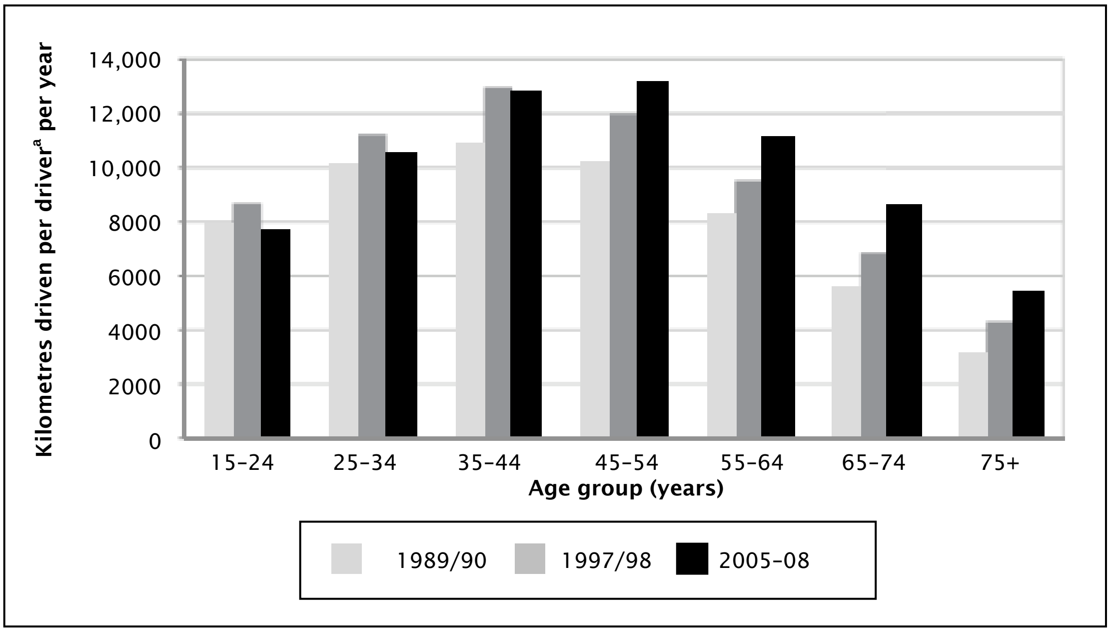
4.1 Overview

This subject has been touched upon in earlier sections in connection with other topics. As will be discussed later in this chapter, older people tend to travel less than and differently from younger groups, and more of their travel is in urban areas and less in the peak times. Elsewhere in this review, we have seen a tendency over time for all cohorts to travel more, while preserving the relative dropping off of travel with age. Also, women tend to drop their driving off earlier than men, and feature more as car passengers and public transport passengers than men. This area will be explored further in this chapter.

4.2 Distance driven by drivers

Figure 4.1 shows that people's driving activity peaks when they are in their forties and fifties, and decreases thereafter. In comparing the results for the three surveys depicted, older drivers are becoming more mobile over time, as is the rest of the population aged over 44.

Figure 4.1 Distance driven in cars, vans, utes and sports utility vehicles (MoT 2009)

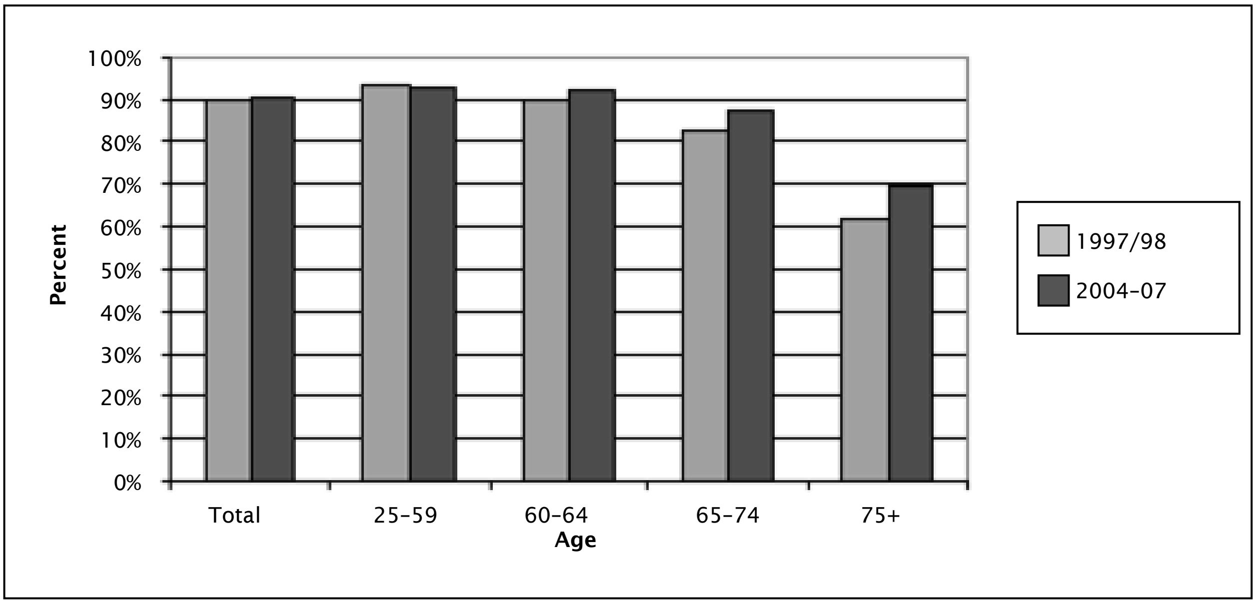


Notes to figure 4.1:

a A 'driver' is defined as someone who reported driving at least 100km during the previous year

This is also reflected in their driver licensing rates, shown in figure 4.2. These licensing rates again decrease with age within given study periods, but a tendency exists for an increase over time for the 60+ age group.

Figure 4.2 Proportion of population (by age group) holding a car driver licence 1997/98 and 2004–07 (O'Fallon and Sullivan 2009)



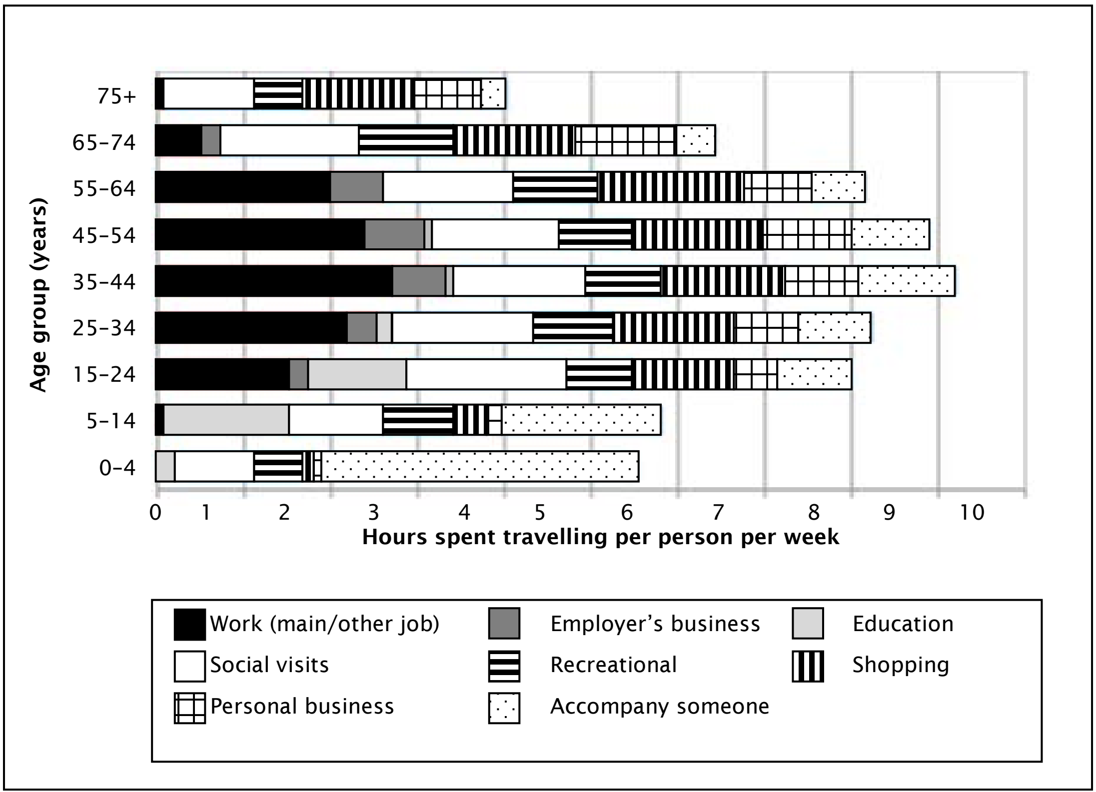
While the other age groups shown have stayed relatively constant, the proportion of those aged over 60 holding a driver's licence has increased appreciably, with the largest percentage increase among those aged 75+.

4.3 Work-related changes in older persons' travel

Work-related changes in older persons' travel are covered in O'Fallon and Sullivan (2009). Workforce[7] statistics (SNZ 2008a) show that the proportion of the population aged 65+ in the workforce increased from 6% in 1991 to 12% in 2006, and is projected by SNZ to increase to 20% in 2016. In absolute numbers, it is projected to increase to 160,000 in 2021 and about 200,000 from around the mid-2030s. Similar trends are apparent from travel survey figures for older age groups. These report that in 1997/98, 11% of 65–74-year-olds were in the paid workforce, with only 2% of the 75+ age group being paid to work. By 2004–07, 19% of 65–74-year-olds were in paid work, with those being paid to work in the 75+ age group still being less than 3%. These changes are reflected in travel as illustrated in figure 4.3, which shows time spent on work-related travel dropping steeply after age 64 and becoming small after 75. If, through better health status, the years of active work increase, as projected by SNZ, these changes will be pushed out further. Changes in the workforce are allowed for in travel projections made later in this report.

7 The workforce comprises people aged 15 years and over who regularly work for one or more hours per week for financial gain, or work without pay in a family business, or are unemployed and actively seeking part-time or full-time work (SNZ 2008a).

Figure 4.3 Reason for travel by age group, 2004–2008 (MoT 2009)



A key determinant of the timing of travel is the reason for the travel. In particular, work travel is more likely to take place during times of high congestion. Work-related travel drops off after the age of 65 (see figure 4.3), with a consequent relatively low amount of older persons' travel in high-congestion peak commuting times. This is illustrated in table 4.1, which looks at the leaving time of trip segments by age group from the Household Travel Survey[8]. The table reveals a tendency for older people to travel at off-peak times, with most trips in the 65+ age group taking place between 9:00am and 3:00pm. Again, this is likely to change if, as projected, a higher proportion of older people continue working and thus need to make more work journeys.

Table 4.1 Leaving time of trip segments by age group, 2004–07 (O'Fallon and Sullivan 2009)

Leaving time	Total	Age group			
		25–59	60–64	65–74	75+
Unweighted segments	*N* = 81,892	*N* = 62,658	*N* = 5636	*N* = 8662	*N* = 4936
Up to 9:00am	17.3%	18.7%	14.4%	11.9%	7.9%
9:01am to 3:00pm	44.6%	41.5%	49.5%	57.5%	66.3%
3:01pm to 6:29pm	26.3%	27.0%	25.8%	22.9%	20.8%
6:30pm onwards	11.8%	12.8%	10.4%	7.7%	5.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

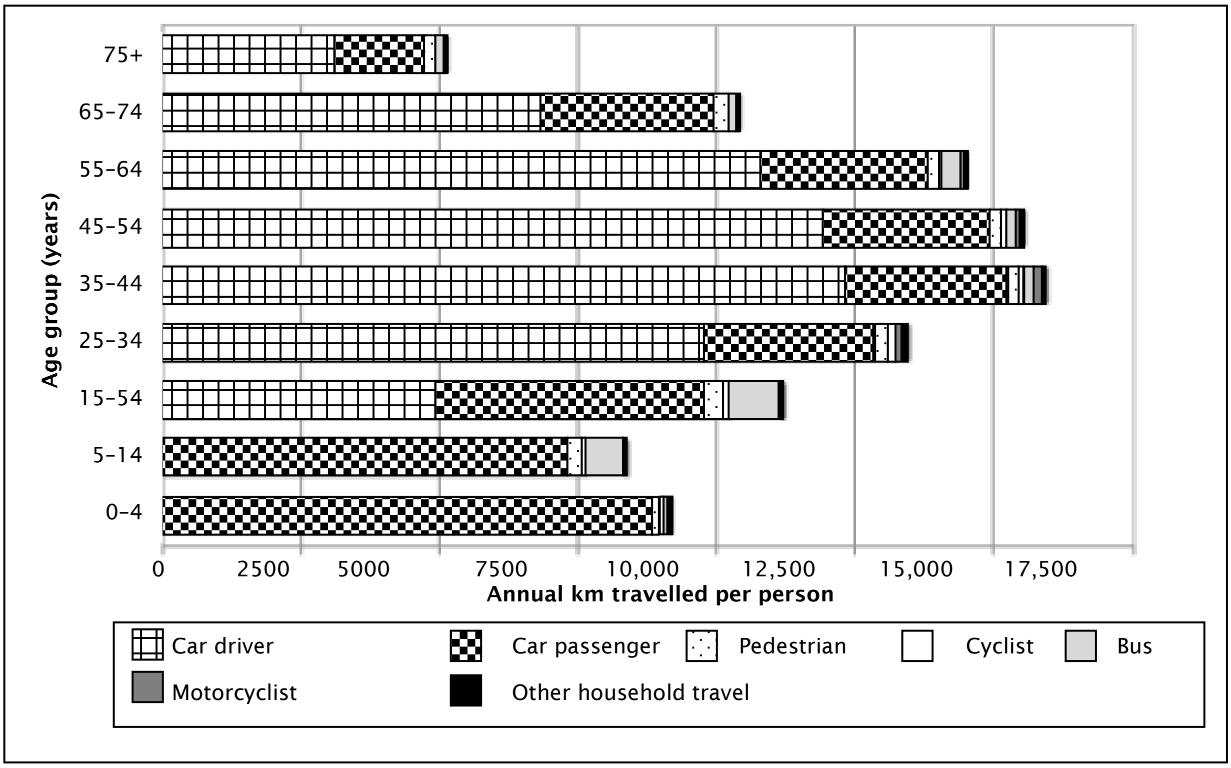
8 Using 2004–2007 data.

The size of this change, along with the level of the overall increase in older persons' travel, will help determine the effect on congestion, along with other factors like public transport uptake and the changes taking place in other age groups.

4.4 Travel by older people by various modes

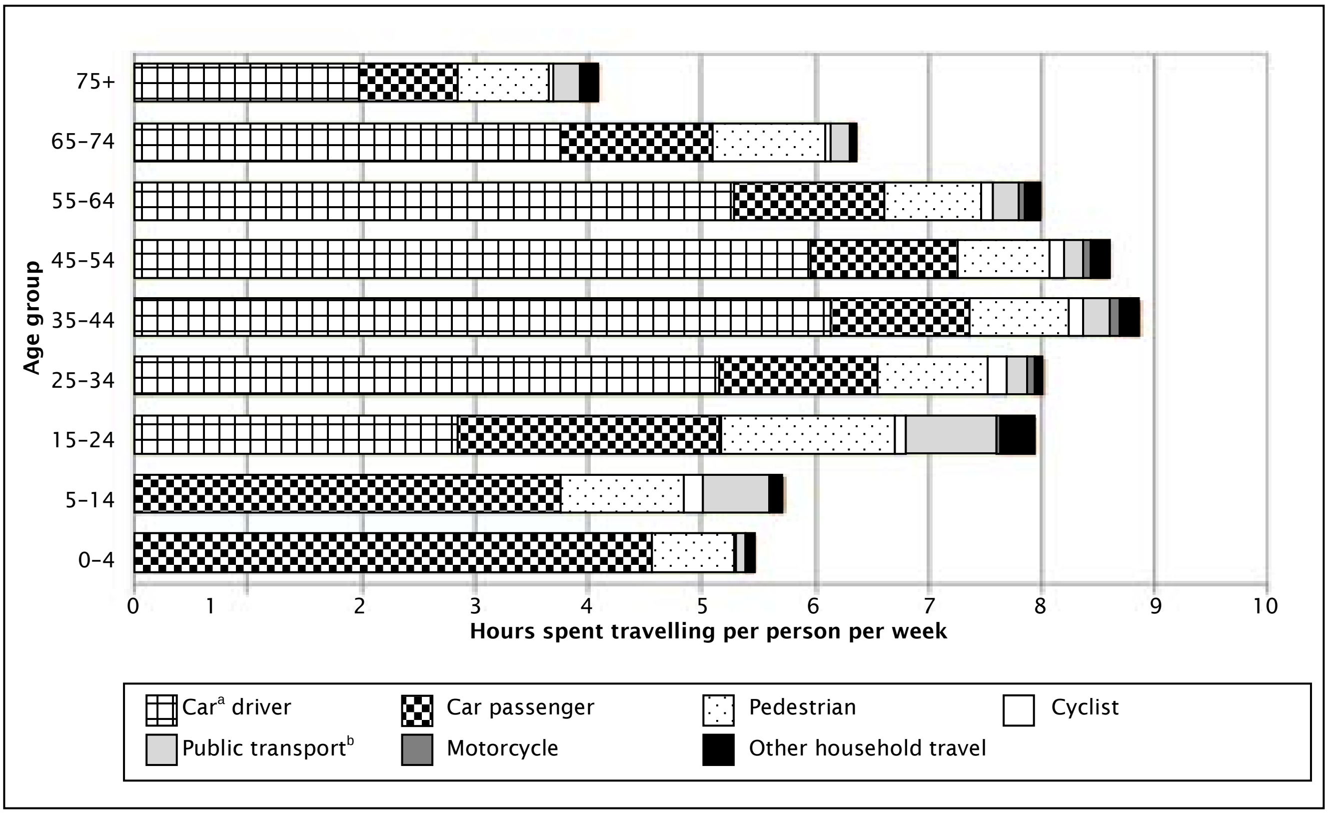
The annual distance travelled per person per year, by age and mode 2004–2008, is shown in figure 4.4. As people get older, the proportion of total distance they travel that is covered as a passenger increases as they become more dependent on the driving services of others. Clearly, for all age groups, a small proportion of trips are made by bus.

Figure 4.4 Distance travelled per person per year, by age group, 2004–2008 (MoT 2009)



A different picture is shown in figure 4.5, where the time spent travelling is expressed for the same modes and age groups. Using time as a criterion gives walking much greater prominence in the older age groups, reflecting the slower speed of walking.

Figure 4.5 Weekly time spent travelling, by age group, 2004–2008 (adapted from MoT 2009)



Notes to figure 4.5:

a 'Car' includes vans, four-wheel drives and SUVs

b 'Public transport' includes bus, train and ferry

The main modes used in trip chains are shown in table 4.2, with 'walking' being the main mode of 11.9% of trip chains in the 65–74 age group, and 15.3% of trip chains in the 75+ age group. The table generally illustrates the reduction of driving with age and the accompanying increase in proportion of travel as a car passenger, pedestrian or bus passenger.

Table 4.2 Main mode used in a trip chain by adult age groups: national estimates, 2004–07 (O'Fallon and Sullivan 2009)

Main mode of trip chain (mode used for longest distance)	Total	Age group			
		25–59	60–64	65–74	75+
Unweighted trip chains	*N* = 45,928	*N* = 36,051	*N* = 3221	*N* = 4224	*N* = 2432
Vehicle driver	73.4%	74.8%	74.5%	67.5%	56.7%
Vehicle passenger	13.4%	12.5%	13.0%	17.2%	22.7%
Walk	9.1%	8.5%	9.7%	11.9%	15.3%
Cycle	1.1%	1.2%	0.7%	0.7%	0.6%
Bus	1.6%	1.6%	0.8%	1.0%	2.7%
Other (includes train, ferry, taxi, mobility scooter; not plane)	1.4%	1.4%	1.2%	1.7%	2.0%

The low use of public transport by older people relates, at least in part, to difficulties they have with its use. These difficulties are exacerbated by age and reduced physical mobility. These factors are discussed in section 4.6.

4.5 International comparisons

Where data is available, this New Zealand data is broadly similar to that found in similar overseas studies. Two examples are shown in tables 4.3 and 4.4 (Gorti 2004), which look at the travel behaviour of older Americans using the US National Household Travel Survey of 2001 and the US National Person Travel Survey of 1990). Table 4.3 shows that between 1990 and 2001, travel by the 65+ group increased considerably more than that by society as a whole, while still lagging in absolute values behind that of other age groups.

Table 4.3 Average per-person travel day trips, time travelled (minutes) and distance travelled (miles) by Americans aged 65+ and Americans of all ages (Gorti 2004)

	1990 (*N* = 26,955,210)		2001 (*N* = 33,428,016)	
	All ages	**Over 65**	**All ages**	**Over 65**
Total number trips on travel day	3.75	2.49	4.06	3.44
Total travel time on travel day (min)	61.68	38.98	79.01	66.26
Total distance travelled on travel day (miles)	37.13	21.17	40.29	29.20

The data displayed in table 4.4 indicates a high use of cars, low use of public transport and an increased tendency to travel as a passenger with age, as has been already shown to occur in New Zealand.

Table 4.4 Modes used by Americans aged 65+ using the US National Household Travel Survey of 2001 and the US National Person Travel Survey of 1990 (Gorti 2004)

Mode	65–74 years old		75–84 years old		Over 85 years old	
	2001	**1990**	**2001**	**1990**	**2001**	**1990**
SOV[a]	43.6[d]	49.0	40.9	49.1	35.3	37.9
HOV[b] driver	23.1	20.4	20.1	20.0	17.0	15.2
HOV passenger	24.2	22.5	27.7	23.2	35.1	31.6
Transit[c]	0.9	1.6	1.5	2.3	1.9	2.5
Walk	7.0	6.0	8.7	4.1	9.1	11.0
Other	1.2	1.1	1.1	1.3	1.6	1.8

Notes to table 4.4:

a SOV, single occupant vehicle

b HOV, a vehicle with two or more occupants

c Public transport

d Figures indicate the percent of trips made using that mode within each column

4.6 Time budget for travel

A day has only 24 hours but only a certain part of those hours are feasible or desirable to spend travelling. As an extreme example, a person who commutes by fast train in two hours from York to London for work is unlikely to make the same journey by bicycle because of time and other constraints. Overall, people have historically had, on average (not taking age into account), a travel time budget of around an hour a day. These sorts of figures have been appearing in the literature for a considerable period. Prendergast and Williams (1980) argue for the hypothesis of a stable travel time budget using British survey data. Metz (2004) makes the point that over the last 30 years, people have increased their mobility while keeping their travel time relatively constant by increasing their average speed. One would expect a variation in daily time spent travelling with age, and this is apparent from looking at figure 4.5, with the 75+ age group travelling around four hours a week on average compared to the nearly nine hours travelled on average by the 35–44 age group. This is also apparent from the data on travel time on travel days from the US travel surveys of 1990 and 2001, as shown in table 4.3. One might expect a general upswing in older persons' travel if the widely predicted increases in the medical and physical fitness of older people eventuate. The corresponding distance enabled by this amount of travel time varies as above with age, and also increases with income and the availability of high-speed transport. It will, however, be subject to a ceiling related to time budgets, with presumably little likelihood of it rivalling that of younger people. This is because for this to happen, it would require no drop in the appetite for travel with age, an unlikely future scenario. It is likely that if comfort of travel and health status improve, the gap in time budgets between older and younger people may lessen. This report will not speculate as to the size of any decrease.

4.7 Reasons for reductions in travel demand with age

Plenty of evidence indicates that this reduction of travel demand with age is predominantly an innate symptom of aging, although some may be just better use of resources by car-owning couples after retirement by sharing car trips. As is discussed in section 8, older women tend not to be the primary household driver, suggesting that retired couples tend to travel together somewhat, where they may have previously made separate trips. This is concordant with findings that women's driving drops off faster after the age of 65 than that of men (O'Fallon and Sullivan 2009). As mentioned in section 3.2.2, it is not clear at present to what extent this male predominance in older person driving will continue. When we consider the figures for women, we get a different picture of their mobility when we look at person trips than we do if we look at driver trips. Also, as we have seen earlier, as overall travel has increased, so has that of older people. Regarding the younger group of older people (those in their early 60s), we have no reason to believe their travel is being reduced prematurely below their desires by the unavailability of viable transport options. However, some suppressed demand certainly exists among those who are old enough to exhibit a degree of dependency on others for their travel needs.

Older individuals may increase their travel if transport availability is enhanced or the price is reduced. Suppressed demand occurs when a person's travel desires are not met because of circumstances beyond the person's control. Charlton et al (2003) surveyed 656 drivers aged 55+ years and 29 former drivers in Victoria, Australia. Almost 80% of drivers said they were driving about as much as they would like to. Of former drivers interviewed, about a quarter said they were not satisfied with their current ability to get places. This indicates some suppressed demand for transport among older non-drivers but that a majority are doing the travel they wish to undertake at their stage of life.

4.8 Sources of suppressed demand

Various factors influence satisfaction with the transport choices on offer, including:

- ability to drive
- ability to walk
- access to a car
- safety issues associated with public transport.

Those who are not satisfied with their transport choices tend to be those no longer able to drive a car or those without access to a car. Such people tend to be older and female, as can be seen from figure 4.6. These proportions also vary regionally, as shown in figure 4.7.

