

## Original Paper

# Driving and Advanced Age

Jacqueline Beaton<sup>1</sup>, Ngaire Kerse<sup>2</sup> & Martin Connolly<sup>3</sup>

<sup>1</sup> Psychology, University of Waikato, Hamilton, New Zealand

<sup>2</sup> Population Health – School of Medicine – Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand

<sup>3</sup> School of Medicine – Faculty of Medical and Health Sciences, University of Auckland, Auckland, New Zealand

### Octogenarian Group

*Aim of this research is to evaluate continued driving by people of an advanced age.*

*This work is part of the LiLAC Cohort Study presently in New Zealand: - Driving*

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### **Abstract**

**Background:** *Advanced aged people continue to use their vehicles, utilising them for a wide variety of purposes. Within that age group female drivers from both New Zealand Māori and non-Māori are predominantly noticeable.*

**Method:** *Following the first wave of the LiLAC Study the present study examined the results of the Transport and Nottingham Extended Activities of Daily Living sub-sections involving New Zealand Māori aged between 75-95 years and non-Māori participants only aged 85 years. Questions asked of the recipients involved whether they had ever driven, did the still drive, how often and how far they drove in a typical week; and why they drove. Analysis of the results were conducted using a scaled questionnaire, binomial logistic regression, chi-square tests for association, ordinal logistic regression and descriptive analysis.*

**Results:** *Participant number totalled 931 with 421 New Zealand Māori and 510 New Zealand Māori non-Māori.*

**New Zealand Māori:** *Nearly double the number of females had ever driven. Of those who do drive both male (73) and female (69) indicated that they did, although females also offered the service of driving to both family and non-family members. Females also presented 1.028 higher odds of having ever driven a car. However, as New Zealand Māori aged a reduction in having ever driven was shown in the results (0.688). Typical weekly use of the car by New Zealand Māori males was grouped (*p*-value =*

0.063), whereas female Māori took the car out daily. Increase in age was found not to be associated with how often New Zealand Māori drove. The odds ratio of Māori males was greater than that of females ( $p$ -value = 0.463), similarly with age ( $p$ -value = 0.192). In comparison both male and female covered a wide distance, although most noticeable were ones made 1.5-25 kilometres.

New Zealand non-Māori: New Zealand non-Māori like New Zealand Māori females were also in the majority as to the number having ever driven. Of those still driving a higher number of males (154) compared to female (136) non-Māori were shown to be still driving. However, unlike New Zealand Māori, none of the non-Māori indicated that they offered their driving services to someone else. Typical weekly driving scores between male and female were not statistically significant different ( $p$  = 0.201). Median driving distances for male and female were the same (3.00).

A varied use of the car was apparent by both New Zealand Māori and non-Māori.

**Conclusion:** Maintaining independence is of primary concern to both New Zealand Māori and non-Māori. To enable this population group to remain as a contributing part of their community further research is required into their decision making, the licensing procedure and surrounding support facilities.

## 1. Introduction

Mobility to an individual is about activities of daily living (ADLs) and the isolation a person may feel if they are unable to make choices associated with such events in their life (Stacey, Owsley, Sloane, & Ball 1