Figure 4.6 Proportion of people aged 65+ years living in households with no access to motor vehicles, by age group and gender, 2001 (SNZ 2006)

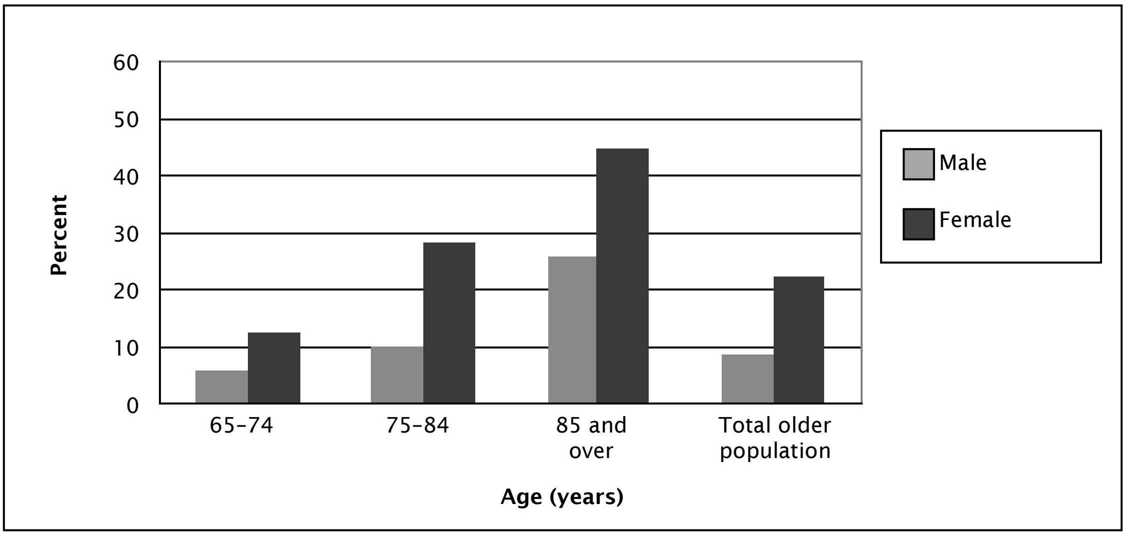
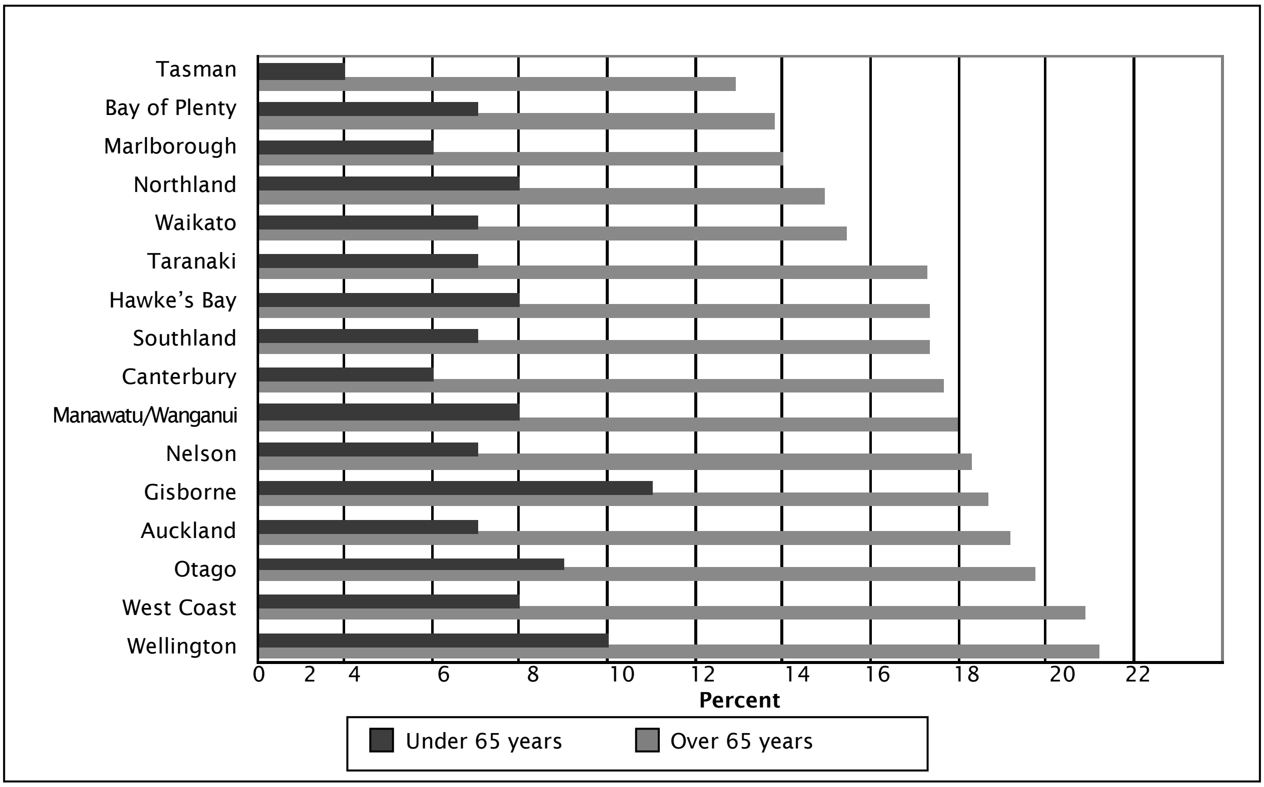


Figure 4.7 Non-accessibility to motor vehicles, by region and age group, 2001 (SNZ 2006)

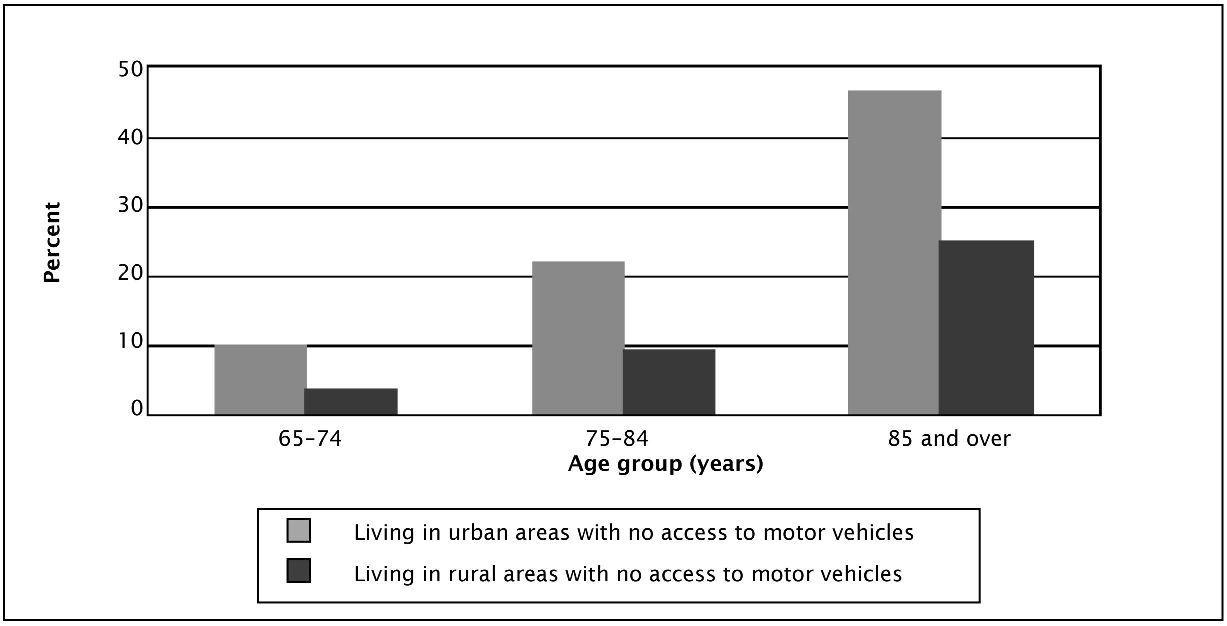


According to SNZ (2006), 86% of New Zealand's overall population in 2001 lived in urban areas. The proportion of people aged 65+ living in urban areas was marginally higher at 89%. Seventeen percent of people aged 65+ and living in urban areas did not have access to a motor vehicle, compared with 6% of older people living in rural areas.

> *The higher accessibility to motor vehicles in rural areas is perhaps because rural areas in general involve travelling greater distances and offer limited public transport.* (SNZ 2006)

In figure 4.8, these findings are disaggregated by age among those aged 65+, which shows that access to a motor vehicle decreases markedly with age.

Figure 4.8 Distribution of older people living in households without access to motor vehicles, by age and urban/rural spread, 2001 (SNZ 2006)



Some older people are unable to drive motor vehicles for reasons related to cognition. These might include such people as more severe dementia sufferers. However, one group finds it hard to drive – or even use motor vehicles as passengers – for reasons of physical disability. This problem is being tackled by the provision of purpose-built accessible vehicles, which are relatively expensive at present, but can be expected to become cheaper and more common as the population ages and demand increases.

Toyota's Welcab development (Toyota 2003) provides an example of the above from one vehicle manufacturer. Toyota has undertaken the development and popularisation of Welcab vehicles for the disabled, under the philosophy of offering all people easier mobility. Toyota claims that by the end of 2002, it had been extended to 109 types of vehicle in 51 vehicle series. Figure 4.9 shows an example of such a vehicle. With the aim of giving all people access to the technology that Toyota has accumulated, ongoing development is being promoted under five key points:

- communication and care
- friendliness to drivers and carers
- ease of ingress and egress
- high comfort
- reasonable pricing.

Figure 4.9 Toyota Welcab car with driver's mobility seat (Toyota 2003)

In the future, it can be expected that such vehicles will become more common on our networks, although affordability is an issue.

The low use of public transport by older people relates, at least in part, to difficulties they have with its use, including difficulties reaching where the vehicles stop, entering the vehicles once they have stopped and difficulties on the vehicle. These difficulties worsen with age. They are described in Harris (2002). This depicted the results of a 2002 survey of 125 older Royal Automobile Club of Victoria members who no longer drove. Of these, 85 said they 'got around' by receiving lifts from family and friends, 82 used taxis, 46 used buses, 22 used trains, 20 used community transport, 19 had electric scooters and 10 used trams. With regard to ease of use, 38% reported difficulty using buses, 26% reported problems using trains, 26% had difficulty walking, 8% reported problems with taking lifts from others and in using taxis, 5% had problems using trams and 2% had problems using mobility scooters and community transport.

Davey (2004) surveyed 28 couples and 43 single people (average age: over 80) from New Zealand cities and towns who had been without access to private transport for at least six months. She discussed the constraints on such people, whose main means of getting around was lifts from family, and how they can be ameliorated. The aforementioned results of Harris (2002) are also relevant here. For those people for whom the car is not an alternative, public transport is likely to stay a small provider of transport unless facilities (including vehicle and vehicle-related infrastructure) and responsiveness improve significantly:

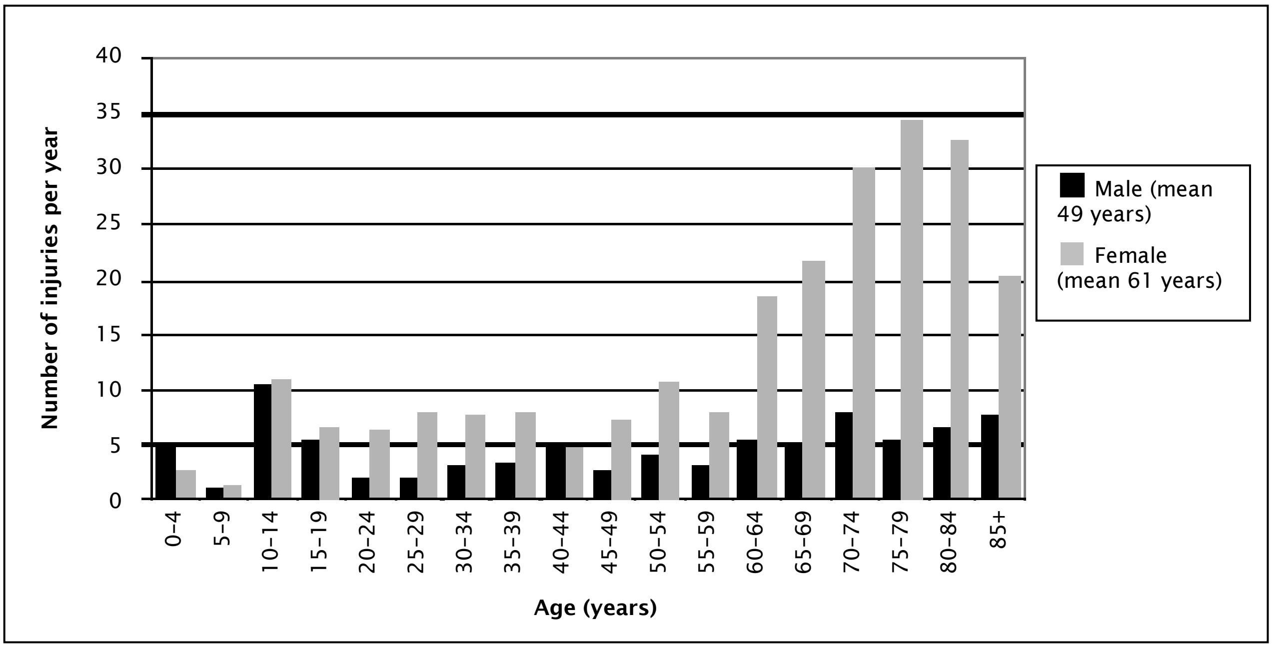
> *Better access, more security, rest rooms, places to sit while waiting, readable signage, and courteous employees are all necessary for elderly patronage. Existing public transportation needs to be made more elderly friendly. Yet public transportation, even with improvements cannot completely fill the need, especially in low-density areas.* (Skinner and Stearns 1999)

Some safety issues also limit the use of public transport and specialised transport by older people. Older people using buses are at considerable risk of non-collision injury. Canavan et al (2005) found that older people were over-represented in non-collision bus passenger injuries in southwest Dublin. Kirk et al (2003) used British road crash data[9] to report bus passenger falls and found that 64% of injuries were in non-collision incidents, with 58% of those injured being passengers 60 years of age or over. Ninety-four percent of the injuries were in areas with urban speed limits (30 miles per hour). These incidents were, in the main, caused by tripping or slipping on suboptimal floor surfaces, and typically occurred during wet weather or during braking or accelerating. Analyses were presented describing the age distribution of

9 Britain is one of the few countries to require drivers of public transport vehicles to report all injury-producing incidents, which are then eligible for inclusion in official road crash data.

injuries recorded and this data is shown in figure 4.10. It shows that for females, older passengers accounted for high levels of injury, a finding not shared by male passengers, whose injuries were more evenly distributed across the different age groups. The extent to which the injury levels were commensurate with passenger numbers could not be determined. Palacio et al (2009) also simulated the behaviour of standing passengers on an accelerating bus and found that peak bus accelerations and decelerations exceeded thresholds for balance loss for a standing passenger using a handgrip, and that bus interiors generally posed a high risk for falls.

Figure 4.10 Age/gender in non-collision bus injuries in Britain from 1994 to 1998 (Kirk et al 2003)



For the higher dependency users of specialised transport, other hazards have to be surmounted. A small amount of literature assesses the safety of specialised transport services, much of it from the University of Lund in Sweden.

Wretstrand et al (2010a) used quantitative as well as qualitative research techniques applied to four different sets of data: one set of hospital-based records, two Special Transport Service (STS) incident report databases and interviews with wheelchair-seated STS passengers. The results showed that injury rates for the STS are around 10 per 100, 000 trips. These injuries stem from non-collision incidents which cause injury particularly because of the frail nature of elderly passengers. They estimated the costs to be, on average, US$14 per trip. The results suggest future emphasis on safe boarding and alighting procedures, and continuing development of wheelchair tie-down and occupant restraint systems (WTORSs).

Wretstrand et al (2010b) looked at the organisation of STS providers from a safety viewpoint by holding focus groups with drivers of both taxi companies and bus companies. Defects were found in the attitudes of the organisations, which were judged to have had a reactive response to safety issues. Safety hazards before and after the ride and while the vehicle was motionless were identified. It was concluded that along with the technical aspects of vehicle and wheelchair safety, the safety of the system needed to be considered. It was argued that driver error should be perceived as a systems failure, rather than a cause.

Wretstrand et al (2004) looked at safety as perceived by wheelchair-seated passengers using STS. Questionnaires were returned by 801 respondents in five Swedish regions, and 15 in-depth interviews were also conducted. Five percent reported personal incident-related injuries during the period that they had been eligible for STS. Injuries were most likely to occur during normal driving, but the passengers were also exposed to risks during boarding and alighting procedures. However, 80% were satisfied with the degree of safety. A large majority (97%) reported that they always used WTORSs tie-down systems and 78% always used safety belts. These results indicate that, despite general satisfaction with the STS system, malfunction of the existing safety equipment is a problem, since safety is especially critical for STS passengers – a vulnerable road-user group with few alternative travel modes. Therefore, WTORSs that are easier to handle by the operators and more suitable for the passengers and their wheelchairs are needed. A low-floor vehicle concept might also reduce injury risks related to boarding and alighting procedures.

For older people with limited access to or ability to use a car, suppressed demand for travel will continue into the future. This is related to practical difficulties using other modes, including public transport, STS and using cars (for some with disabilities). Regarding public transport, this indicates that if a greater proportion of an aging population is to willingly and safely use public transport in greater quantities in the future, its friendliness towards them requires improvement. This would be a constraint regardless of the price to the consumer.

4.9 Alternative flexible transport services for older people

The Operation for Economic Co-operation and Development (2001) has identified a range of paratransit[10] services which might prove effective in providing post-driving alternatives and thus reduce the constraints on people with limited car access.

Several public transport options are possible:

- **Service routes:** mid-sized buses with low floors and wheelchair ramps and spaces are used along scheduled routes between residential areas and sites with social and leisure facilities. Passengers can board or disembark at intervening locations as required. The driver will help passengers board if requested, and will wait for them to be safely seated before starting.
- **Flex-route services:** the route operates between two end nodes with fixed departure times, again using small low-floor buses. As one model, advanced bookings are required up to 15 minutes before the trip, with the route and preliminary pick-up times subsequently calculated. All passengers are then called to confirm or change the pick-up times. The route between the end nodes is thus flexible according to demand for pick-up and drop-off. Pick-up is at the door for passengers eligible for STS and entails only a short walking distance for other users.

In addition, paratransit services can also be used to assist in meeting older people's mobility needs. Services include many public and private transport options (usually small minibuses, taxis or private cars) providing demand-responsive shared rides on a kerb-to-kerb or door-to-door basis, often referred to as 'Dial-a-Ride'. These services are particularly appropriate for areas where demand is low, either because of low population density (rural areas) or generally reduced demand.

Taxi schemes are also able to provide door-to-door transport, usually at a lower cost to the community than public transport and paratransit services, and enable older people to remain mobile at an overall lower cost to the community. Often, these schemes are subsidised by government or other agencies to make the service more affordable to qualified users.

10 An alternative mode of flexible passenger transportation that does not follow fixed routes or schedules.

New Zealand's Total Mobility Scheme (MoT 2005) provides people who have serious mobility constraints with discounted taxi fares by way of vouchers. The scheme is used New Zealand-wide but is mainly limited to urban areas and administered by local government, usually through regional councils. The discount is usually 50% of the standard fare.

Table 4.5 (Office for Disability Issues and Statistics New Zealand 2009) contains estimates of the number of people who used total mobility scheme discount vouchers in the previous 12 months, according to the 2006 New Zealand Disability Survey.

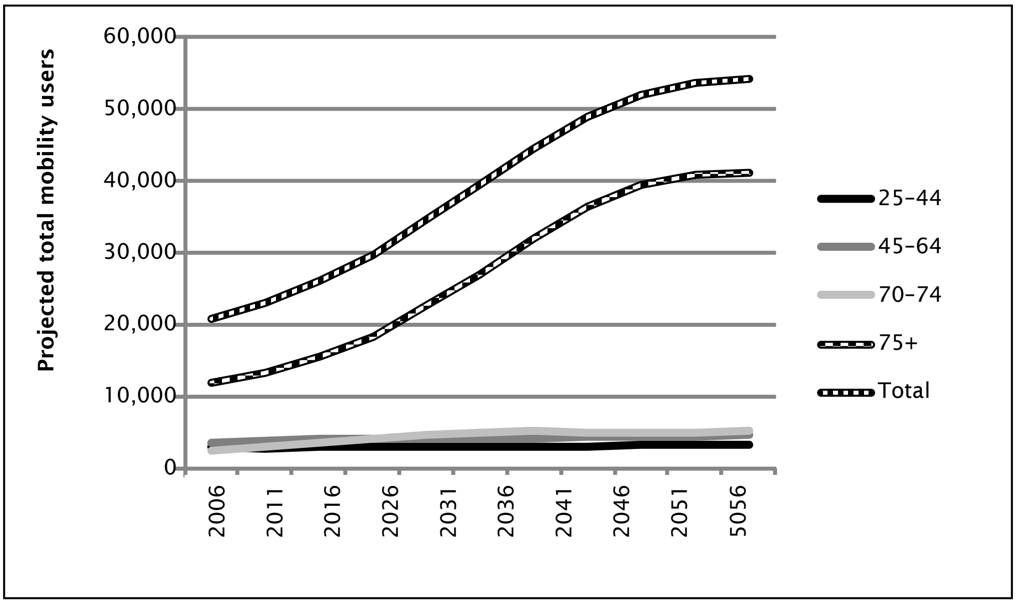
Table 4.5 Disabled adults (ie those of driving age) using Total Mobility Scheme vouchers over a 12-month period in 2006

Age group	N	%
15–24	–	–
25–44	2900	3
45–64	3500	2
65–74	2500	3
75+	12,000	11
Total	**21,400**	**4**

These figures are different from the membership of the scheme, which was estimated to be 43,000 around the country (MoT 2005).

If the numbers in table 4.5 are projected into the future, using the same projected age groups from the SNZ projections in 2006 (medium series 5), we obtain the data in figure 4.11.

Figure 4.11 Projected numbers of Total Mobility Scheme users to 2056 according to age group



Assuming that the pattern for people using the Total Mobility Scheme according to their age remain similar to those in 2006, this would indicate that by 2056, the number of active Total Mobility Scheme members (ie members who use the vouchers at least once in a 12-month period) could exceed 50,000. Of the projected number in 2056, three-quarters would be in the 75+ age bracket.

Voluntary driver car schemes operate in an equivalent manner, taking older people to key services such as hospitals, day centres and shops. Typically, the driver is fully reimbursed for expenses but is not salaried. Regarding Australia, Anderson (2006) makes the following point:

> *Volunteer driver programs are becoming increasingly popular due to their simplicity, familiarity and flexibility, whereas public transport or paratransit can be too complex, expensive and often can't cater for mobility difficulties.*

Another important point, also from Anderson (2006), is that:

> *Providing alternative mobility options is a difficult issue, in that alternatives need to be compared to the car in terms of 'the 4 As', namely availability, accessibility, affordability and adaptability. The alternatives should be at least acceptable, if not optimal, in these areas.*

5 Habitation trends in older people

5.1 Relevance

The future transport needs of older people will be influenced by:

- where they choose to live
- in what type of dwelling they choose to live
- with whom they choose to live.

With their contribution to the population increasing, these needs will flow through to a larger extent into total travel than at present.

5.2 Geographical location of household

Up to now, the population aged 65+ in New Zealand cities has not always been rising. For instance, SNZ (2009a) records that between 1991 and 2006, the percentage of the population aged 65+ declined in much of Auckland City. The article states that the decline was created by a combination of smaller population cohorts reaching the age of 65, net immigration at younger ages and net emigration at older ages. However, in the period from the present to 2031, the proportion aged 65+ is projected by SNZ to increase in Auckland. The percentage of the population in each of the Auckland region's former territorial authorities who are aged 65+, for 1991, 2006 and 2031, is shown in table 5.1.

Table 5.1 Percentage of population aged 65+ years in the Auckland region by territorial authority, 1991, 2006 and 2031 (SNZ 2009a)

Territorial authority	Percent		
	1991	2006	2031
Rodney District	14.0	15.0	23.8
North Shore City	11.5	10.7	19.0
Waitakere City	7.5	9.2	17.2
Auckland City	13.0	9.4	15.4
Manukau City	7.7	8.3	15.4
Papakura District	8.2	10.0	16.9
Part of Franklin District*	9.6	11.1	22.0

* The part in Auckland region

This indicates that Rodney District, a semi-rural area on the Auckland’s periphery that is popular with older people, has the largest percentage of people aged 65+. The Franklin District, also on the periphery of the city, is similarly popular with older people. These sorts of trends are emulated elsewhere, for example along the Kapiti Coast on the outskirts of the Wellington area. The future figures are based on current population projections (2006-based medium series), which presume the continuation of the prior trend of older people congregating in the peripheral areas of cities. A wildcard in the pack regarding this tendency is the cost of travel. This could conceivably have a profound effect on the growth of these peripheral areas, but conversely, retired populations with lower commuting requirements may find these areas attractive. This might happen if costs of travel made younger people tend to live nearer city workplaces, thus lowering younger person demand on the periphery, which would have a downward effect on prices. This would, of course, depend on the level of services available in the periphery for older people. In the country as a whole, the effects of aging will be unevenly distributed. Projected changes in the population's age between the base year of 2006 and 2031 by territorial local authority are shown in figure 5.1, with the national average indicated by a black bar.

This indicates much greater aging in rural areas than in urban areas. However, the effect on networks is likely to be not as great as one might think because, by strength of numbers, the cities will experience the greater absolute increase, notwithstanding their lower percentage increases. This is illustrated from SNZ figures (2009) which indicate that the 65+ population of the combined Auckland, Wellington and Canterbury regions is predicted to grow by 330,000 between 2006 and 2031, which is 58% of the predicted growth for the whole country over that period.

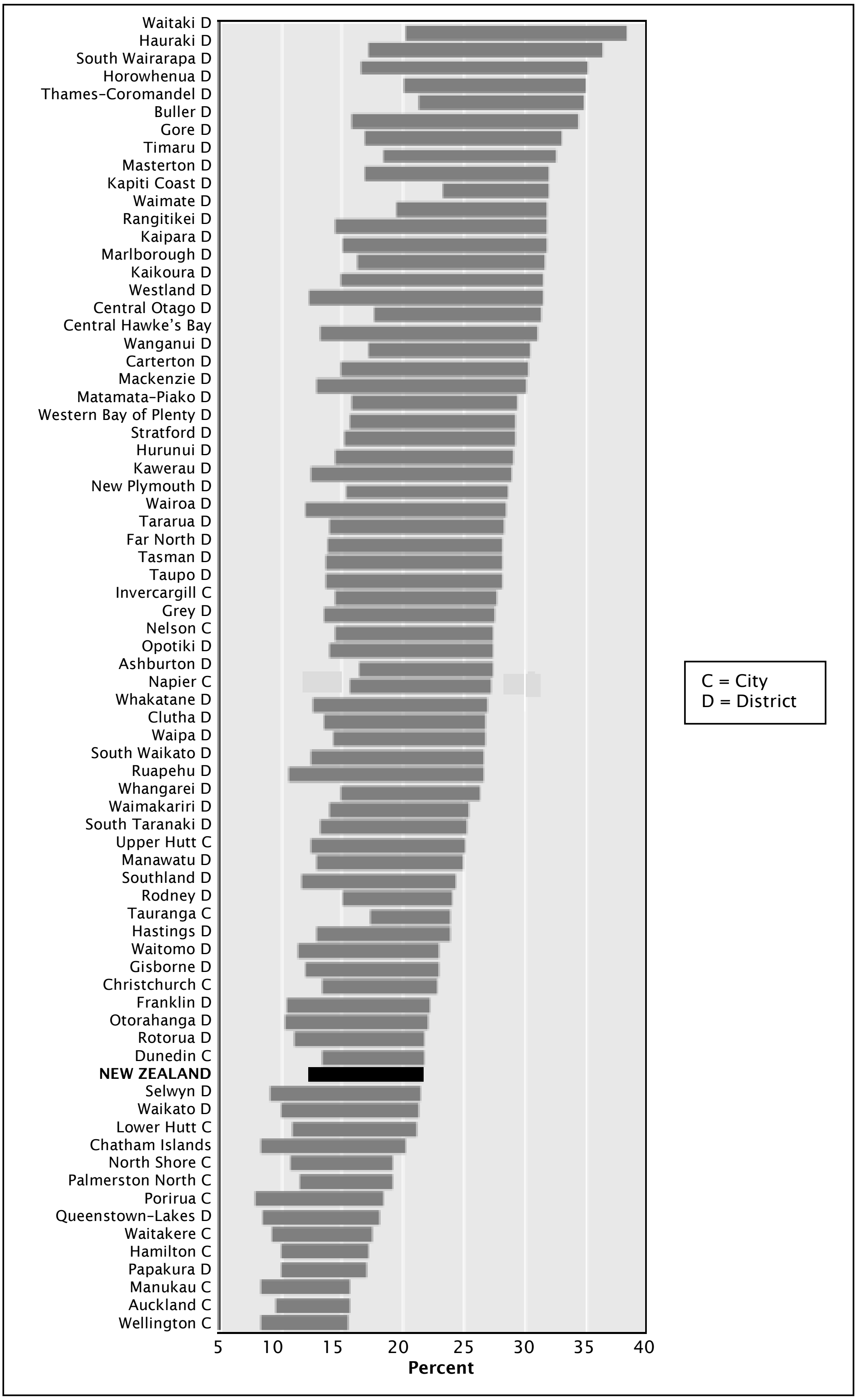
5.3 Household type

According to O'Fallon and Sullivan (2009), in 1997/98, in the 75+ group, 40% lived in single-person households, compared with 27% of 65–74-year-olds and 15% in the 60–64 age group. This had not changed significantly in the figures they derived from the later continuous household travel survey. Using 2006 census data, Saville-Smith et al (2008) calculated the proportion of people aged 65+ living in each household type, as displayed in table 5.2. This is broadly concordant with O'Fallon and Sullivan's figures for the 65+ age group. Overall, these findings indicate, not unsurprisingly, that the number of single-person households increases with age.

Table 5.2 Percent of 65+ population living in various types of households (using 2006 census figures); source: Saville-Smith et al (2008)

Household composition	Percent of 65+ population
One person only	31.1
Couple with no child(ren)	49.7
Couple with child(ren)	4.8
Couple and other adult(s) but no children	2.1
Couple with child(ren) and other adult(s)	1.9
One parent with child(ren)	3.4
One parent with child(ren) and other adult(s)	1.2
Two or more families (with or without others)	3.1
Other multi-person household	2.7
Total	*100*

Figure 5.1 Proportion of population 65+ in territorial authority areas from 2006 to 2031 (SNZ 2007)



5.4 Dwelling type

In terms of dwellings, a survey of 1600 dwellings of people aged 65+ (Saville-Smith et al 2008) indicated that most (88.7%) of people aged 65+ people live in detached dwellings, with the rest spread throughout a number of different higher density situations (see table 5.3).

Table 5.3 Dwelling types of people of aged 65+ (source: Saville-Smith et al (2008))

Dwelling type	Dwellings	%
Detached single-storey	1060	66.3
Detached with more than one storey	359	22.4
Semi-detached single-storey	66	4.1
Semi-detached with more than one storey	24	1.5
Terrace	11	0.7
Purpose-built flat	32	2.0
Flat in a converted building	19	1.2
Apartment in an apartment block with more than two floors	18	1.1
Other	11	0.7
Total	1600	100

Further information is provided in table 5.4, which shows how household composition varies across older sub-groups.

Table 5.4 Dwelling type by age of oldest adult (source: Davey et al (2004))

Age	Private dwelling (not specified) %	Separate house %	Multi-unit dwelling %	Other %	Total %
65–74	8	74	18	1	100
75–84	12	64	24	0	100
85+	14	57	29	0	100

This indicates that the prevalence of multi-unit dwellings increases with age, but at no age are they the norm. By the age of 85+, nearly 30% are in multi-unit dwellings. Given these figures, it is apparent that unless present conditions change radically through some unknown external influence, older people will continue to live in lower density environments with the attendant problems these pose to non-personal transport provision.

Relatively few older people live in non-private dwellings at present. SNZ's national family and household projections (2009b) indicate that population aging contributes to a projected large proportional increase in the numbers of people living in non-private dwellings (including retirement homes), with a projected increase of 1.4% a year between 2006 and 2031. The number of people aged 80+ years living in a non-private dwelling is projected to almost double between 2006 and 2031, from 23,000 to 43,000. This increase is in spite of the projections assuming a small decrease in the proportion of older people living in non-private dwellings, related to assumed increases in life expectancy and wellbeing in the older ages.

5.5 Land use planning and transport provision

As indicated above, most of today's middle-aged and older people live in suburbs with a lower residential density. These suburbs are equipped with fewer services and facilities, and are less well served by public transport. If these people age in place, they will be overly reliant on the private car for access to the necessary commercial, recreational, medical and other facilities. This is also likely to be the case if they follow the tendency mentioned earlier for older people to congregate in the peripheral areas of conurbations, like the Kapiti Coast and parts of Rodney District.

Obvious benefits can be gained from encouraging middle-aged and younger people to consider relocating to places where essential services can be reached by public transport or by walking, prior to reaching old age.

However, as noted in the New Zealand Positive Ageing Strategy's Goals and Actions (SNZ 2001), older people who feel safe and secure can 'age in place'. Part of aging in place is being able to maintain social networks and other well-established life patterns. Any relocation prompted for mobility and safety reasons may well be resisted by many older people, despite possible travel and access difficulties.

A second, longer-term solution allows aging in place to be continued, subject to satisfactory land use planning. As noted by the OECD (2001):

> *Mobility and transport needs are strongly affected by land-use patterns. Given that ageing is often accompanied by a range of mobility restrictions, land-use planning that aims to reduce the amount of travel needed to access services, facilities and social networks is of particular benefit to older people.*

In this context, land use is much more than the location and density of residential development, along with the permitted mix of uses (residential, retail, services, employment, health, leisure, etc). It also includes:

- the distance to shopping, health care, leisure and other services
- the detailed local road layout which, alongside residential density, helps to determine the feasibility of efficient, usable public transport
- the network of paths or sidewalks for pedestrians, powered wheelchairs, scooters and bicycles, including safe road crossings to encourage use of these transport modes where applicable.

In current land use planning practices, especially for new developments, marketing concerns often outweigh considerations of functionality for future generations. While compact communities with locally available facilities and services benefit older people specifically, this pattern of land use development is of general benefit to society and supports environmental sustainability policies.

Howard and Szwed (2005) have provided a comprehensive list of safe land transport system planning practices that are highly likely to benefit all road users, especially older people. These include (but are not restricted to):

- providing employment, education and recreational opportunities within the new development
- clustering land uses into activity nodes (including schools and shops) to maximise public transport, walking and cycling options
- integrating planning, from the start of the planning process, for all transport modes (not only cars, motorcycles and trucks but also public transport, cycling and walking)

- planning for direct and convenient bus routes within walking distance of all new residential allotments
- introducing public transport services early in new growth areas
- locating activity centres near railway stations or other public transport interchanges so that public transport is convenient
- providing safe and convenient access to transport interchanges by people of all abilities and ages, and by all modes of transport, particularly walking and cycling
- scheduling public transport infrastructure development (stations and public transport interchanges) to suit residential development needs
- encouraging bus operators to extend routes into new residential estates at the earliest possible stage so that reliance on cars can be minimised
- planning activity centres to be free of vehicular traffic if possible; otherwise, speeds should be engineered to be as low as possible
- scheduling main bus routes to provide direct connections with major activity centres
- developing pedestrian and cycle paths to provide direct, continuous access
- as far as possible, separating pedestrian and cycle paths from major traffic routes, while maintaining personal security (ie being open and visible)
- ensuring paths are continuous and convenient, and connect with adjacent networks, and have a consistent standard and are well signed.

Howard and Szwed urge that successful land use planning – in keeping with safe system principles – will need to involve a broad range of people:

- the developers: town planners, urban designers and traffic engineers
- local government: councillors, planners and traffic engineers
- regional government: infrastructure planning, land use planning and education
- the community: consumers, workers, local residents etc.

The extent to which these types of practices are used in the future, in both new developments and in retrofitting of existing infrastructure, will impact on the effect of the older population on the network.

6 Parts of the road network used by older people

Older people generally tend to drive shorter distances than younger people. A natural consequence of this is a tendency for more of their driving to be on urban roads closer to their homes. Figure 6.1, which is based on statistics supplied by the MoT, shows distance driven by age and road type for age groups up to 75+. It illustrates the large-scale drop-off of driving distance with age, and disaggregates this variable by part of network.

Figure 6.1 Driver distance per year by road type and age (2003–2008)

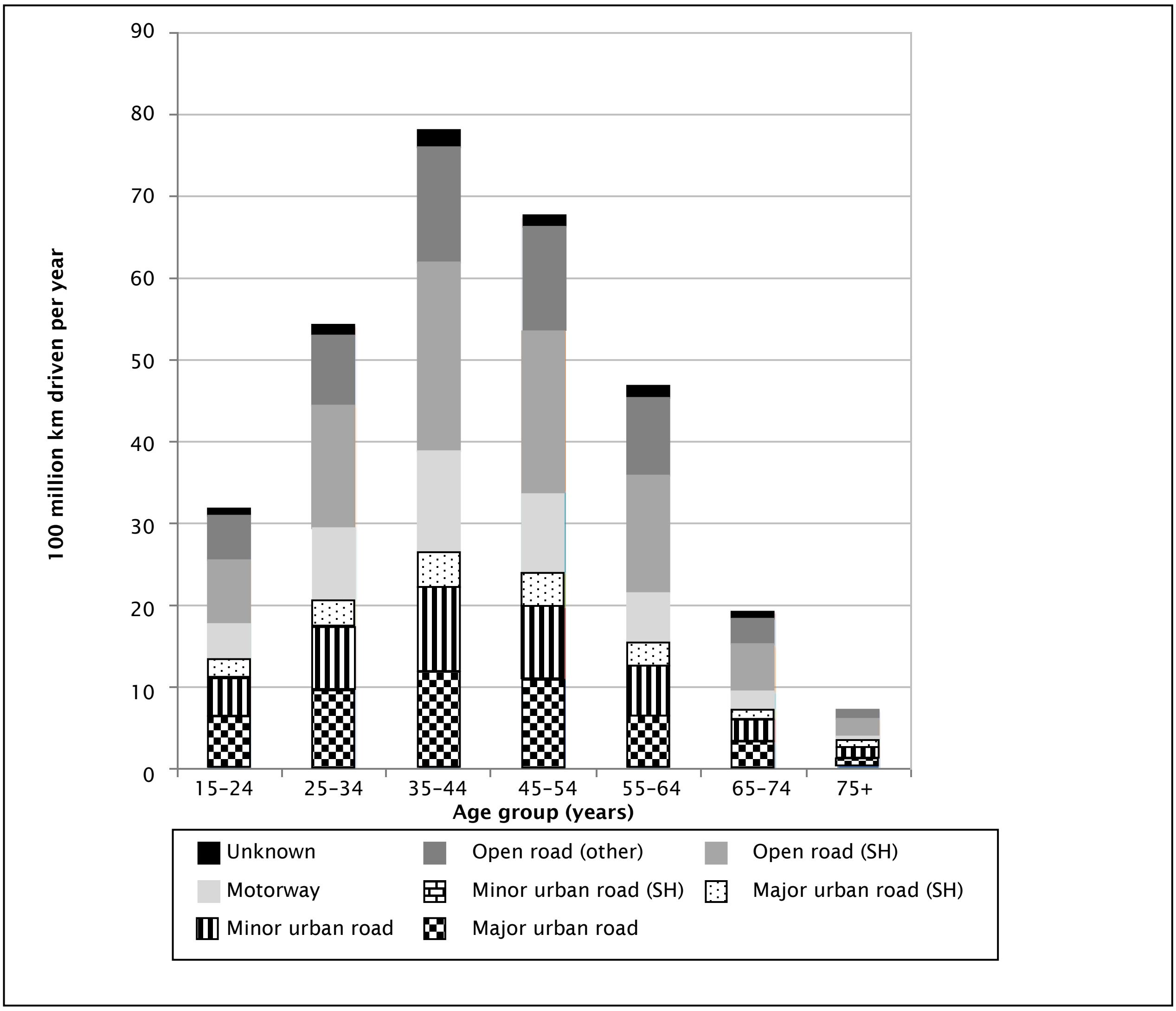


Figure 6.2, which is also based on MoT statistics, focuses more minutely on each age group, in terms of where in the network driving is done, by looking at percentages rather than absolute distance. It is apparent that after the 55–64 age group, the proportion of driving done on urban roads rises. The urban percentage rises from 34% in the 55–64 age groups to 47% in the 75+ group, an increase of 38%.

Figure 6.2 Percentage of distance per year by road type and age (2003–2008)

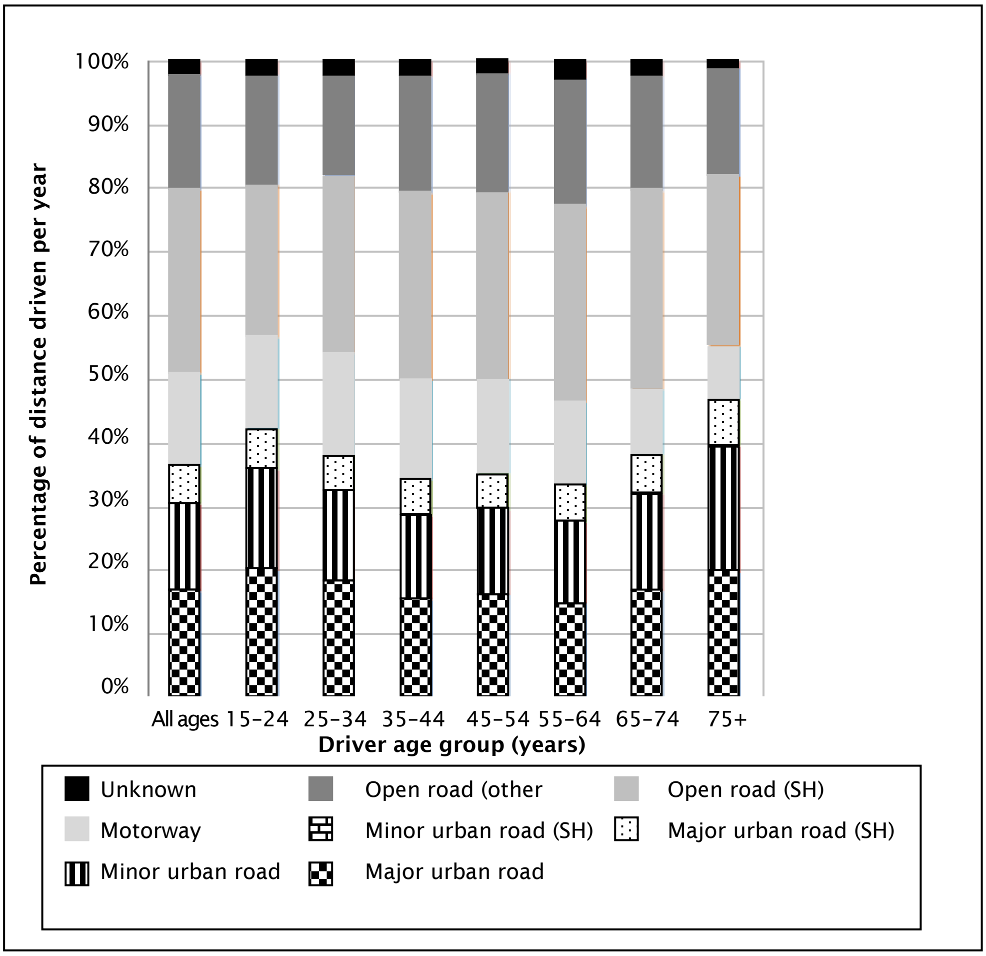
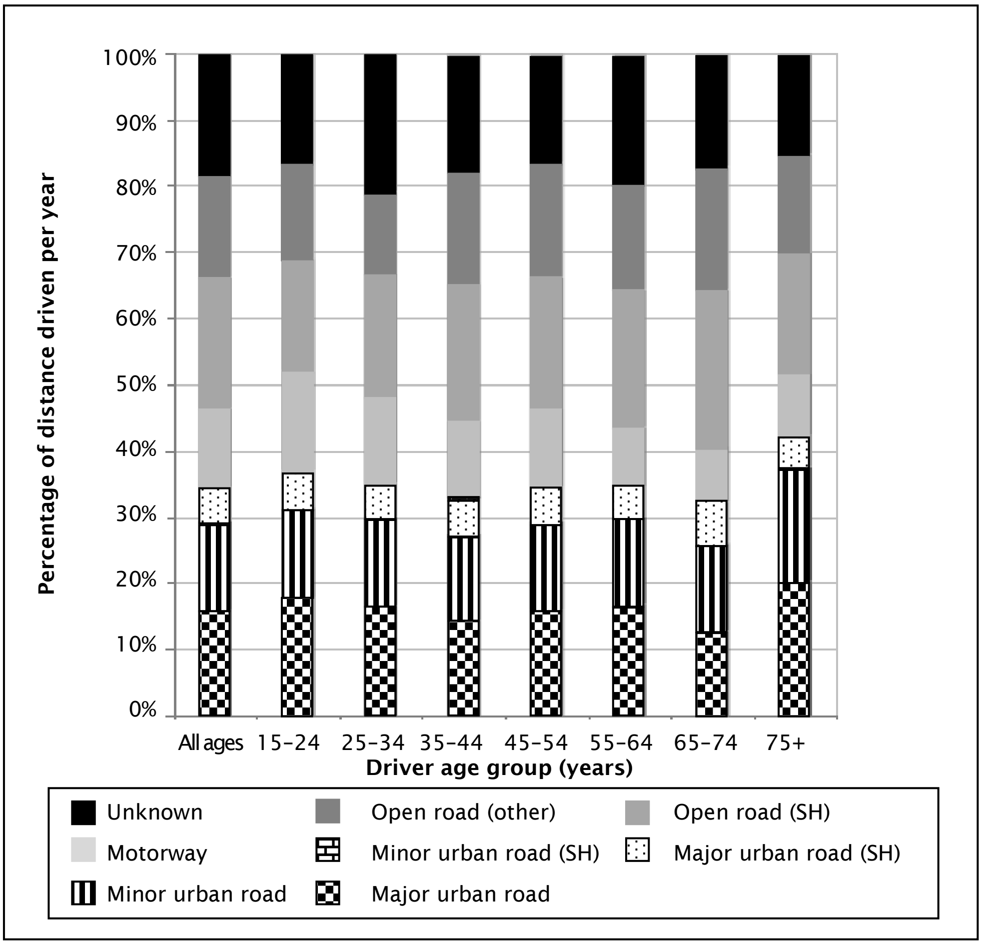


Figure 6.3 depicts similar data to that in figure 6.2, but taken from an earlier travel survey (1997/98). It is apparent that over time, the percentage reported as urban driving has not changed substantively[11].

In chapter 10, projections of future travel by road type will be made.

11 The greater prevalence of unknowns in 1997/98 is probably caused by the greater number of roads with no geocode available in the survey. This was mainly a rural phenomenon, as reflected in the reduced percentage of travel on rural road types in that survey.

Figure 6.3 Percentage of distance per year by road type and age (1997/98)



7 Adapting the road network to an older population

7.1 Older drivers

Older drivers may experience special difficulties with many aspects of the road network. These difficulties can arise from changes in their functional performance, including visual and cognitive capacity and slower reaction times. Given that many aspects of road design are based upon the performance parameters of healthy younger drivers, these difficulties should not be a surprise. An OECD Working Group (2001) summarised older drivers' difficulties thus:

> *A larger share of older driver accidents involves collisions with another vehicle. They have a smaller share of single vehicle and speed related accidents. Older drivers tend to be legally at fault in their collisions. A greater proportion of older drivers' crashes occur at intersections, where typically the older driver is turning against oncoming traffic with right-of-way on the main road. For those aged 80 years and over, the percentage of angle collisions, typically involving intersection situations, is more than double that of the youngest group. The high percentage of angle collisions where the older driver is hit from the side by an oncoming vehicle is another factor that explains why older drivers tend to be the ones injured in their accidents.*

This pattern has since been confirmed by a series of Australian studies. For example, Langford and Koppel (2006) used Australian fatal crashes for 1996–1999 to show that relative to middle-aged drivers (40–55 years), drivers aged 75+ years, consistent with their propensity to be involved in crashes at intersections, were:

- more than twice as likely to be involved in crashes where one vehicle turned right into the path of a vehicle approaching from the opposite direction
- were more than twice as likely to be involved in conflicts at intersections and in crashes between two vehicles entering an intersection along adjacent paths
- were five times more likely to be involved in conflicts in which one vehicle turned right into the path of another vehicle proceeding straight through the intersection.

In total, these three crash types covered 42% of older drivers' involvements in fatal crashes and 14% of middle-aged drivers. The analysis of driver movements immediately prior to the crash in these scenarios indicated that older drivers were five times more likely to be making the turn rather than driving straight ahead.

Many of the difficulties can be resolved through changes in road design features and parameters – changes which, in all likelihood, would benefit drivers of all ages. A comprehensive body of research evidence attests to the following:

- Older drivers have functional changes and difficulties in coping with aspects of the road network.
- Road design improvements benefit older (and other) drivers.

A key document is *Environment and design for older drivers* (Austroads 2004), which comprises an overview of the area and a handbook of suggestions for road design changes related to older drivers. The Handbook is in four sections, each section addressing specific roadway features in four broad traffic environments identified as being problematic for older drivers. These are:

- at-grade intersections (11 specific design features are highlighted and 23 points are discussed)
- freeway interchanges (the design features of entry and exit interchange ramps are highlighted and four points are discussed)
- horizontal curves and passing zones (the design features of curves and passing zones are highlighted; three points addressing roadway curvature design and three points addressing passing zone design are discussed)
- construction/work zones (the design features of the approach to and travel through construction/work zones and highlighted and three points are discussed.

Outside these specific features in the handbook, planners and designers need to consider issues of a more general nature related to driver aides such as signs, pavement markers and road lighting (including glare). A recent review of this topic was provided by Smiley et al (2008), who recommended that:

- left-turn (right-turn in New Zealand) phase indicators should be modified to improve driver comprehension
- larger and better-illuminated signs and devices should be provided for lane assignment on intersection approaches.

Earlier, in a Federal Highways Administration manual, Staplin et al (1998) made the recommendations set out in table 7.1.

Table 7.1 Road design improvements for older drivers (from Staplin et al 1998)

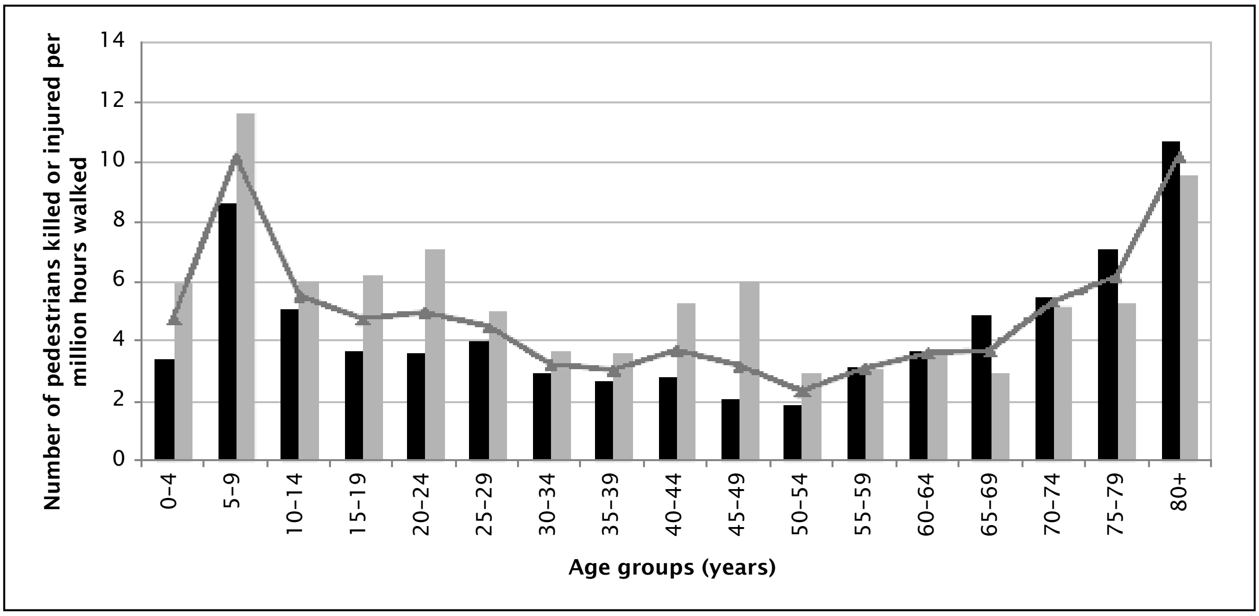
Location	General intersection design	Lane design	Other signage
Intersections (at grade)	• Intersecting angle (skew) • Receiving lane (throat) • Channelisation • Intersection sight distance • Fixed lighting installations • Pedestrian control devices	• Left-turn lane geometry, signing and delineation • Edge treatments • Curb radius • Traffic controls for left-turn movements	• Traffic controls for right-turn movements • Street name signage • One way/wrong way signage • Stop and 'give way' controlled intersection signage • Traffic signal performance issues
Interchanges (grade separated intersections)	• Exit signing and delineation	• Acceleration/deceleration lane design	• Fixed lighting installations • Traffic controls for prohibited movements
Roadway curvature and passing zones	• Pavement markings, delineation and curves	• Pavement width and curves	• Advance signing for sight restricted locations • Passing zone length and passing sight distance
Construction/ work zones	• Advance signing for lane closure • Variable message signing practices	• Channelisation practices • Temporary pavement markings	• Delineation of crossovers/ alternative paths

As the proportion of drivers who are in the older age groups increases, the need to consider which parts of our road network warrant enhancement to improve their friendliness to older drivers will increase, and those considerations must be translated into guidance for professionals.

7.2 Older pedestrians

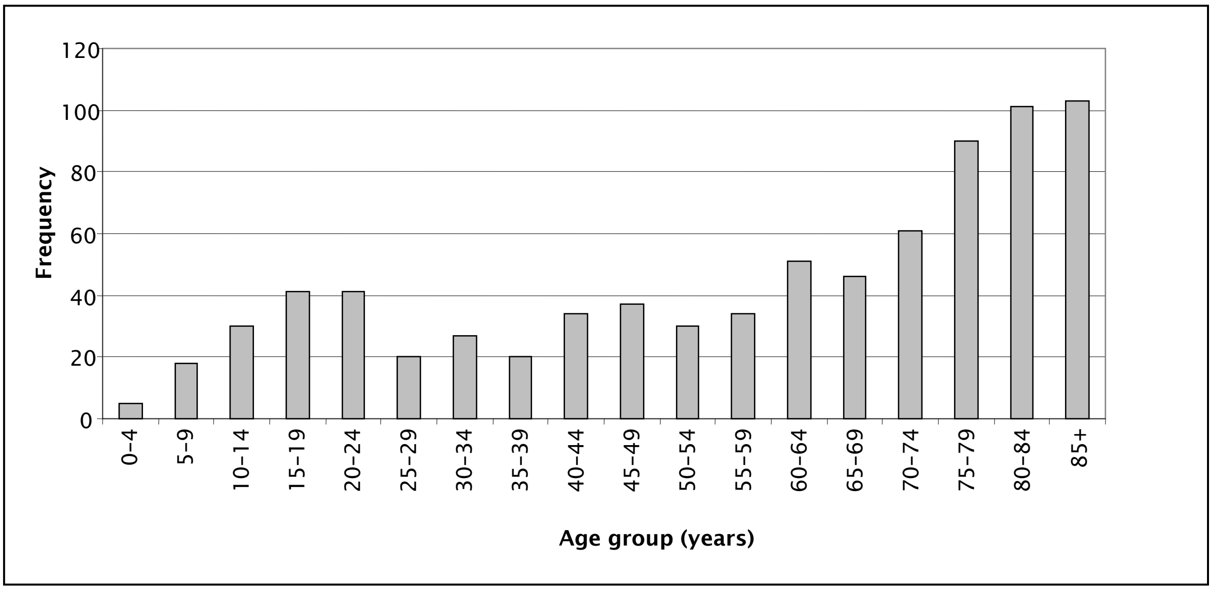
As people become more fragile as they get older, particularly unprotected people like pedestrians, the major issue for older pedestrians is safety (figures 7.1 and 7.2). The older the pedestrian, the greater the risk of death or injury from a road crash with a motor vehicle, or from other injuries not related to a motor vehicle but which happen on the road or roadside.

Figure 7.1 Pedestrians killed or injured in reported motor vehicle injury crashes per million hours spent walking in New Zealand, 2003–2007 (MoT 2008)



However, as mentioned above, pedestrians can also be injured from mishaps on the road or roadside that are not related to motor vehicles (for example, slips, trips or falls). The number of hospital admissions resulting from falls while walking on New Zealand streets and highways in 2007, analysed by age, are shown in figure 7.2.

Figure 7.2 Number of hospitalised injuries by age group from falls on the 'street or highway' in New Zealand, 2007 (drawn from data supplied by the Injury Prevention Research Unit at the University of Otago)



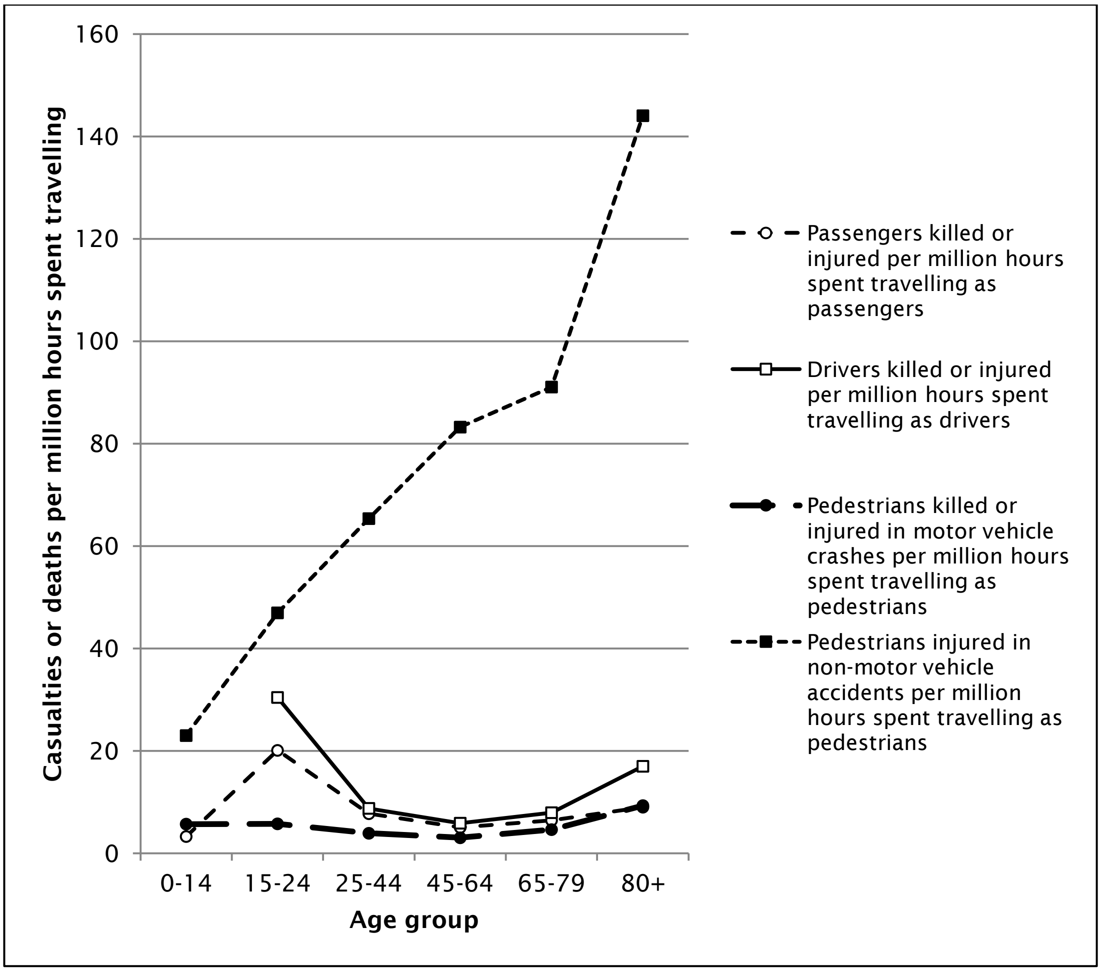
Pedestrians aged 65+ years account for increasing numbers of hospital admissions, with pedestrians aged 80+ (despite their reduced exposure) having the highest admission rates. As older pedestrian numbers are likely to burgeon in the future through demographic factors, pedestrian injuries in the older age group will also increase.

The relative risks of different travel modes are normally compared using hours of travel as the exposure measure. In New Zealand, more than 20,000 injury insurance claims for pedestrian injury are associated with the road or roadside per year. Figure 7.3[12] (Frith and Thomas 2010) shows estimates of Accident Compensation Corporation (ACC)[13] claims for urban road or roadside pedestrian injuries in New Zealand in main urban areas that were not related to motor vehicles, per million hours walked, and the comparative risks for drivers, passengers and pedestrians in motor vehicle crashes. Figure 7.3 seems to indicate that the total injury rate per million hours walked for older pedestrians (composed of both vehicle and non-vehicle accidents) substantially exceeds that for older drivers, passengers and pedestrians injured in motor vehicle crashes, lying in the approximate range of 90–140 injuries per million hours travelled compared to 5–10 for motor vehicle crash injuries. It also shows that on the basis of time spent travelling, pedestrians were at less risk of death or injury from motor vehicle crashes, compared to drivers or passengers.

12 ACC non-motor vehicle pedestrian injury data used covered the six-month period of December 2008 to May 2009 inclusive. In order to estimate an annual rate, the numbers of accidents were simply doubled. Also, the catchment area of ACC claims outside the Wellington District could not be exactly matched to the main urban areas outside the Wellington District, from which the walking exposure estimates were derived. New Zealand Household Travel Suvey data provided the average annual walking exposure levels in millions of hours spent walking by gender and age group using data from July 2003 to June 2009.

13 The ACC is New Zealand's no-fault personal injury insurance provider.

Figure 7.3 Urban risks per million hours spent travelling for drivers, passengers, pedestrians injured in motor vehicle crashes and pedestrians injured in non-motor vehicle accidents (Frith and Thomas 2010)



This indicates that older people are much more vulnerable as pedestrians than when they are in a motor vehicle. The relative severity of the injuries in the non-motor vehicle ACC claims vis-à-vis motor vehicle injury is not available, but the non-motor vehicle injuries can be expected to be somewhat less severe, on average, than the motor vehicle injuries. Research in this area could be profitable.

Work carried out by Frith and Thomas (2010) indicated the following infrastructural issues related to pedestrian safety:

- Kerbs (vertical changes) are a major contributory factor in pedestrian trips, falls and injuries, particularly when stepping up (as opposed to down).
- Maintenance is more of an issue than initial design and construction.
- Site visits suggested that places where accidents occur tend to be rated unfavourably by experts vis-à-vis the part of the infrastructure associated with the accident. They also tend to have one or more faults that violate design standards in the relevant NZTA guide.[14]
- Environments that are not forgiving to pedestrians, who may be fatigued, visually impaired or distracted, are more likely to cause accidents.

14 No controlled study was done to show that accident sites are worse than non-accident sites in similar areas. This might be a subject of subsequent research.

- Uneven construction is the most commonly reported hazard type in roadside pedestrian accidents.
- Environments ought to be predictable to the pedestrian ('no surprises').

Improving walking safety requires attention to these issues. This means attending to materials used in walking infrastructure (eg not using slippery materials), installation (eg avoiding unevenly laid pavers) and maintenance (eg fixing cracks, potholes etc) as well as using good design principles. This is discussed in detail in Frith and Thomas (2010).

With a large proportional increase in the older population impending, these already significant pedestrian issues will become more urgent as time goes by.

7.3 Older people and mobility scooters

Mobility scooters increase their users' mobility and range of activities, and consequently have the potential to improve their users' community participation (Salminen et al 2009). In New Zealand, as in Australia, no licence or registration is necessary to operate a mobility scooter. However, in New Zealand, users are legally required to operate their scooters in 'a careful and considerate manner' and to use the footpath wherever possible. Failure to do so can result in a fine of up to $1000. If the rider of a mobility scooter causes a crash where someone is injured or killed, they can be convicted of careless or inconsiderate use of a vehicle, and face a fine of up to $4500 or up to three months' imprisonment. The safety implications of using mobility scooters and electric wheelchairs are largely unknown, with any injuries resulting from road crashes generally appearing in the databases as pedestrian injuries. However, crashes seem to be comparatively rare, as they did not feature in a 2008/9 survey of 487 claimants to the ACC for injury near or on the road that did not involve a motor vehicle (Frith and Thomas 2010). According to the MoT, between 2005 and 2009, nine people were killed in road crashes involving mobility scooters, 19 people were seriously injured and 81 were left with minor injuries (Cairns 2010).

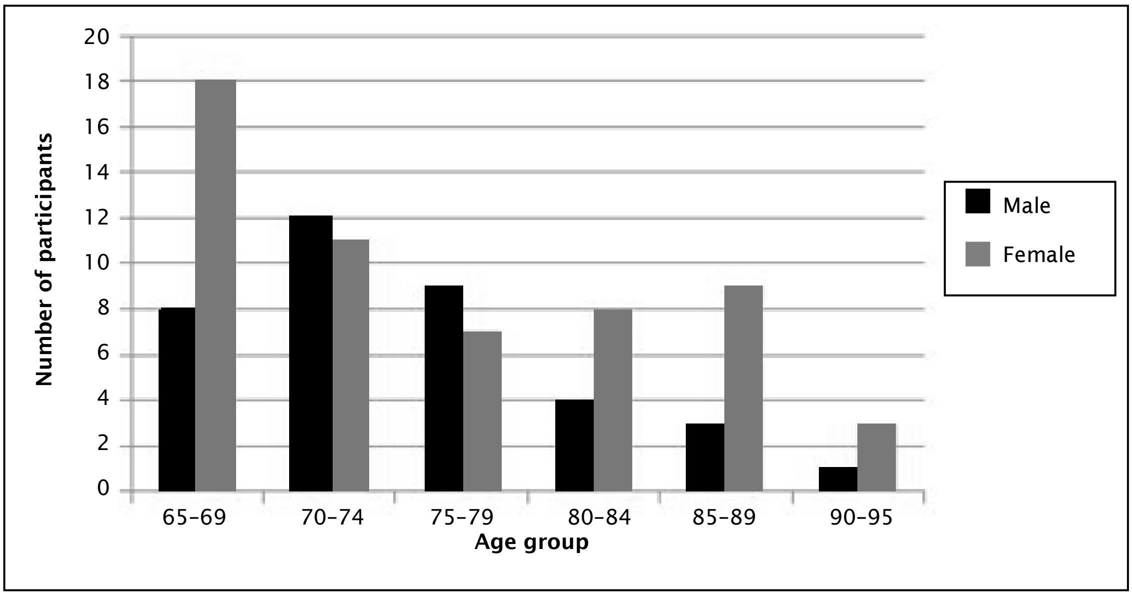
Notwithstanding these relatively low injury numbers, intuitively, users' relative lack of protection when travelling on the road would suggest that they would be at an increased risk per distance travelled compared to car drivers, their slower speeds notwithstanding – especially if it were accepted that some users may be riding scooters because of cognitive or other functional impairments that have prevented them from driving a car. As the use of scooters increases, it would be reasonable to expect a commensurate increase in injuries. As with pedestrians, little work has been done in adapting the road and roadside environment to mobility scooters. More consideration of how and to what extent this is carried out is required, as their use will increase as demographic change dictates.

8 Travel aspirations of older New Zealanders

8.1 Study design

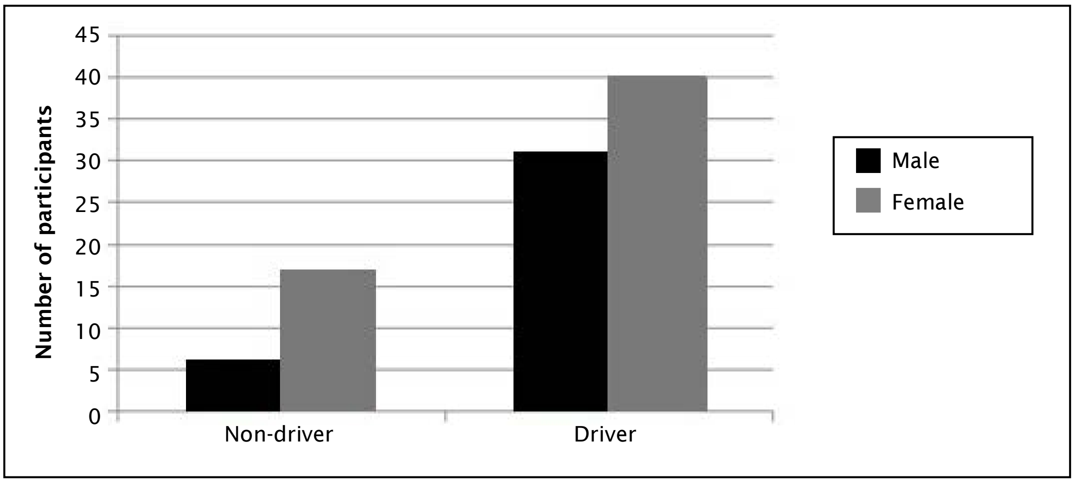
A home interview survey of ~100 New Zealanders aged 65+ residing in the Hutt Valley (a part of the greater Wellington urban area) was carried out in August–September 2010 to gain an insight into older people's travel aspirations. Older people's travel aspirations will affect future travel growth through public pressure helping to shape the government's policies regarding such growth. The survey was carried out by the 'snowball' method, where members of a peer group who were interviewed were asked to nominate other members of the peer group who might be approached. These people were then approached and interviewed until the required number was reached. The age distribution of the participants by gender is shown in figure 8.1.

Figure 8.1 Survey participants' age by by gender



The prevalence of drivers in the sample by gender is shown in figure 8.2.

Figure 8.2 Drivers among survey participants by gender



Most questions in the survey were on a scale of 1 to 5 as explained in table 8.1. In some cases, the meanings were reversed, which is indicated by the letters 'RS'. As 100 participants were involved, the number of participants making a particular answer can also be interpreted as a percentage.

Table 8.1 Five-point scale for the majority of survey questions

Score	Answer
1	Strongly disagree
2	Disagree
3	Not sure/neutral
4	Agree
5	Strongly agree

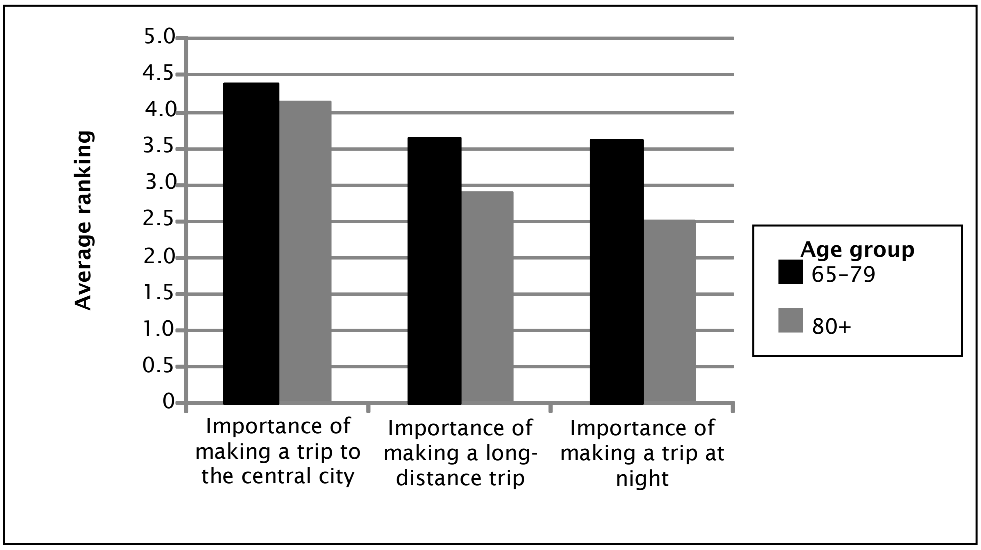
It can be asumed that all questions discussed were answered using this form unless otherwise stated. A list of the relevant questions and the options for answering them are presented in appendix A.

8.2 Importance and ease of making a trip

8.2.1 By age

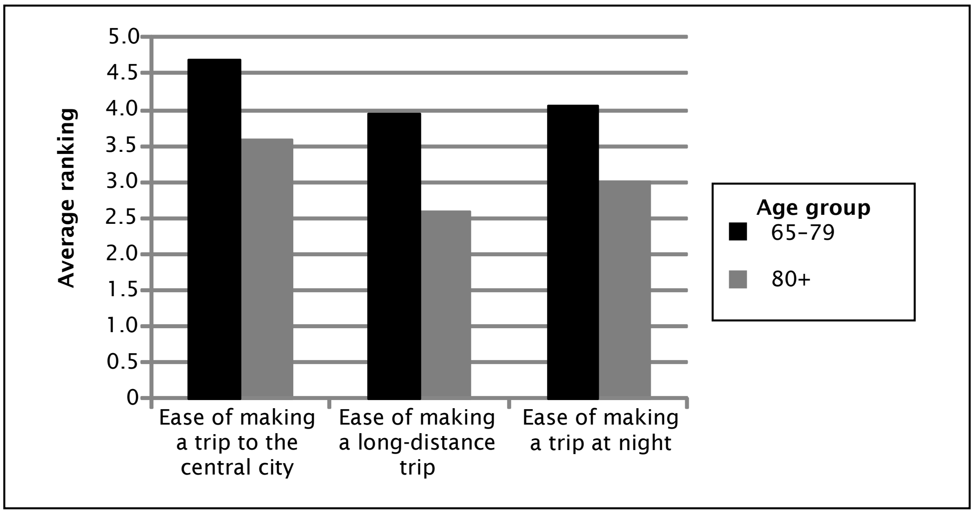
Participants were asked about importance to them of trips to the central city, long-distance trips and night trips, and the ease of making them. The results regarding importance are shown in figure 8.3.

Figure 8.3 Importance of three types of trips by age



It can be seen that all the three trips were rated well above neutral level by the younger group, with trips to the central city being rated as the most important. Trips at night were rated as the least important. The older group's responses showed the same general pattern. However, although levels for the central city were similar, importance dropped off much more for making long-distance trips, followed by night trips. This indicates that the older group values trips within the city almost as much as the younger group, is less keen on longer trips and prefers to travel by day. Figure 8.4 looks at ease of travel for those trips by age.

Figure 8.4 Ease of three types of trips by age

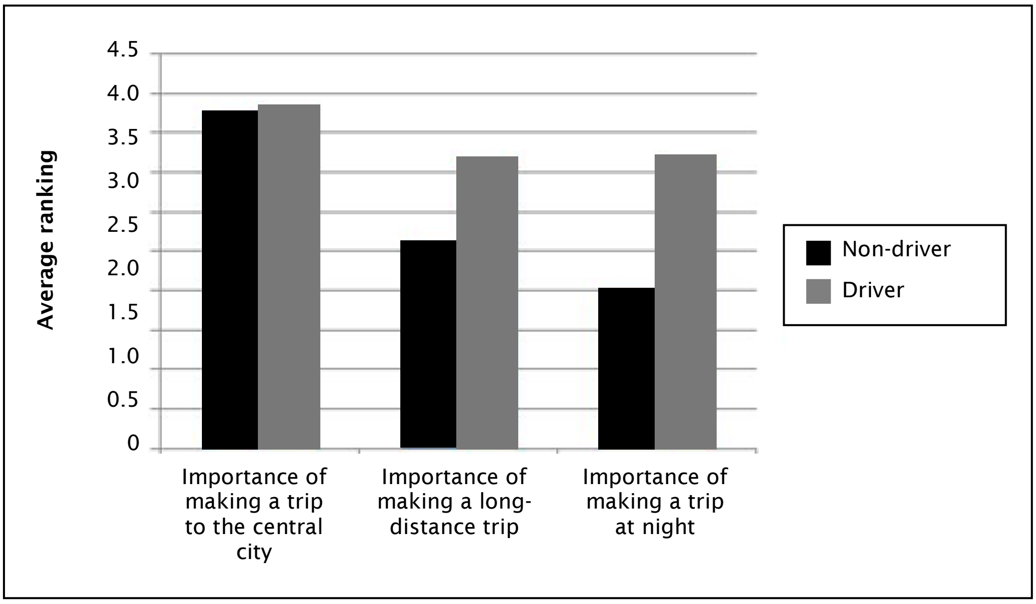


When figure 8.4 is compared with figure 8.3, it can be seen that the ease of making a trip drops off with age faster than the importance for all three trips.The greatest drop-off is for long-distance trips followed by night trips. This would indicate that travel-related frustration increases somewhat with age, which is consistent with later results in this chapter.

8.2.2 By driver v non-driver

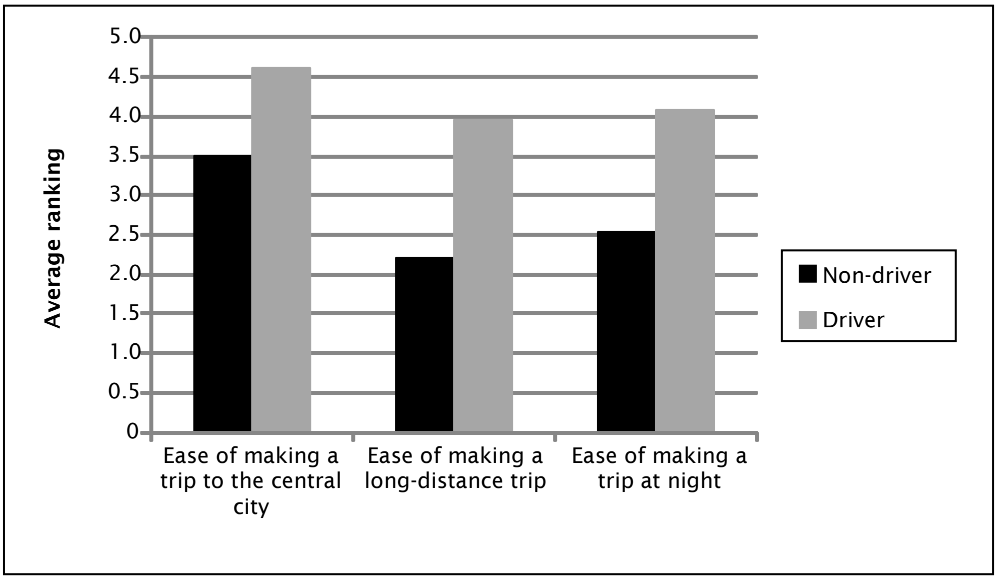
Figures 8.5 and 8.6 show the importance and ease as described above by driver v non-driver.

Figure 8.5 Importance of three types of trips by driver v non-driver



Drivers generally rated the importance of all three trip categories higher than non-drivers did, although the ranking for central city trips was similarly high for both groups. For the other trips, the driver ranking was relatively high, while that of the non-drivers was close to or below the mid-point. These differences in rankings may be related to vehicle ownership.

Figure 8.6 Ease of three types of trips by driver v non-driver



In terms of ease, the drivers, predictably, found all three types relatively easy, while non-drivers' reponses were on or below the mid-point, for all trips except those to the central city. Both groups rated the central city as having good access.

8.2.3 By gender

Male and female ratings were similar vis-à-vis importance, with both considering trips to central city to be the most important, followed by long-distance trips and night trips last. In terms of ease, the females rated central city trips similarly to males but thought long-distance and night trips to be more difficult than did males (figures 8.7 and 8.8).

Figure 8.7 Importance of three types of trips by gender

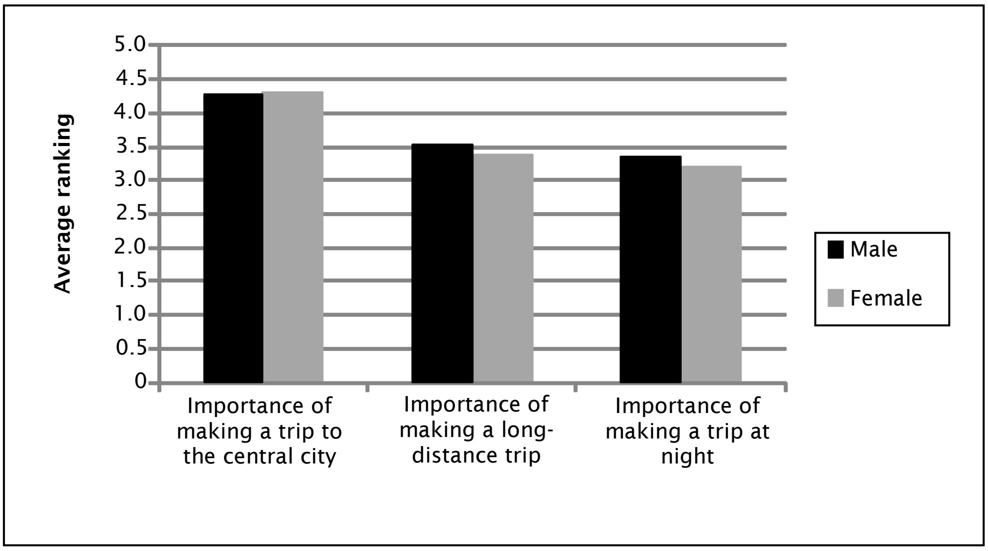
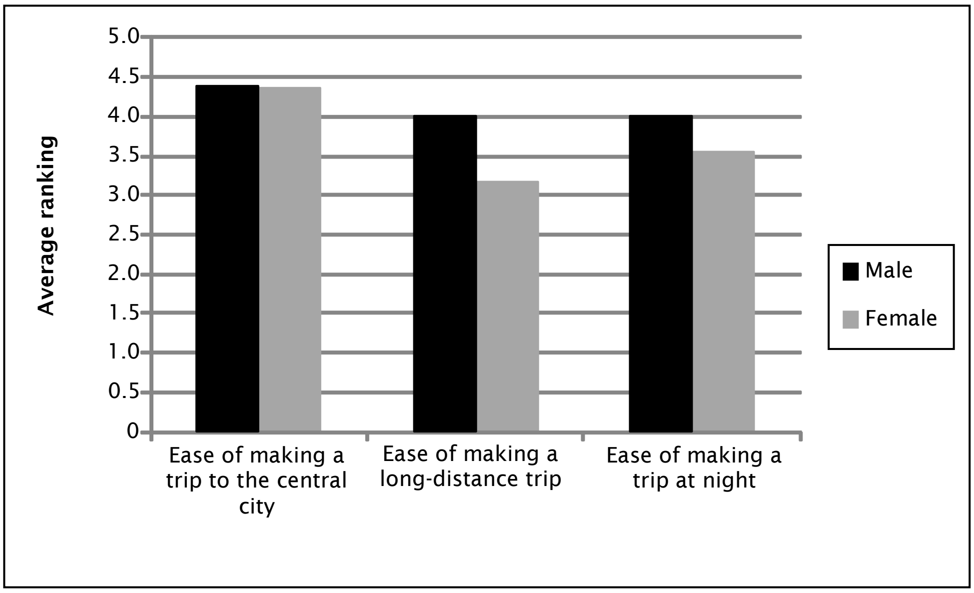


Figure 8.8 Ease of three types of trips by gender



An interesting finding was that the central city was the most important of the three trips to both groups, and also the trip with the greatest ease of access.

8.3 Subjective feelings regarding travel

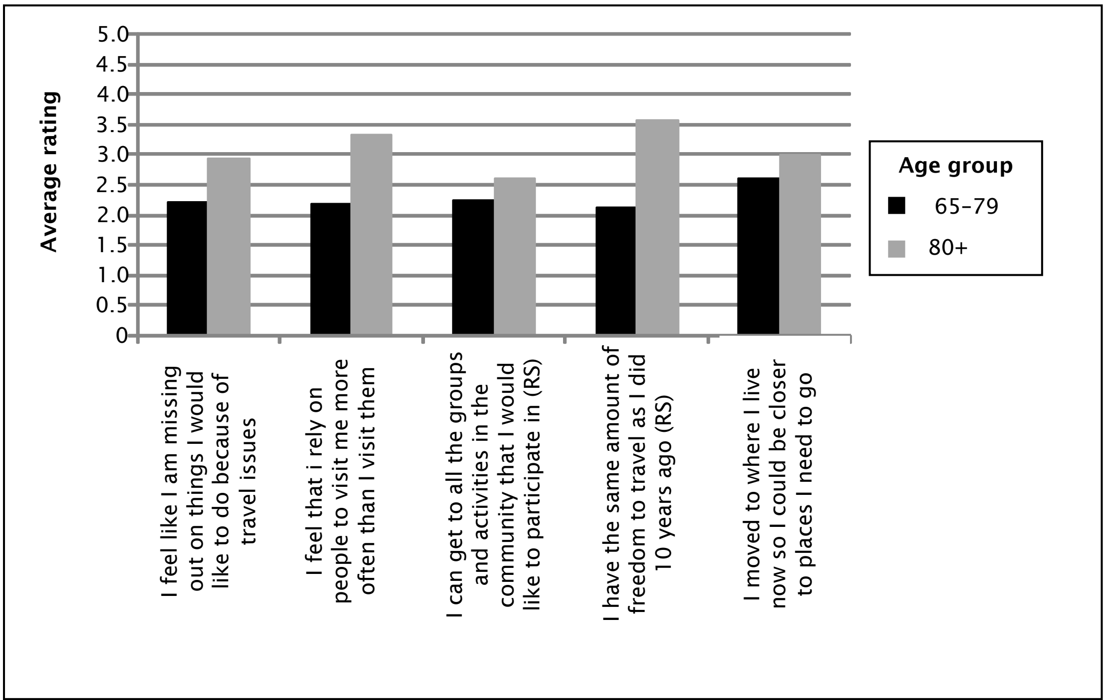
Participants were asked to rate themselves regarding the feelings outlined below by assigning each statement a score from 1 to 5 as described in table 8.1:

- I feel like I am missing out on things I would like to do because of travel issues.
- I feel that I rely on people to visit me more often than I visit them.
- I can get to all the groups and activities in the community that I would like to participate in (RS).
- I have the same amount of freedom to travel as I did ten years ago (RS).
- I moved to where I live now so I could be closer to places I need to go.

The results indicate the not unexpected notion that problems regarding mobility increase with age. The answers for the younger group, which were all on the positive side of neutral, suggest that the participants are generally subjectively at ease with their level of mobility. The answer became less positive with age, with the older group scoring consistently above the middle level on all questions One question had a different emphasis. This was the question related to whether the person had 'moved to where I live now so I could be closer to places I need to go'. The fact that the answers to this question increased in positivity with age indicates that the older participants were taking transport more into account when choosing their dwelling than the younger participants.

This data, disaggregated by age, is shown in figure 8.9.

Figure 8.9 Older peoples' feelings regarding various transport issues by age



It is also of interest to disaggregate the answers to the same questions by driver and non-driver. This is shown in figure 8.10.

Figure 8.10 Older peoples' feelings regarding various transport issues by driver v non-driver

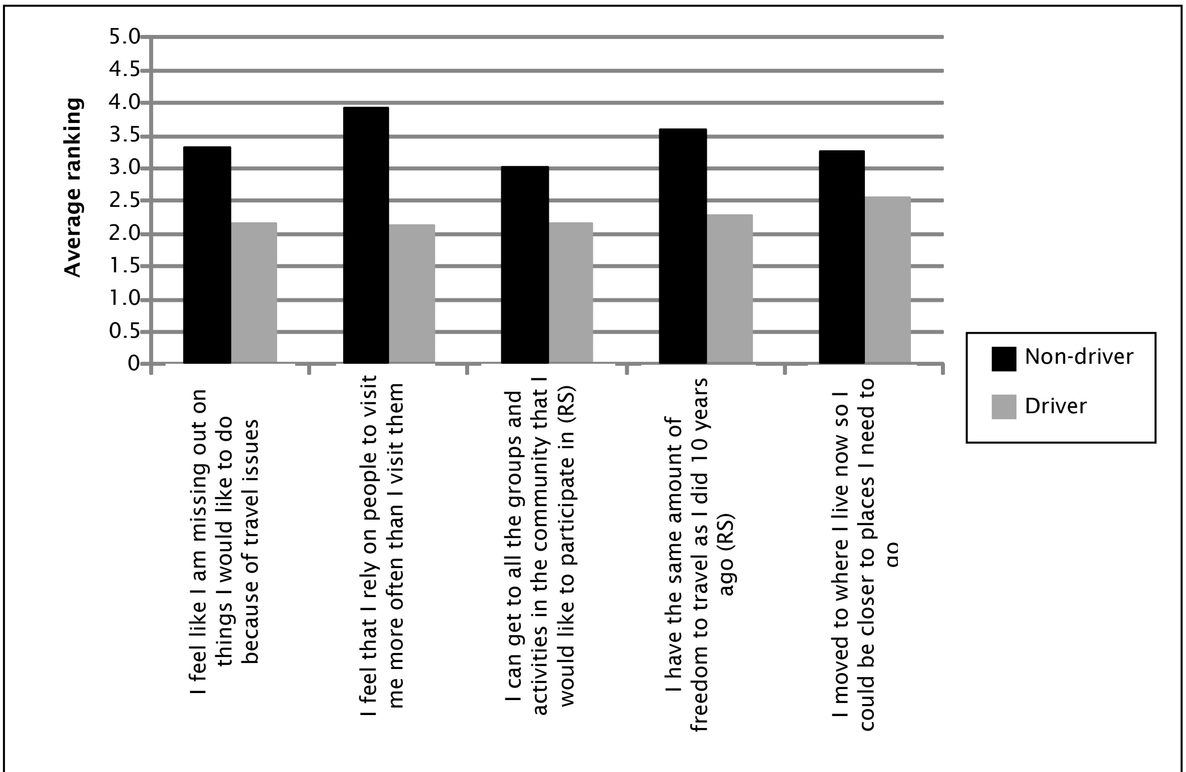
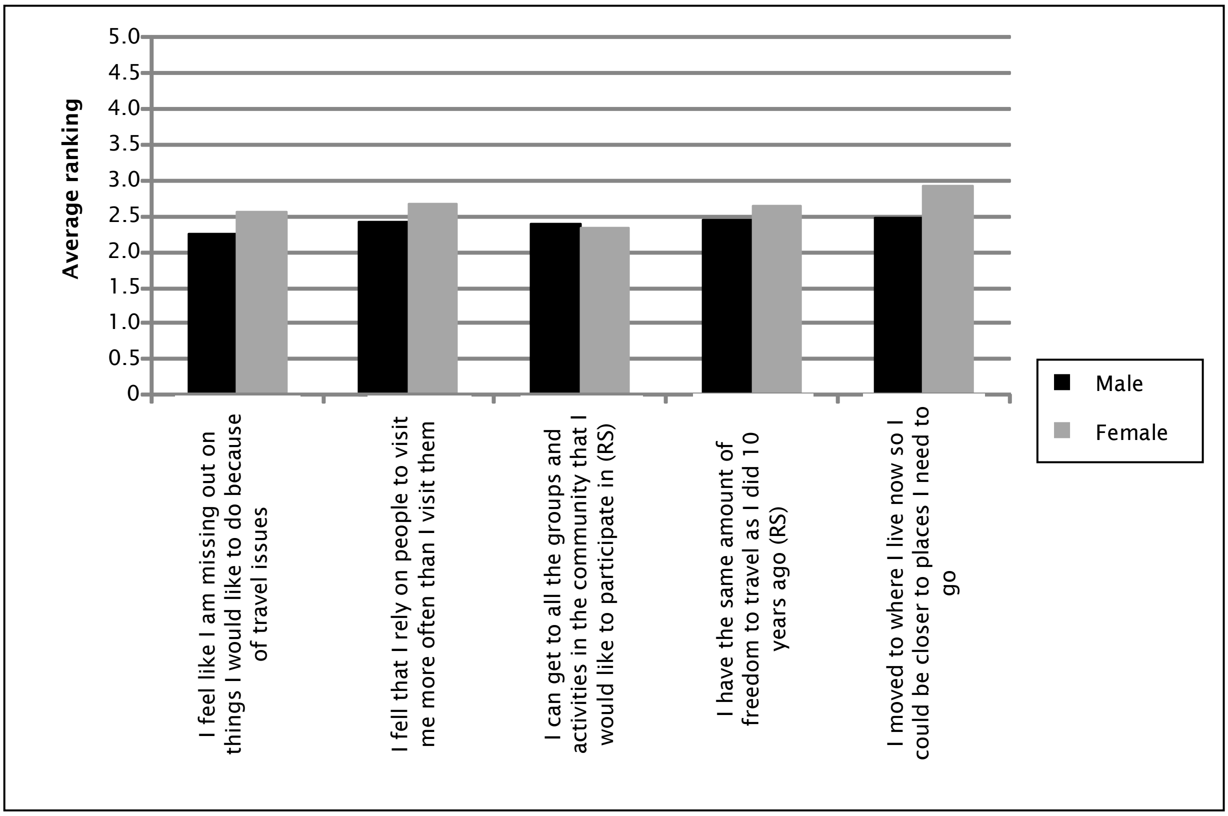


Figure 8.10 clearly indicates that non-drivers consistently feel more transport-constrained regarding transport and travel than drivers. Non-drivers scored consistently above the middle ranking, while drivers scored consistently below it. Also, non-drivers were more inclined to have moved to their current abode to facilitate transport, which is a positive thing for them to have done.

Figure 8.11 shows more feeling of transport constraint among females than males. However, the scores were not much over the middle value (any score over the middle value was considered to indicate constraint).

Figure 8.11 Older peoples' feelings regarding various transport issues by gender



8.4 Summary

The results indicate that, overall, older people find making journeys more difficult as they age. Trips to the city centre rate more highly in importance than night trips or long-distance trips, and are more important to non-drivers than to drivers, who, as would be expected, found travel more difficult than drivers. Non-drivers were more inclined to have moved to their current address with one of the motives being ease of transport. Feelings of lifestyle constraint and a need to rely on others increased with age, and tended to be greater for non-drivers than drivers and for women than men.

9 Historical road traffic growth forecasts in New Zealand

Little literature is available on the subject of historical road traffic growth forecasts for New Zealand. Koorey et al (2000) discussed the subject in a report commissioned by Transfund New Zealand, a legacy organisation of the NZTA. The report outlines various approaches to carrying out such forecasts that have been used in New Zealand and overseas. Methods used included:

- forecasting using economic variables like gross domestic product, fuel price, car ownership and population growth
- network modelling, eg complicated gravity models
- simple time series forecasts of annual average daily traffic.

A survey of New Zealand regional and road controlling authorities at the time revealed the following:

- About 70% used the approach outlined in the *Project evaluation manual*[15] (Transfund New Zealand 1997) and historical count data.
- Cities were more involved in forecasting than regions or districts.
- No common approach was used.
- Some simplistic approaches were occasionally used.
- No freight traffic growth forecasting was undertaken.
- Little alternative mode traffic was forecast.
- Considerable interest was shown in improving their forecasting by road controlling authorities.

More recently, Furnish and Wignall (2009) discussed current transport modelling practice in New Zealand. Neither Koorey et al (2000) nor Furnish and Wignall mentioned any significant attempts to take demographic change into account.

In the NZTA's *Economic evaluation manual* (2010b) (EEM), forecasting requirements do not preclude making allowances for demographic change but do not mention it specifically. The recommended method for estimating future traffic demand on new road schemes is based on extrapolation of historic growth rates. The EEM contains regional growth factors to be used in calculations (table 9.1).

Table 9.1 Regional traffic growth factors for rural and urban New Zealand (source: EEM)

Region	Urban		Rural	
	Arterial percentage growth	Other percentage growth	Strategic percentage growth	Other percentage growth
Northland	3.0	2.0	3.0	2.5
Auckland Region	N/A	N/A	2.5	2.5
Auckland City	1.5	1.5	N/A	N/A
North Shore City	3.0	2.0	N/A	N/A
Waitakere City	3.0	2.0	N/A	N/A

15 The *Project evaluation manual* was a precursor to the present NZTA EEM.

Region	Urban		Rural	
	Arterial percentage growth	**Other percentage growth**	**Strategic percentage growth**	**Other percentage growth**
Manukau City	3.0	2.0	N/A	N/A
Waikato	2.0	1.0	3.0	2.5
Bay of Plenty	2.5	2.0	2.5	2.5
Gisborne	1.0	1.0	1.0	1.0
Hawke's Bay	1.5	1.5	2.0	1.0
Taranaki	1.5	1.0	1.5	0.5
Manawatu-Wanganui	2.0	1.5	2.0	1.5
Wellington	2.0	2.0	2.0	2.0
Nelson-Marlborough	2.5	2.0	2.5	2.5
Canterbury	2.0	2.0	3.0	2.5
West Coast	N/A	2.0	N/A	2.0
Otago	1.5	1.5	2.0	1.5
Southland	1.0	1.0	1.0	1.0

The EEM states that:

> *…in predicting future traffic volumes, normal traffic growth, diverted traffic, generated and redistributed traffic, and intermittent traffic shall be taken into account. The procedure adopted for estimating future traffic volumes must fulfil the requirement that demand is in approximate equilibrium with supply.*

Thus future demographic change is not one of the factors explicitly taken into account.

10 Projections of future demand for household travel

10.1 Introduction

The New Zealand Household Travel Survey (NZHTS) (MoT 2009) is an ongoing survey of household travel conducted for the MoT. Each year, occupants of a sample of households throughout New Zealand are invited to participate in the survey by recording all their travel over a two-day period. Each person in the household is then interviewed about their travel. This travel information is then available for use to provide estimates of travel by various demographic, travel behaviour and geographic subgroups.

These projections are derived by using travel estimates from the full six years of the ongoing travel survey as a baseline for projecting travel into the future. These projections use the appropriate national or regional SNZ population projection series as a basis for expanding or contracting the baseline according to the projected demographic change. The level to which the travel in the survey can be disaggregated is determined by travel survey sampling errors. The sampling errors preclude projections for cycling, motorcycling and public transport, so these modes are considered on a more qualitative basis. All travel is estimated in terms of kilometres travelled except for pedestrians, where the measure used is hours spent walking.

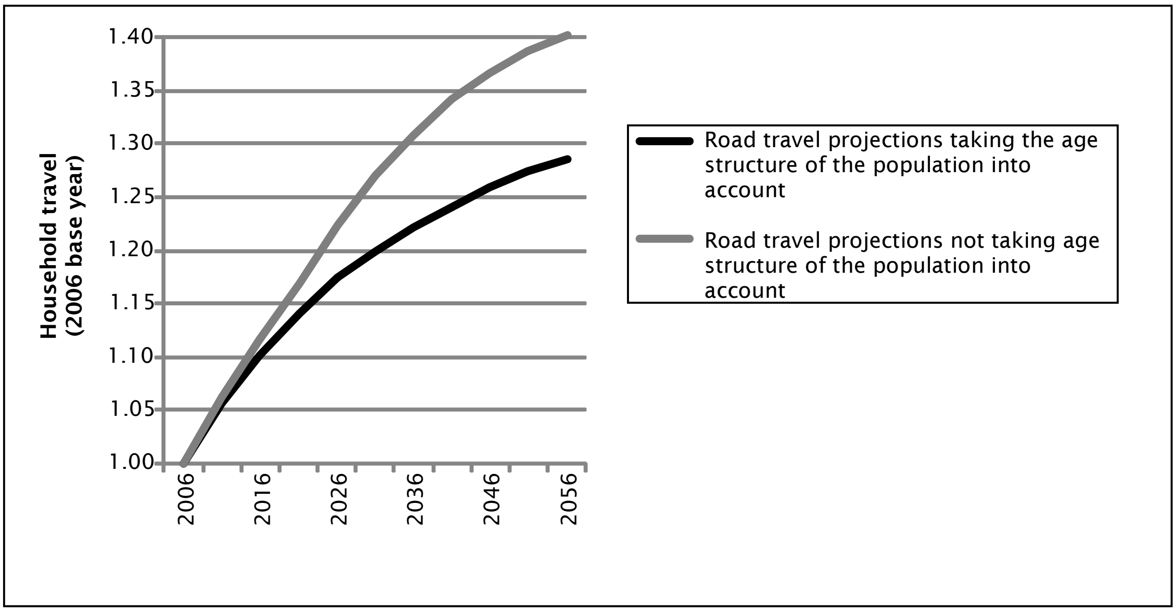
As only household travel is covered by the travel survey, the other travel not related to households is excluded. This includes that by professional drivers in the course of work.

This report is to do with demographic change and does not seek to take into account other factors such as fuel cost. One assumption involved in projecting travel using the population growth of an area as a projection criterion is that only that area's demographic change affects the travel in that area. Travel growth in region or indeed in a country may be affected by demographic change in other areas. This report does not take this factor into account.

10.2 Driver travel projections

If it is assumed that the increase in traffic growth from 2006 to 2056 reflects general population growth in those of driving age (ie for ages 15 years and above) then, between 2006 and 2056, a 40.2% growth in traffic is estimated. If the projections take the age structure of the population into account by deriving annual travel estimates for each SNZ age band and combining these, the resulting estimates give a growth increase of 28.5% between 2006 and 2056. The difference between the projections taking the age structure of the population into account and those not taking it into account can be taken as a measure of the effect of the changes in the age structure on network traffic. The resulting projections by the two methods are illustrated in figure 10.1.

Figure 10.1 Household travel projections by road according to SNZ, series 5 medium assumptions, taking 2006 as the base year using overall population projections (for those aged 15+) and taking population age structure into account

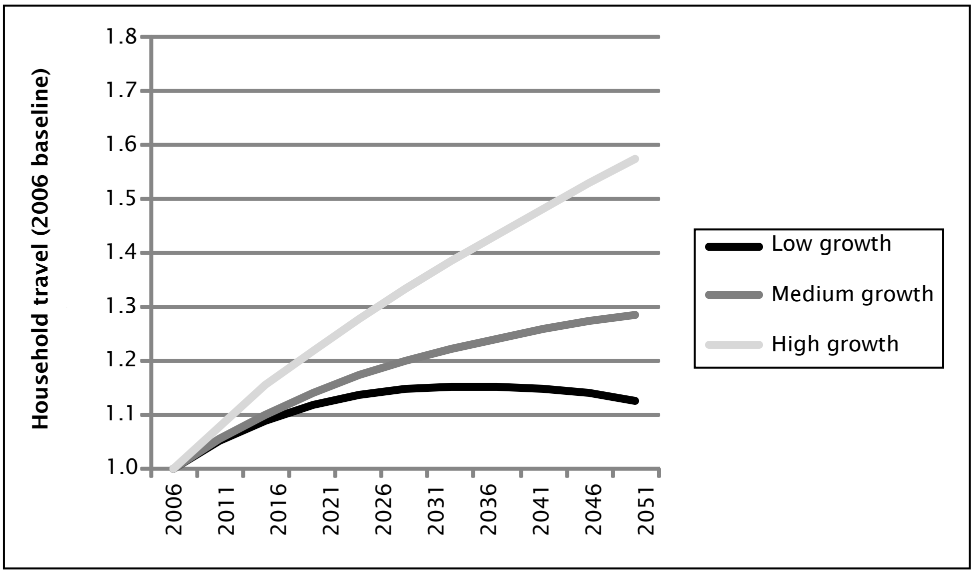


Subtraction of the results of the two projections indicates an overall decrease in household travel related to changes in population age structure by 2056 of around 29%. This is consistent with the relatively lower per capita propensity to travel of the older age group, which is projected to increase in size considerably relative to other groups (the size of the 65+ group is projected to increase by 273% by 2061, a much greater change than that projected for younger age groups). Another way of looking at the figures is that not taking the changes in population structure into account may overstate the increase in household travel on New Zealand roads between 2006 and 2056 by around 40%. It is thus important to take these changes into account.

10.3 The effect of population growth assumptions on projections

Figure 10.1 is derived from medium growth tables from SNZ. As a comparison, SNZ also provides low- and high-growth tables from the 2006 base. The resulting travel growth estimates, assuming traffic growth mirrors age-specific population growth, are given in figure 10.2. It can be seen that the high-growth scenario predicts strong growth extending after 2056. For the other two series, growth tends to level off by ~2050 for the medium series, while a maximum is reached around 2030 for the lower growth series.

Figure 10.2 Household travel projections (2006 base year), assuming that traffic growth mirrors age-specific population growth

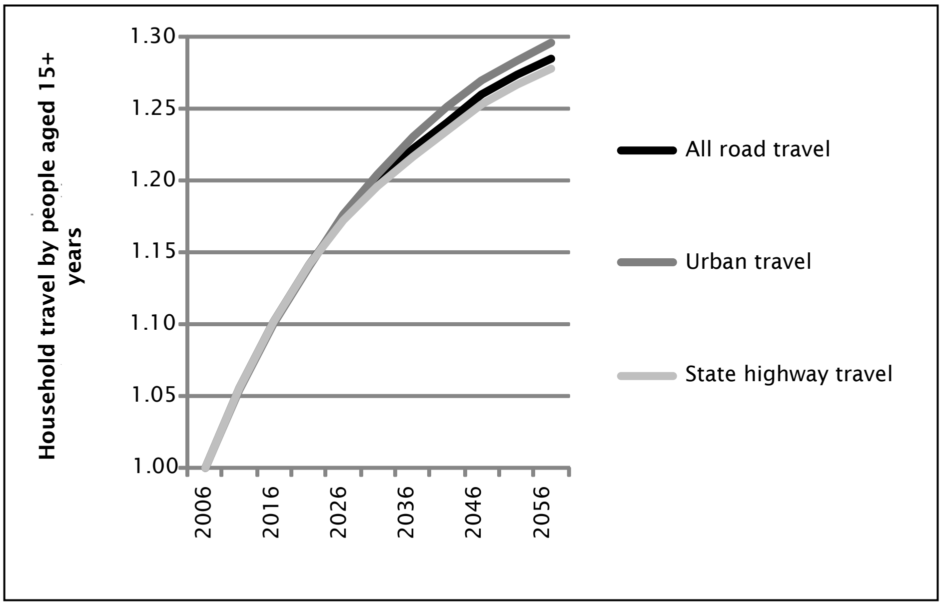


This indicates that the uncertainty in household road travel growth related to population growth assumptions is substantial, with the high-growth scenario producing growth of 57.6%, the medium-growth scenario producing 28.5% and the low-growth scenario producing 112.7%, all by 2056. The differences in growth mirror the differences in demographic assumptions related to the series (see table 1.1).

10.4 Driver travel by part of road network used

Figure 10.3 shows projections of driver travel by part of network used, related to a base year of 2006 and taking population age structure into account. This shows that the various projections are closely clustered around the overall projection for the whole road network. Within the close clustering, we find that the greatest increase is for urban travel and the smallest increases are for state highway and open road travel. This is consistent with the greater propensity of the increasing older group to travel on urban roads.

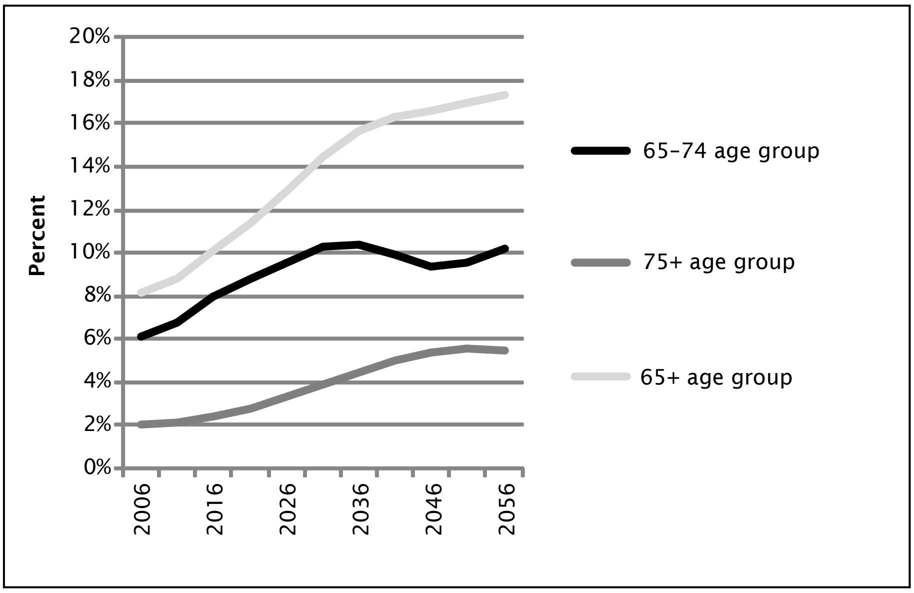
Figure 10.3 Road travel projections for drivers (age 15+ years), to 2056 for all roads, urban roads, open roads and state highways, indexed to 2006 and accounting for age structure



Figures 10.4 to 10.6[16] show the projected percentage of travel on all roads, urban roads (defined as those with a 70km/h or lower speed limit) and state highway roads when the driver is in an older age bracket. The figures indicate that the road network with the greatest proportion of older drivers in the traffic is urban roads and will continue to be urban roads. The percentage on state highways (mostly a subcategory of open roads[17]) is a little smaller. In all cases, most of the increase will have occurred by around 2036. To summarise, by around 2036, our state highways are projected to have around 15.7% of drivers aged 65+ and urban areas will have around 18%. For the 75+ group, the percentages are projected to rise to 4.5% and 6.7% respectively.

These changes, which represent an approximate doubling of the 65+ proportion of the driver population on all networks, are happening now and need to be taken account of in design of infrastructure because of the different requirements of the older population in terms of such areas as visual acuity.

Figure 10.4 The percentage of state highway travel by various older age groups



16 The vaguely sinusoidal oscillations of the line for the 65-74 age group are related to similar fluctuations in the projected proportion of the population aged 15+ who are aged 65 -74.

17 The indexed figures for open roads were so close to those for state highways as to be indistinguishable in the chart, so they were omitted.

Figure 10.5 The percentage of open road travel by various older age groups

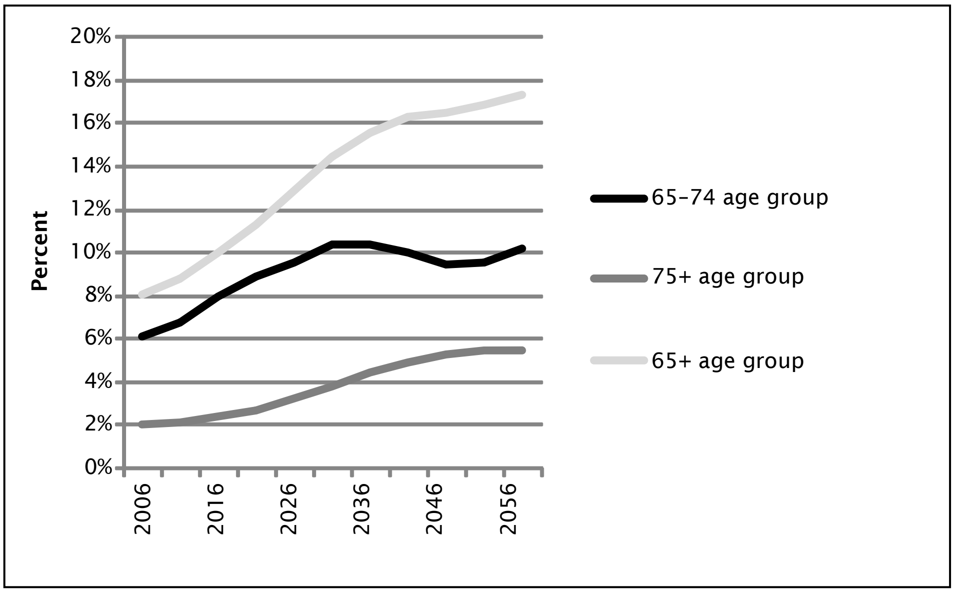
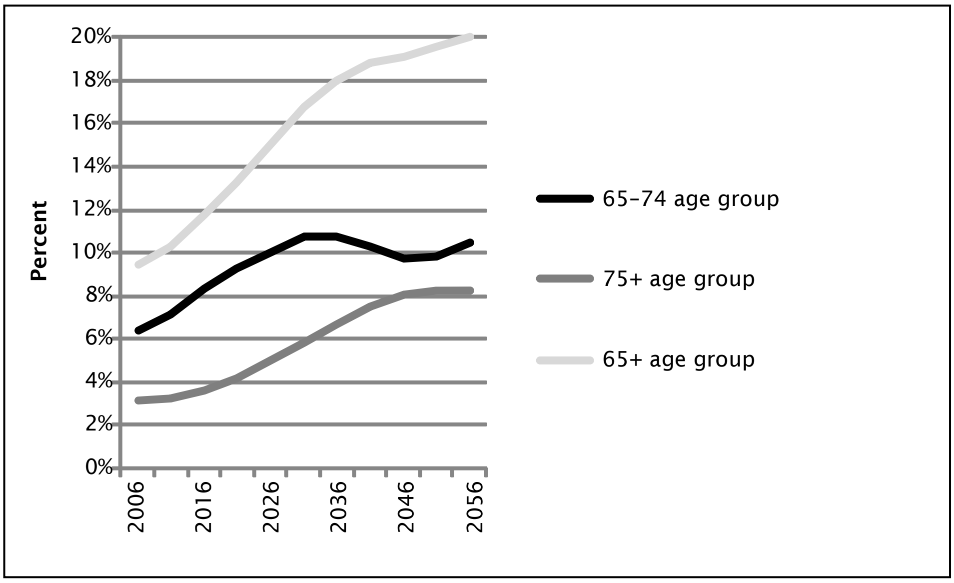


Figure 10.6 The percentage of urban travel by various older age groups



10.5 Work-related travel

Future work-related travel[18] will, of necessity, be related to the future age structure of the workforce. It is useful to examine the effect of changes in the workforce and its age structure. In particular, the total workforce is projected to grow from 2.24 million in 2006 to 2.65 million in 2031 and 2.79 million in 2061 using SNZ series 5 (medium) projections. However, the projection for the 65+ workforce is that it will increase from 62,000 in 2006 to 160,000 in 2021 and about 200,000 from the mid-2030s. Thus, the age

18 The analyses in this section are based on the three household travel survey trip purpose categories related to work. These are 'main job', 'other job' and 'employer's business'. Thus the analyses cover the journey to work but not the journey from work to home.

structure of the workforce is projected to change substantially. This is illustrated by figure 10.7 (SNZ 2010).

The workforce itself (figure 10.8) is expected to continue to grow but at a slower rate after the late 2020s (SNZ 2008b).

Figure 10.7 Age distribution of the workforce 1991–2061 (series 5 medium projections) (adapted from SNZ 2008b)

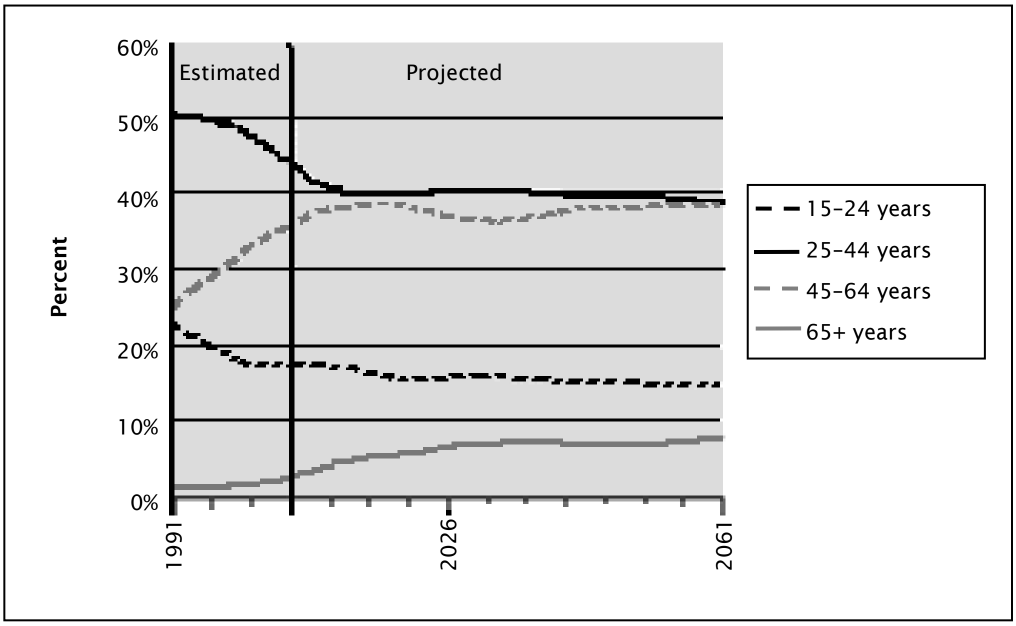


Figure 10.8 New Zealand workforce 1991–2061 (series 5 medium projections) (adapted from SNZ 2008b)

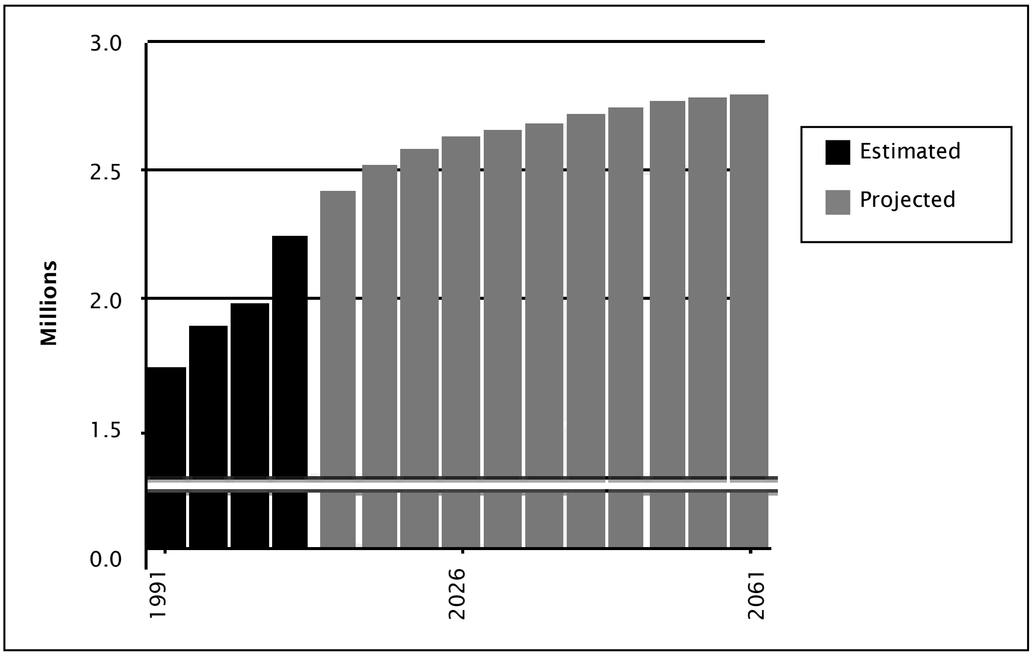
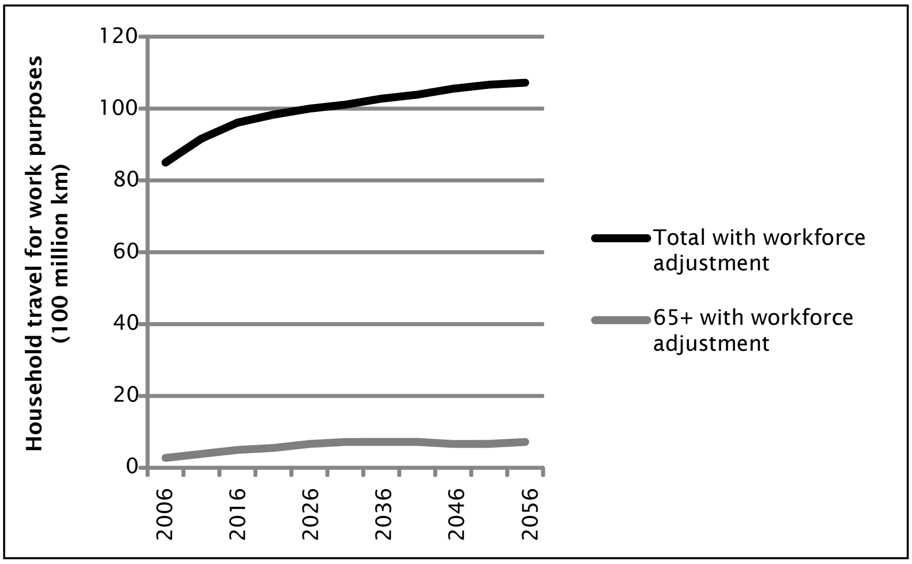


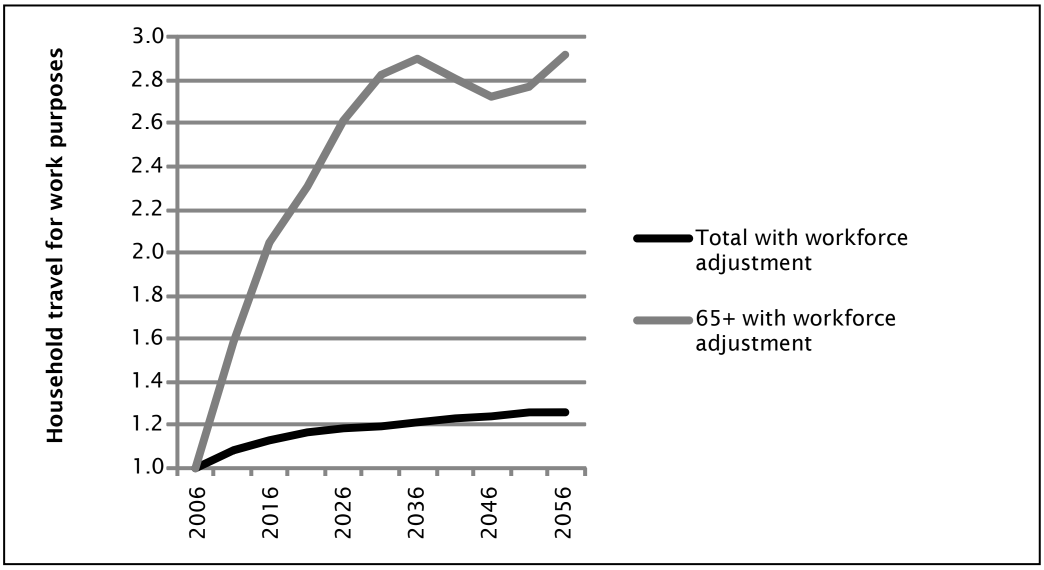
Figure 10.9 shows work-related travel projections made by indexing work-related travel using workforce projections for travel by all age groups and the 65+ group.

Figure 10.9 Annual work-related household travel for all ages and 65+ using workforce projections



To show the changes in the two series in more detail, the two series are shown in figure 10.10 indexed to the 2006 value.

Figure 10.10 Total annual work-related travel (taking the age structure of the population into account) and 65+ travel, both with workforce adjustment, indexed to 2006



This indicates a 190% rise for the 65+ group by 2056, compared with 26% for the population as a whole. The projected changes in the age structure of the workforce would have a noticeable effect on work-related transport demand. A comparison of projected household kilometres travelled for work purposes with and without an allowance for workforce changes using workforce projections (series 5 medium scenario) is displayed in figure 10.11.

Figure 10.11 Projected household travel for work purposes with and without an allowance for workforce changes

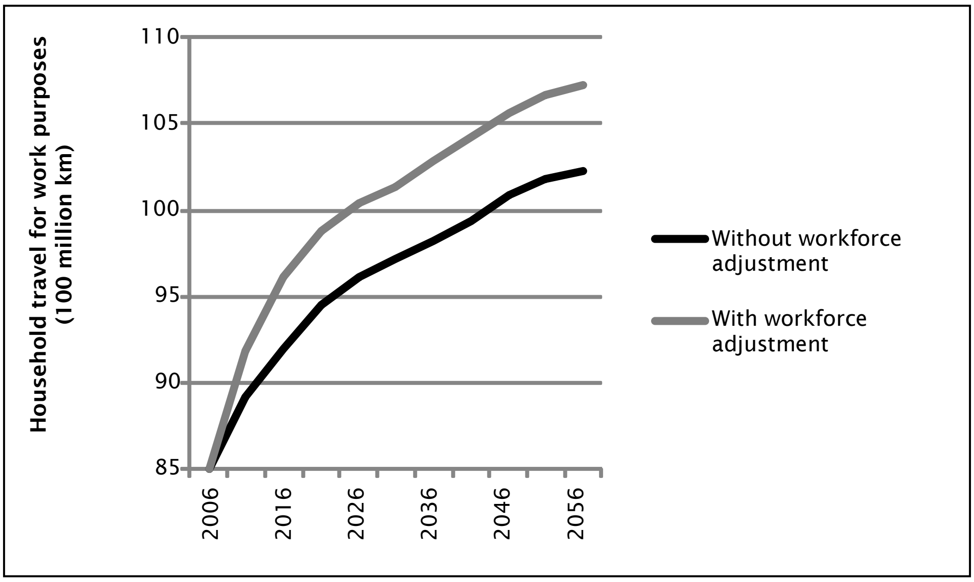


Figure 10.11 shows that these projected changes would have the effect of increasing work-related travel, primarily related to the effect of older groups working more by 4.3% at 2031 and 4.9% at 2056. This increase has an absolute size of 500 million kilometres per year in 2056, which, although substantial in absolute terms, is only a little over 1% of the 46.18 billion kilometres projected for 2056 without allowing for that factor.

10.6 Passengers

Projecting passenger travel involves the use of population projections covering all age-groups, as no age qualification is associated with being a passenger. Figure 10.12 shows growth in overall household passengers by year, using the SNZ medium series 5, disaggregated by age group. Figure 10.13 is similar but shows figures for people aged 65+ years. This indicates that in older and younger age groups, most of the passenger kilometres are outside urban areas. For those aged 65+, passenger travel increases at a steepening rate until 2031, when a distinct levelling off occurs for all networks.

Similar to those in other analyses, the increases in the older bracket are much greater percentage-wise than in the younger bracket. Overall, passenger travel in general is projected to increase by 20% by 2056; 65+ passenger travel by 73%. As all travel is projected to increase by 27% during the same period, this could indicate an overall decrease in vehicle occupancy over the period, as demography changes.

Figure 10.12 Projected household passenger kilometres by location within the road network

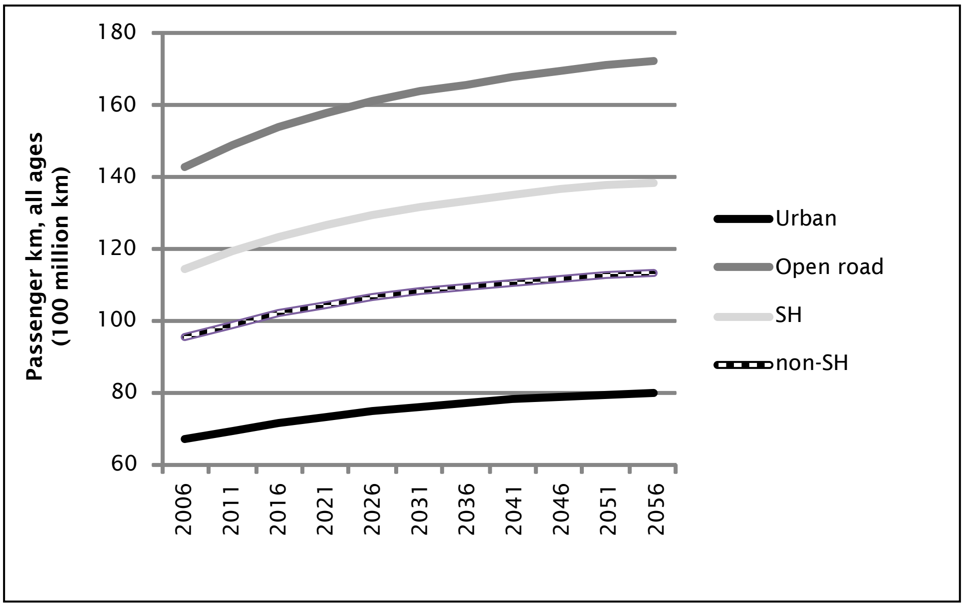
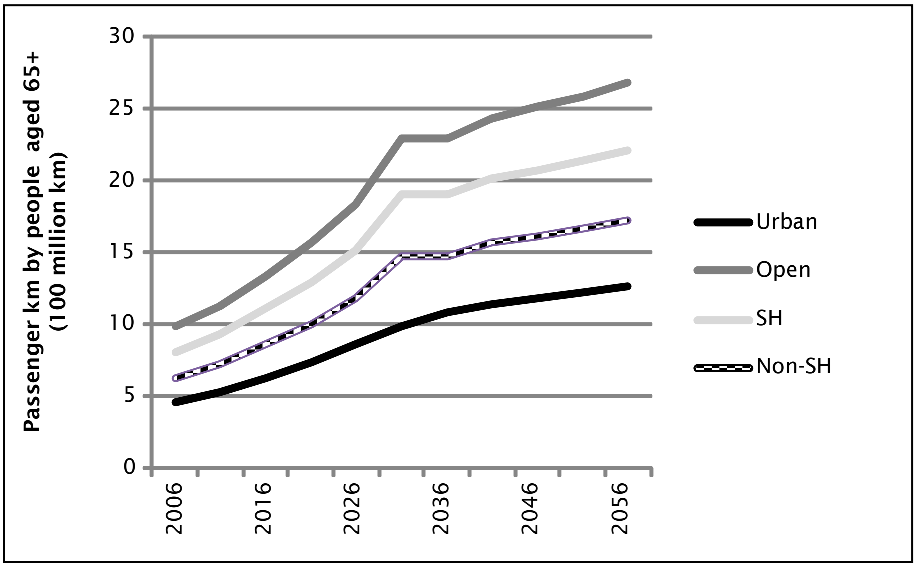


Figure 10.13 Projected household passenger kilometres by people aged 65+ by location within the road network



10.7 Pedestrians

Projections of the annual time spent walking by pedestrians, using data from the NZHTS disaggregated by age using series 5 medium population projections, are given in figure 10.14. This indicates a total increase in walking of 32% by 2056, most of which (22%) would happen by 2031. Similarly, the data displayed in figure 10.15 indicates that walking by those aged 65+ may increase by 173%, of which 113% would occur by 2031.

Figure 10.14 Projected time spent walking per year for all ages

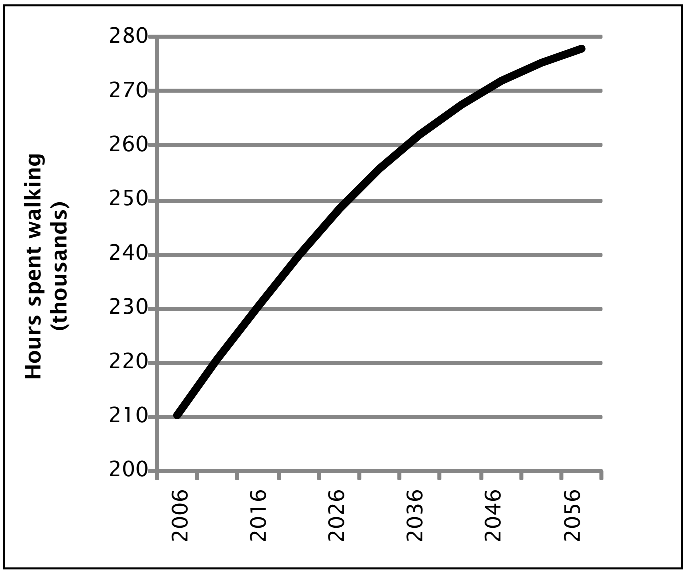
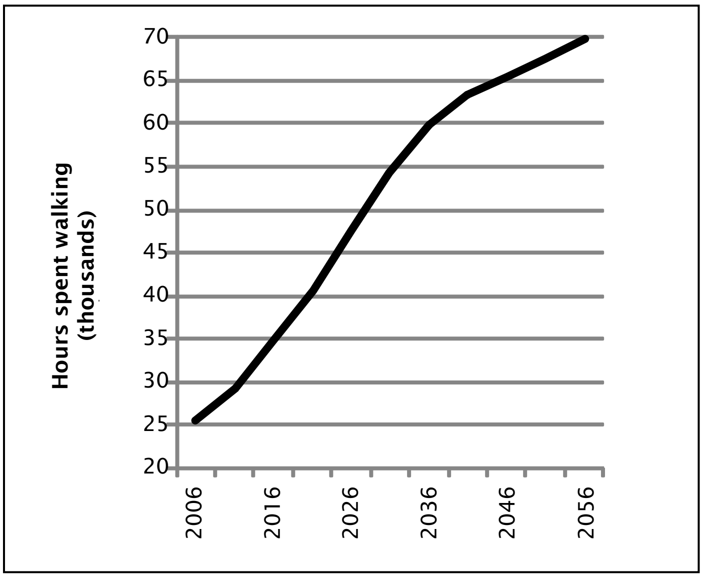


Figure 10.15 Projected time spent walking per year for those aged 65+



As was mentioned in more detail in chapter 7, the main consequence of this to the system is greater injury costs related to slips, trips and falls on the road and roadside, along with more pedestrian v motor vehicle collisions.

10.8 Cyclists

Given that the population groups which cycle[19] the most are likely to remain relatively static in size rather than increase, cycling will probably grow only a little without heavy promotion. The injury problems one expects with larger numbers of older pedestrians will hopefully be less so in the cycling area, particularly

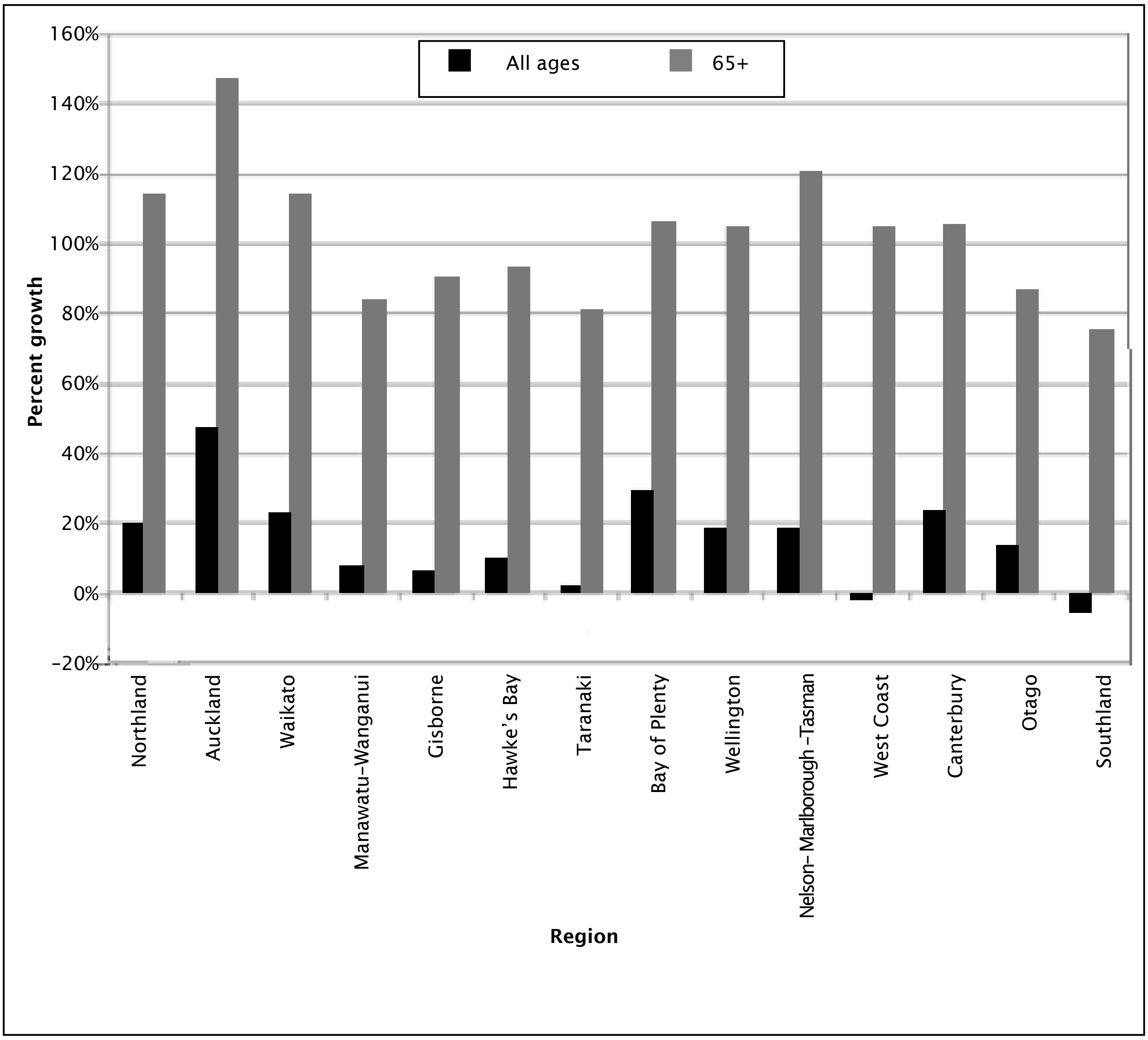
19 Projections for cyclists were not attempted, owing to small travel survey numbers.

if encouragement to cycle is sensibly moderated by knowledge of the varying consequences of a crash at different stages of life.

10.9 Regional changes

How demographic change will affect different regions is related to population change within those regions and their age distributions, from which we determine projections of how road traffic will change within them. Figure 10.16 looks at driver travel growth for all drivers and drivers aged 65+. The two bars on the chart represent projections of regional household driver travel growth based on the growth of the 15+ population disaggregated into age bands, and projections of regional household driver travel growth for drivers aged 65+. These projections are based on the assumption that the travel within a region is related to the population of that region. This assumption may have less validity in places with a larger through-traffic component (eg Marlborough) than in places with a smaller through-traffic component.

Figure 10.16 Driver travel growth by region, 2006–2031



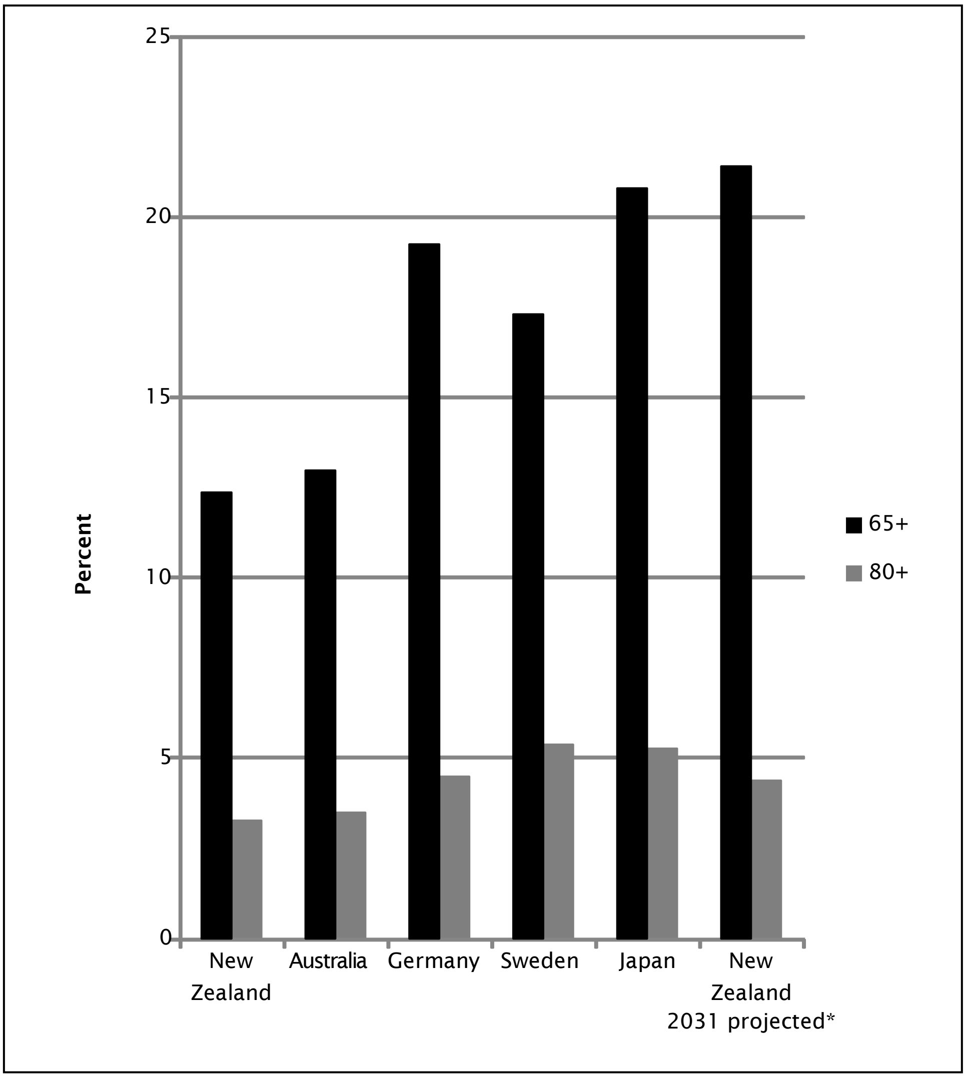
This indicates that the growth of older drivers' travel varies widely by region relative to the growth of all drivers' travel, with the greatest contribution being in provincial areas. All areas have 65+ growth greater than 80% except Southland, where the figure is 74.9%. Six regions have overall growth under 10% with two, West Coast and Southland, having negative projected growth. How regions react to this will depend on their local situations and networks, and all regions will need to plan for the future with this in mind.

11 Effects of the aging population on road network safety

11.1 Future older person population proportion compared with other countries

A comparison of New Zealand's 2006 population proportion aged 65+ and 80+ against a selection of other developed countries[20] using series 5 medium (2006 base year) SNZ population projections for 2031 is given in figure 11.1.

Figure 11.1 Percentage of the population aged 65+ and 80+ for New Zealand (projected for 2031 and actual) and selected countries in 2006



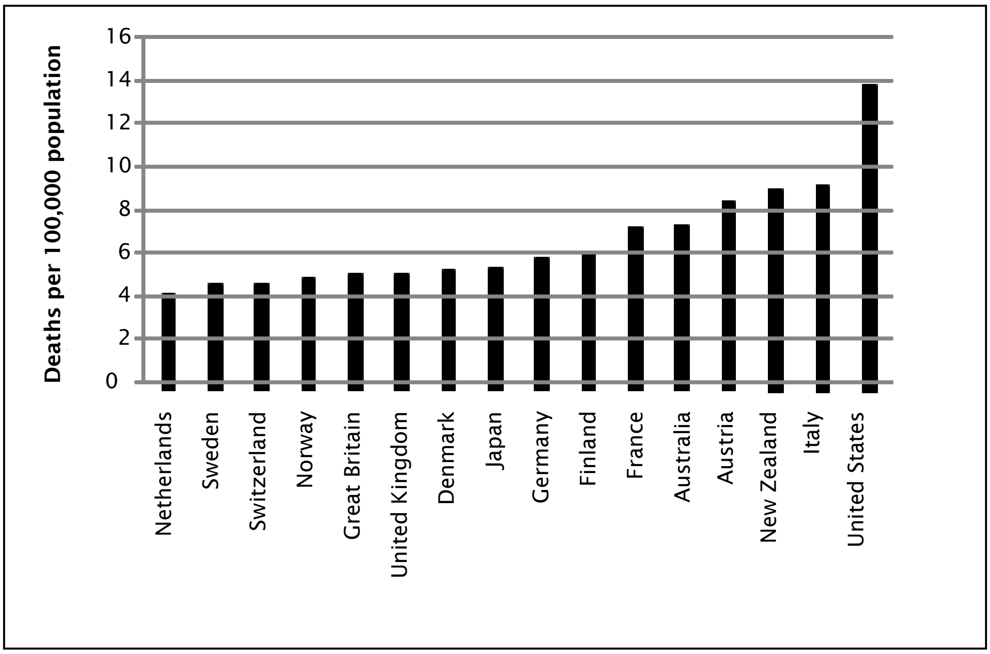
From this, it is apparent that our (and Australia's) proportion of older people, both those aged 65+ and 80+, is currently lower than the selected European countries and Japan, but will become reasonably close to the current European/Japanese 80+ bracket by 2031 and will overtake the current 65+ bracket in these

20 The 2006 statistics used in this figure come from International Road Traffic and Accident Database (www.irtad.net) via the MoT.

countries by a small margin in the same period. Thus we should be able to learn, to a certain extent, from European and Japanese experience, and take comfort from the generally good road safety records of these countries with older populations than ours.

With regard to safety, one can see from figure 11.1 that Sweden, Japan and Germany's current proportion aged 80+ is similar to our projected proportion in 2031. Figure 11.2 depicts overall road user deaths per 100,000 for a number of countries. This chart shows that the more demographically aged European countries and Japan tend to have better per person death rates than New Zealand.

Figure 11.2 All road user deaths per 100,000 population, 2006



The fact that these countries have better overall per person road user death rates than New Zealand, notwithstanding that their population structures are older, is positive for the effect of changes in the population age distribution on our future road safety.

11.2 The restricted shelf life of road safety projections

Hu et al (2000) attempted to make projections of older road users' travel as part of a study aimed at projecting older road users' safety. The results of Hu et al's projections illustrate the problems involved in projecting road safety, as related to older people – or, in fact, any road user group – without timely updated follow-up. Their projections of US road fatalities used 1995 as a baseline, and also used standard statistical methods underpinned by a series of assumptions, the applicability of which could be argued. These assumptions, *inter alia*, related to health status, seatbelt wearing, population growth, amount of driving per driver, number of drivers and crash risk. Their crash assumptions were based on the early 1990s when the US road toll was increasing. They projected that with an aging population, the US's older driver fatalities would increase by 286% from 1995 to 2025, which has been illustrated in figure 11.3. This would result in considerable increases over the period from 1995 to the present (2010) for all the age groups shown in figure 11.4. However, the reality has been different, with considerable decreases in deaths of drivers aged 65+ and in road fatalities overall.

Figure 11.3 Older driver fatality projections, male and female (adapted from data in Hu et al 2000)

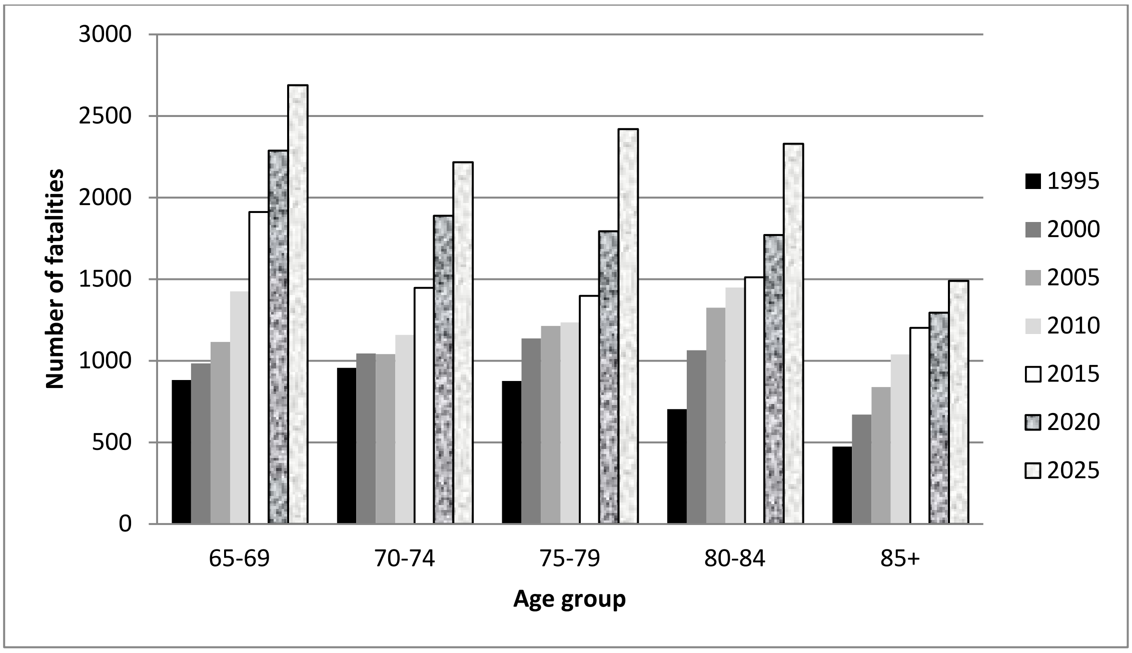
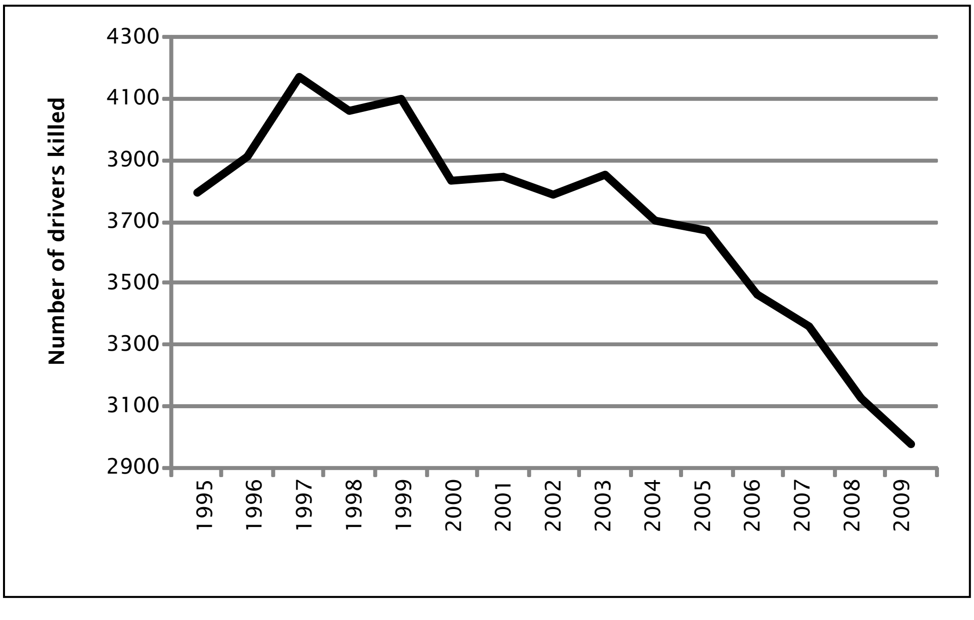


Figure 11.4 US driver deaths for all passenger vehicles*, by year, for drivers aged 65+ using fatality analysis reporting system data (National Highway Traffic Safety Administration 2010)



*Passenger vehicles include passenger cars and light trucks. Light trucks include sports utility vehicles, vans, utes and other light trucks.

Similar downward trends have been shown in Australia and New Zealand. The lesson is that although the work of Hu et al (2000) was arguably fine at the time it was carried out, developments unforeseen in the report soon made its findings out of date. Thus such projections need to be continually revised.

11.3 The basis of the analyses in this report

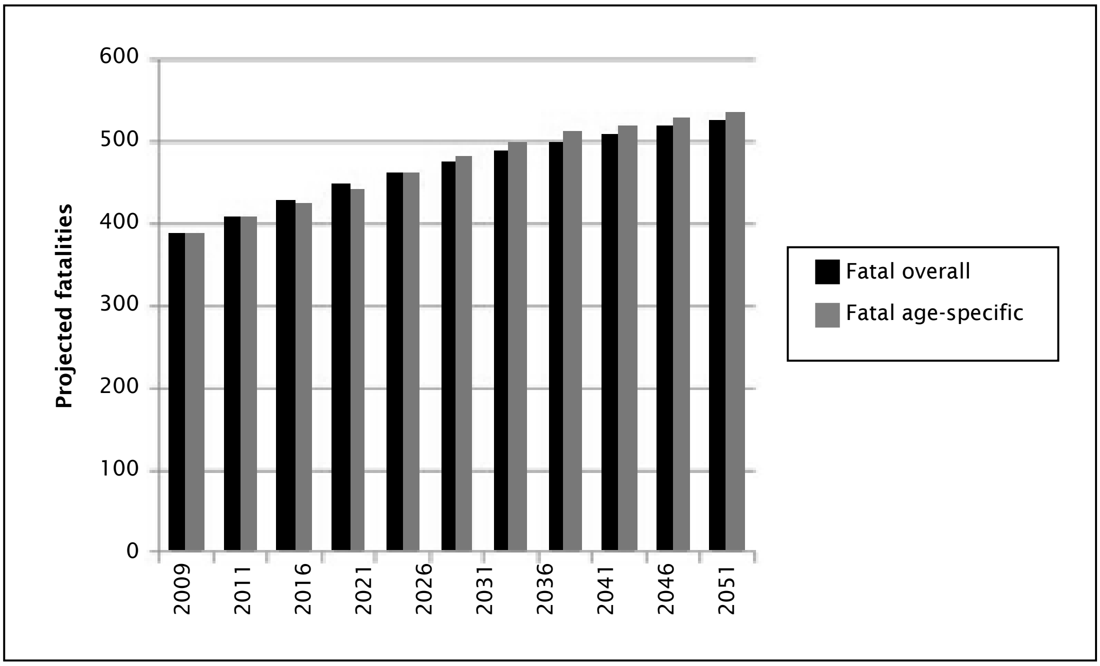
In carrying out these analyses, the view has been taken that in a stand-alone document that will not be continually updated, it is not appropriate to attempt analyses after the style of Hu et al (2000). The analyses in this report produce future road injury projections by projecting present death and injury rates per head of population into the future using SNZ population projections. As injury rates per head of population have reduced in recent years, if this trend continues or even if it flattens, these projections will present worst-case scenarios for the level of demographic change assumed.

11.4 The effect of demographic change on the overall road toll

This series of analyses using a medium population growth scenario assumes that the current age-specific injury and death rates remain constant. The work here relates to total casualties. The trends found in the analyses, as they are population based, also relate to drivers. If, instead, we were using driver casualties as a base, we would come up with similar trends because the expansion factors would be the same.

Figure 11.5 depicts total New Zealand fatalities reported to the police for a range of years up to 2056 under two scenarios. In the first scenario, the population increases to the level of medium SNZ population projections but with no demographic change (labelled fatal overall). Secondly, the population follows the SNZ scenario of medium population growth for the various age groups included in the SNZ projections (labelled fatal age-specific)[21].

Figure 11.5 Projections of fatalities with overall population growth and age-specific population growth for New Zealand (SNZ medium growth assumptions)



21 Series 5 medium growth SNZ projections using the average age-specific fatalities for 2006 to 2009 as a base and providing rates per population by dividing this average by the average of 2006 to 2009 population estimates. The fatalities listed for 2009 are those actually recorded for that year.

This chart shows that under this scenario, allowance for changes in the population age distribution would result in a relatively small increase in fatalities by 2031 and 2056 compared with equivalent population growth and no change in age distribution, given the assumption of a constant level of overall road safety. This is likely to be a worst-case scenario, as it would be hoped that road safety measures under the New Zealand Government's Safer Journeys Road Safety Strategy (MoT 2010) will achieve road safety gains.

11.5 Projected changes in the number of fatalities by age group over time

These changes come about through differing changes in the various age groups.

Figure 11.6 shows projected fatalities up to 2056 using the average age-specific fatalities for 2006 to 2009 as a base and providing rates per population by dividing this average by the 2006–2009 population estimates. These rates per population are then projected using SNZ medium (series 5) population projections (for this analysis, those of 2009). The projections thus assume constant per population fatality rates per age group. This is a conservative assumption, as fatality rates per population have trended down over the last decade or so (see figure 11.7) and, as mentioned previously, it is to be hoped that this trend will continue. Figure 11.6 indicates that the 70+ age group will become the largest source of road fatalities among the age groups depicted by around 2040.

Figure 11.6 Road fatality projections for different age groups for 2009–2061

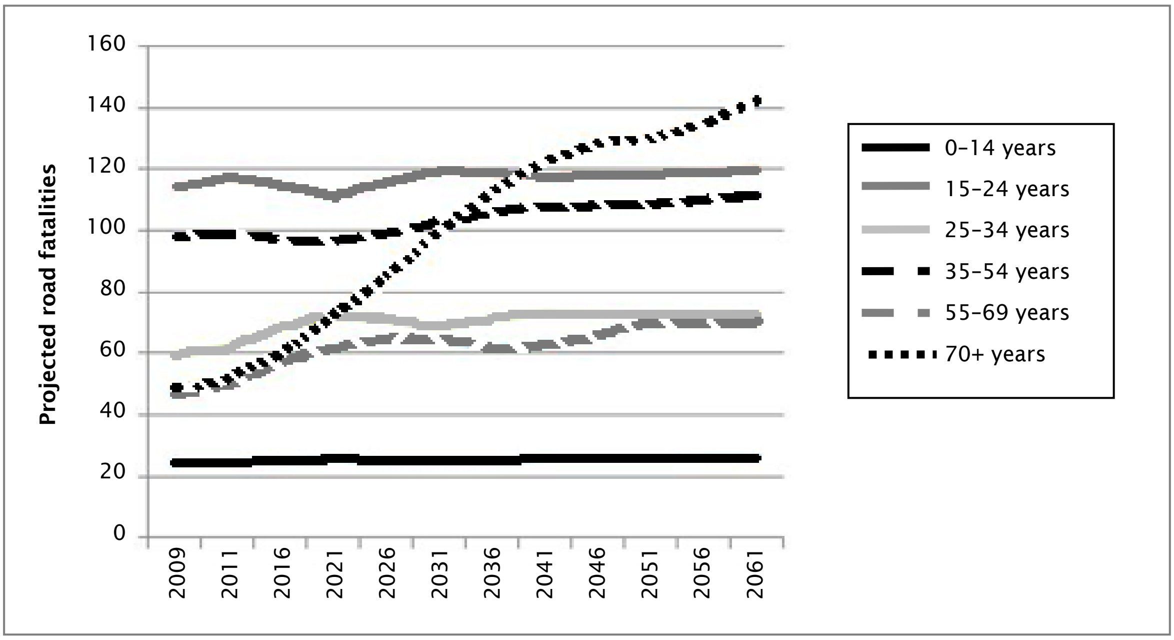
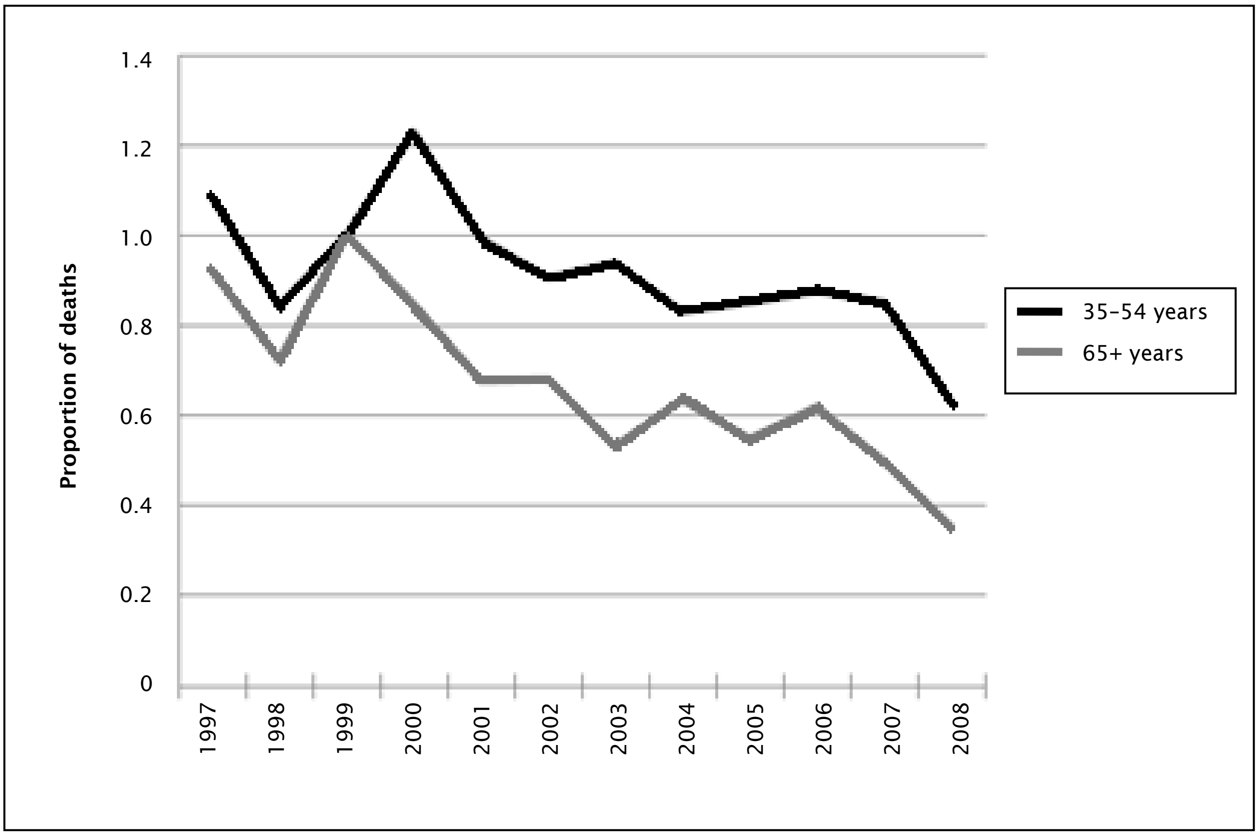


Figure 11.7 New Zealand driver deaths per 10,000 population, by age, indexed to 1999



11.6 The impact of higher or lower population growth

Population growth may outstrip or fall behind the medium growth projections we have been looking at up to now. This may be related to a number of factors but the one of interest here is mortality, which we can use as a rough surrogate for health status. SNZ publishes nine series as described in table 1.1. Figures 11.8 and 11.9 depict projections related to high, medium and low mortality. We will look at low mortality series to try to gauge the effect of a healthier future population than that associated with medium projections, and a higher mortality series to gauge the effect of a less healthy future population. The other assumptions in the relevant official series related to fertility and migration are taken as givens. In no series are all factors other than mortality held constant, so we cannot control for these. It is clear that in New Zealand, these population health factors make a relatively small difference in the time up to around 2020, but variation is greater after that time. The differences between the projections tend to widen but, for the trend of the projections, also tends to flatten in slope after around 2040.

Figure 11.8 Projections of all age-group fatalities for New Zealand using high, medium and low assumptions

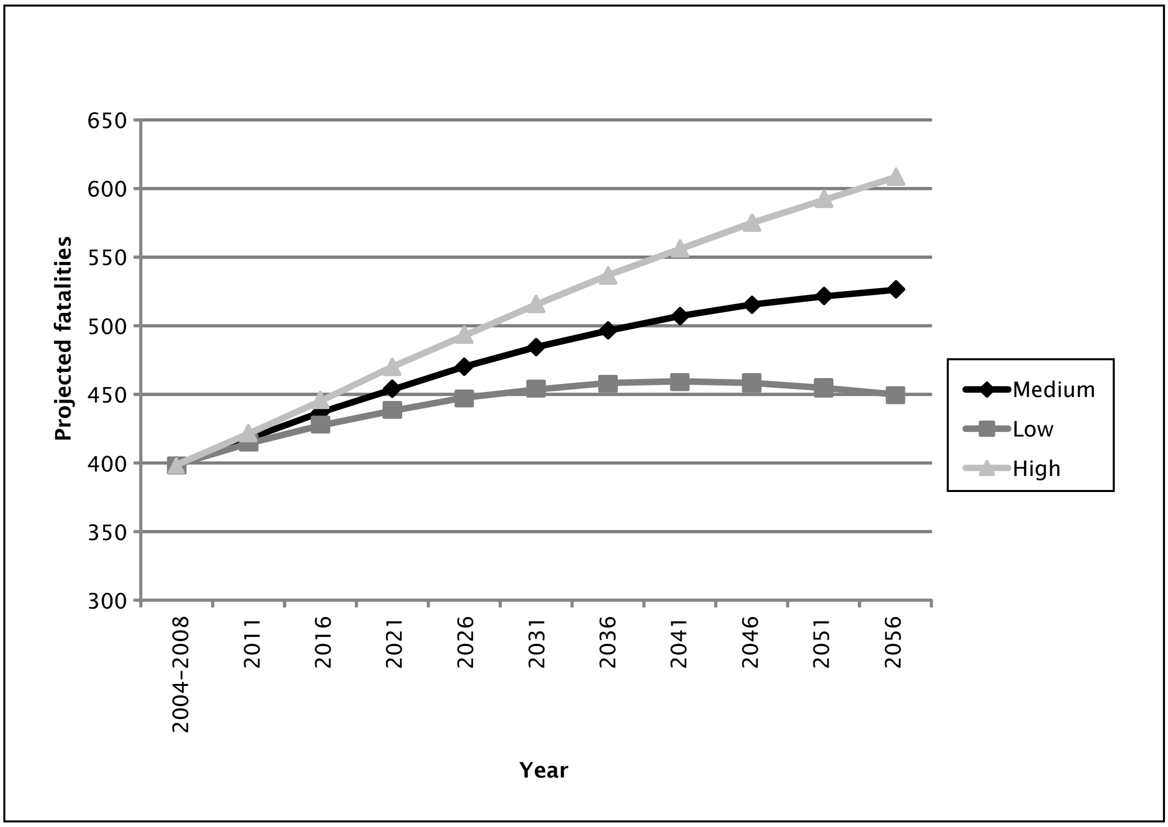
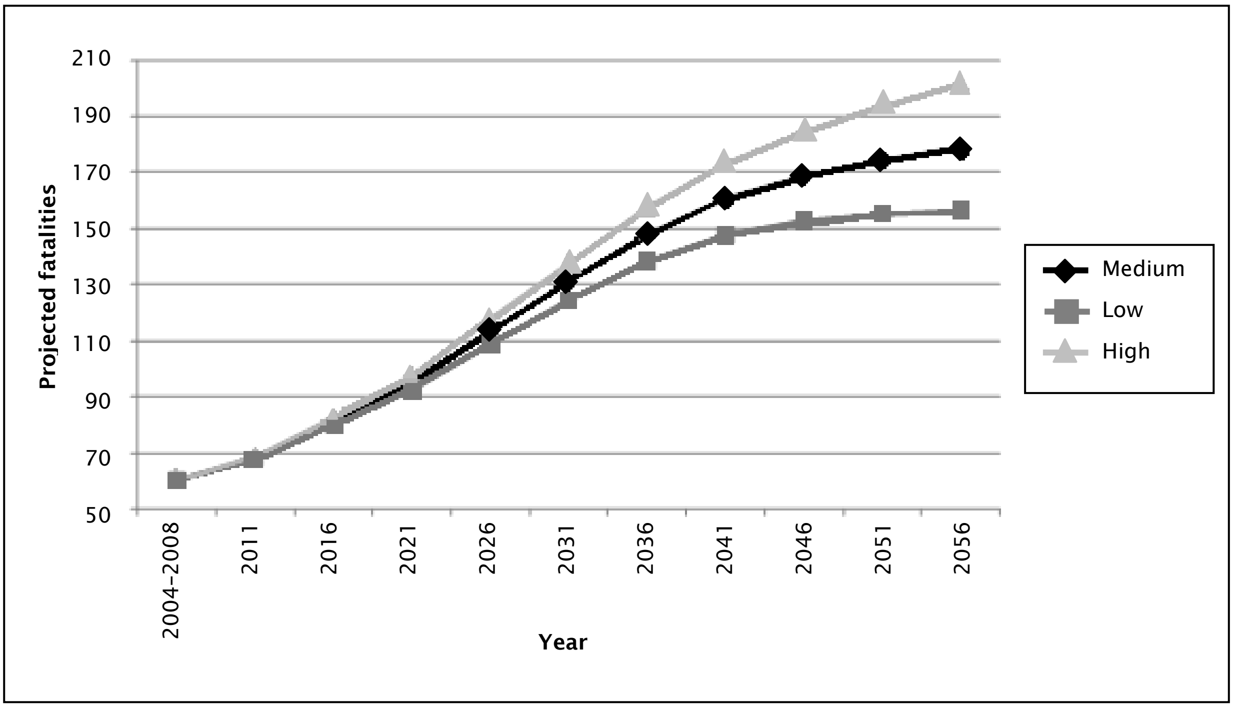


Figure 11.9 Projections of 65+ age group fatalities for New Zealand using high, medium and low assumptions



11.7 Regional safety

How demographic change will affect regional safety is related to population change in the regions, from which we determine projections of how road traffic will change within those regions. Driver travel growth by region for all drivers and drivers aged 65+ is displayed in figure 10.16. This indicates that the growth of older drivers' travel relative to the growth of all drivers' travel varies greatly, with the greatest contribution being in provincial areas. All areas have 65+ growth greater than 80%, except Southland, where the figure is 74.9%. Six regions have overall growth under 10% with two, West Coast and Southland, having negative projected growth. Travel changes related to demographic change will inevitably have an effect on road safety and resultant road safety strategies. Tables 11.2 and 11.3 give the casualty projections for all people, including those under driving age (15 years) for fatal and serious injuries only.

Table 11.2 Total fatal and serious injuries 2004–2008

	0–14 years	15+ years	65+ years	Percent 65+
Northland	57	743	63	7.8%
Auckland	209	2611	232	8.2%
Waikato	145	1688	162	8.8%
Bay of Plenty	76	904	93	9.3%
Gisborne	20	170	14	7.6%
Hawke's Bay	62	703	77	9.9%
Taranaki	15	391	44	10.1%
Manawatu-Wanganui	75	1008	111	9.9%
Wellington	81	1066	122	10.3%
Nsn-Mlb-Tas	23	486	50	9.3%
West Coast	5	209	23	9.9%
Canterbury	93	1693	214	11.2%
Otago	63	1174	126	9.7%
Southland	41	611	59	8.8%
Nationwide	965	13457	1390	9.4%

Nsn-Mlb-Tas = Nelson-Marlborough-Tasman

Annual injuries by region and age are projected using the population projections from SNZ. The growth in these injuries for the older population reflects the growth in population within regions.

Table 11.3 Projected annual fatal and serious injuries 2031

	0–14 years	15+ years	65+ years	Percent 65+	Percent increase from 2004–2008 average for 65+
Northland	11	178	27	13.2%	171%
Auckland	43	767	114	13.0%	197%
Waikato	29	413	69	14.4%	170%
Bay of Plenty	15	234	38	14.1%	163%
Gisborne	4	36	5	12.9%	143%[b]
Hawke's Bay	12	154	30	16.2%	156%
Taranaki	3	80	16	16.7%	145%[b]
Manawatu-Wanganui	14	217	41	15.8%	148%
Wellington	16	253	50	16.5%	`164%
Nsn-Mlb-Tas[a]	5	115	22	16.1%	176%
West Coast	1	41	9	18.6%	157%[b]
Canterbury	19	417	88	17.4%	164%
Otago	12	266	47	15.0%	149%
Southland	8	115	21	15.2%	142%
Nationwide	194	3411	594	14.8%	171%

Notes to table 11.3:

a Nsn-Mlb-Tas = Nelson-Marlborough-Tasman

b Caution: based on small numbers

The tables indicate that large percentage increases in older persons' injury (142% to 197%), related to population growth, translate to the percentage of all injuries that happen to older persons increasing from 7.6–11.2% to 13–17.4%. This means that older persons' injuries will become a greater proportion of road trauma, which should be taken into account by authorities in setting their road safety priorities. These proportions differ by region, as will the resultant road safety priorities. This means that any road safety programmes related to older drivers will need to be worked out on a local basis in relation to the local network and the needs of the local population. To take a couple of examples, Canterbury, with a projected 17.4% of its fatal and serious injuries in the 65+ bracket by 2031, is likely to require a greater proportion of resources in that area than Auckland, which will have a projected 13.5% in 2031.

12 Conclusions

12.1 Preamble

Between 2006 and 2061, the New Zealand population is projected to increase in size, with changes in its age structure. In particular, older age groups are projected to increase both in numbers and as a proportion of the total population. Because individual travel tends to decrease as the individual reaches around 55 years and older, this change in the population's age structure is likely to result in reduced overall travel compared with the travel of a population of the same size with the present age structure. It would also result in a road user population with different characteristics and needs from the present population.

12.2 Allowing for age structure in estimates of future travel

The propensity of a person to travel decreases with age after the mid-50s and projections need to take the age structure of future populations into account to make realistic projections. Projections for an aging population made without taking aging into account are likely to produce a substantial overstatement of future travel. This work indicates such projections may overstate the increase in household travel on New Zealand roads between 2006 and 2056 by around 40%. We also know that older people travel more in urban speed zones than on the open road, which again means that estimates of travel by urban/rural/ state highway/non-state highway that do not take aging into account are likely to be inaccurate.

12.3 The influence of population health status

If we look at three sets of population projections provided by SNZ which assume different mortality rates, it is plain that in New Zealand, changes in population health factors make a relatively small impact on population projections for the period 2006–2020 but a greater impact is apparent after that time.

12.4 The influence of changes in the age distribution of the workforce

The workforce is projected to grow substantially, albeit at a slower rate after the late 2020s. Within this growth context, a 190% rise in the number of workers aged 65+ years is expected by 2056, compared with a 26% increase for the population as a whole. The projected changes in the age structure of the workforce is expected to have a noticeable effect on work-related transport demand, increasing work-related travel by 4.3% by 2031 and by 4.9% by 2056. This increase, which represents the net effect of an increase in older workers outweighing the reduced propensity to travel of the same age group, amounts to an additional 500 million kilometres of travel per year by 2056. This is only a little over 1% of the 46.18 billion kilometres of total travel projected for 2056 without allowing for workforce changes.

12.5 Regional travel projections

The projected increase in the numbers of older people is likely to vary across New Zealand's different regions. All regions are expected to experience more than 80% growth in the number of people aged 65+ years, except Southland, where the growth is likely to be 74.9%. Six regions have less than 10% overall population growth for all ages, with two (West Coast and Southland) having negative projected growth.

These variations will result in a diversity of total travel and travel by older people by region by 2031. Each region will require its own approach to the provision of transport, according to its future mix of traffic and age groups. Some smaller regions will have higher proportions of older people, but relatively low overall older person travel; other, larger regions will have a relatively low proportion of older people but a relatively high absolute level of older persons' travel. Thus both the proportion of older people in the population and the overall size of the population should be key criteria in deciding future regional action in this area.

12.6 Habitation trends, and future public and private transport demand

Older people living in cities already tend to congregate in peripheral areas such as Kapiti and parts of Rodney County. This trend is expected to continue. This evidence gives little indication that older people will move to living areas easily served by public transport and the projections prepared for this report do not reflect such an assumption. Thus public transport is expected to continue to be a minor mode for older people unless future town planning encourages movement to neighbourhoods better served by public transport. Even then, the problem of an existing infrastructure, which will be hard to change, will remain. Thus the present reliance on the car as either driver or passenger will continue.

The most positive sign for public transport is the SGC. If this scheme is continued, survey results indicate that substantially more older people will use public transport as the 65+ population increases, as long as its cost advantages over other modes is at least retained.

12.7 Time budget for travel

A day has only 24 hours, and it is feasible and desirable to spend only some of those hours in travelling. Historically, people overall have averaged around one hour a day. This budget decreases with age. It might be expected that if the widely predicted increases in the medical and physical fitness of older people eventuate, a general upswing in older persons' travel will occur and the gap in time budgets between older and younger people may lessen. This trend may intensify if infrastructure and other changes make travel more comfortable for older people.

12.8 Suppressed demand for travel in older people

Generally, after about the age of 55, individual demand for travel decreases. Surveys of samples of older people indicate that the 65–79 age group are relatively content with their treatment by the transport system, whereas those who are older indicate that they would travel more if the system made it easier for them to do so. This indicates the following:

- A future healthier aged population might travel more.
- The present day older population might travel more if travelling was made easier.

However, such changes would be limited by the individual's time budget for travel. Survey information also indicated that older women feel slightly more constrained in their travel choices than do older men.

Some vehicle safety vehicle operator and vehicle accessibility issues are related to public transport and special transport for the disabled, which need to be improved if these modes are to become more acceptable to older people.

12.9 Road safety

With regard to safety, older people are as safe as middle-aged people when using the road network in various capacities, considering the time spent travelling. Projections indicate that despite a changed age structure, the amount of future road deaths and injuries will be little different from those which would ensue from the same population growth with no age structure change.

By 2031, regional road injuries incurred by older people (aged 65+ years) are projected to increase by 42–97%, depending on the specific region being considered.

Depending again on the specific region being considered, the percentage of all injuries which happen to people aged 65+ is projected to increase from a between-region range of 7.6–11.2% to a between-region range of 13–17.4%. The finding that older persons' injuries will become a greater proportion of road trauma needs to be taken into account by authorities in setting their road safety priorities.

As the proportions of older people differ by region, so will the resultant road safety priorities. Thus any road safety programmes related to older drivers will need to include significant local components, worked out in relation to the local network and the needs of the local population.

Highway design efforts will need to respond to the larger proportion of older drivers on the road, whose decreased visual and other sensory capabilities will need to be catered for. This will emerge as a priority to varying degrees around the country, depending on the proportions of older drivers in the traffic stream.

Pedestrian safety, including pedestrian collisions with motor vehicles and non-motor vehicle related pedestrian injury, will be a special concern in the future, as the projected increase in older people will bring with it a large increase in older pedestrians. Older pedestrians are a particularly vulnerable road user group because of their frailty.

13 Recommendations

- New Zealand has an aging population. Projections used in future planning of our transport network should take this factor into account, given the lower travel propensity of older people. A failure to do so is likely to produce excessively high travel projections, overstating the increase in household travel on New Zealand roads between 2006 and 2056 by around 40%.
- Projected network travel changes differ markedly by region so that region-specific policies will be required in future.
- Highway design should be moderated to meet the special mobility and safety challenges presented by a future larger proportion of older drivers.
- Pedestrian safety regarding both injuries from motor vehicle crashes and non-motor vehicle accidents on the road and roadside will need greater attention as the number of older pedestrians increases. This is an area for territorial authorities to consider with regard to both pavement design and maintenance, and for the NZTA and regions to consider with regard to standards.
- Encouragement to cycle should be sensibly moderated by knowledge of older cyclists' frailty and increased vulnerability to injury in the event of a crash.
- Attention is needed to make public transport and special transport more acceptable to and useable by older passengers.
- Further encouragement for people to take their transport needs into account when making housing decisions is needed.
- Urban planning needs to ensure that community services and facilities are more accessible by public transport and non-motorised forms of transport, including walking.

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Appendix A Survey questionnaire

Table A1 lists the questions in the survey of New Zealanders aged 65+ years that are relevant to this report, along with the potential answers. The survey contained other questions to be used in wider research, which have been omitted here.

Table A1 Survey questions and potential answers

Question variable	Description of question	Answer options	Answer code
Driver	Driver or not	No	0
		Yes	1
Q1_vehicleaccess_current	Sort of vehicle access respondents currently have	NA*	–
Q1_vehicleaccess_currentdetail	Explanation of the access they have (eg car and licence)	NA	–
Q2_vehicleaccess_past	Sort of vehicle access the respondent had in past (eg car and licence)	NA	–
Q2_vehicleaccess_pastdetail	Explanation of the access they had (eg car and licence)	NA	–
Q3_SGC	Whether the respondent has an SGC	Yes	1
		No	2
Q4_SGC_often	How often respondents use the SGC	Never use it	1
			2
		Occasionally	3
			4
		Daily	5
Q5_SGC_alt	If respondents had no SGC, trips they would make anyway	None	1
		Few	2
		About half	3
		Most	4
		All	5
Q6_SGC_tripsfree	How many trips only made because they are free	None	1
		Few	2
		About half	3
		Most	4
		All	5
Q7_noSGC	If respondents had no SGC, how many trips would they still make?	None	1
		Few	2
		About half	3
		Most	4
		All	5

Question variable	Description of question	Answer options	Answer code
Q8_missactivities1	Any activities missed out on participating in because of transport	NA	-
Q8_missactivities2	Any activities missed out on participating in because of transport (if more than one)	NA	-
Q8_missactivities3	Any activities missed out on participating in because of transport (if more than two)	NA	-
Q8_missactivities4	Any activities miss out on participating in because of transport (if more than three)	NA	-
Q9a_40s_car	Percent of trips made by car in 40s	NA	-
Q9a_40s_pass	Percent of trips made as passenger in 40s	NA	-
Q9a_40s_walkcycle	Percent of trips made by bike/walking in 40s	NA	-
Q9a_40s_PT	Percent of trips made by public transport in 40s	NA	-
Q9b_60s_car	Percent of trips made by car in 60s	NA	-
Q9b_60s_pass	Percent of trips made as passenger in 60s	NA	-
Q9b_60s_walkcycle	Percent of trips made by bike/walking in 60s	NA	-
Q9b_60s_PT	Percent of trips made by public transport in 60s	NA	-
Q9c_now_car	Percent of trips made by car now	NA	-
Q9c_now_pass	Percent of trips made as passenger now	NA	-
Q9c_now_walkcycle	Percent of trips made by bike/walking now	NA	-
Q9c_now_PT	Percent of trips made by public transport now	NA	-
Q10_imp_centcity	Importance of making trip to the central city	Do not want to at all	1
			2
		Not sure/neutral	3
			4
		Would very much like to	5
Q11_easy_centcity	How easy it would be to make a trip to the central city	It would be very difficult	1
		It would be somewhat difficult	2
		I could make it if I had to	3
		It would be possible	4
		It would be very easy	5

Question variable	Description of question	Answer options	Answer code
Q12_imp_Ldtrip	Importance of making a long-distance trip	Do not want to at all	1
			2
		Not sure/neutral	3
			4
		Would very much like to	5
Q13_easy_Ldtrip	How easy it would be to make a long-distance trip	It would be very difficult	1
		It would be somewhat difficult	2
		I could make it if I had to	3
		It would be possible	4
		It would be very easy	5
Q14_imp_dark	Importance of making trip at night	Do not want to at all	1
		Not sure/neutral	3
			4
		Would very much like to	5
Q15_easy_dark	How easy it would be to make a trip at night	It would be very difficult	1
		It would be somewhat difficult	2
		I could make it if I had to	3
		It would be possible	4
		It would be very easy	5
Q16_drivedark	How respondent feels about driving in the dark	I always avoid it	1
			2
		I do it if I have to	3
			4
		I have no problem with it	5
Q17_drivepeak	How respondent feels about driving in peak times	I always avoid it	1
			2
		I do it if I have to	3
			4
		I have no problem with it	5

Question variable	Description of question	Answer options	Answer code
Q18_drivewet	How respondent feels about driving on wet roads	I always avoid it	1
			2
		I do it if I have to	3
			4
		I have no problem with it	5
Q19_drivenew	How respondent feels about driving to places they haven't been	I always avoid it	1
			2
		I do it if I have to	3
			4
		I have no problem with it	5
Q20a_reactions	I worry more now than I used to that when I drive, my reactions might be too slow.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q20b_holdup	I feel like I hold up traffic when I drive more than I used to.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q20c_causeacc	I worry more now than I used to that when I drive I may cause an accident.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5

Question variable	Description of question	Answer options	Answer code
Q20d_control	I feel like I have as much control of the situation when I am driving as I used to.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q21a_missingout	I feel like I am missing out on things I would like to do because of travel issues.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q21b_rely	I feel that I rely on people to visit me more often than I visit them.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q21c_community	I can get to all the groups and activities in the community that I would like to participate in.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q21d_freedom	I have the same amount of freedom to travel as I did 10 years ago.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q21e_moved	I moved to where I live now so I could be closer to places I need to go.	Strongly disagree	1
		Disagree	2
		Not sure/neutral	3
		Agree	4
		Strongly agree	5
Q22_ind_ownage	How much independence respondents feel they have compared to others their age.	Much less	1
			2
		About the same	3
			4
		Much more	5

Question variable	Description of question	Answer options	Answer code
Q23_ind_younger	How much independence respondents feel they have compared to others 10 years younger	Much less	1
			2
		About the same	3
			4
		Much more	5
Q24a_newtrip	New taxi scheme – any new trip respondents would make	NA	-
Q24b_replacetrip	New taxi scheme – any old trip respondents would replace	NA	-
Q25_mobility	Physical mobility compared to others their own age	Much worse	1
			2
		About the same	3
			4
		Much better	5
Q26_eyesight	Eyesight compared to others their own age	Much worse	1
			2
		About the same	3
			4
		Much better	5
Q27_activity	Physical activity compared to others their own age	Much worse	1
			2
		About the same	3
			4
		Much better	5
Q28_age	Participant's age	65-69	1
		70-74	2
		75-79	3
		80-84	4
		85-89	5
		90-94	6
		95+	7
Q29_gender	Participant's gender	Male	1
		Female	2

Question variable	Description of question	Answer options	Answer code
Q30_household	Household living situation	Single person living alone	1
		Single person living with other adults	2
		Married/de facto couple	3
		Living with extended family	4
		Other	5
Q30_householdother	Specified other household living situation	NA	
Q31_income	Total household income	Under $10,000	1
		$10,001-$20,000	2
		$20,001-$30,000	3
		$30,001-$40,000	4
		$40,001-$50,000	5
		$50,001-$60 000	6
		$60,001-$70,000	7
		$70,001 or over	8

*NA indicates that the answers to this question could not be provided as options suitable for encoding, as the range of potential answers was too wide.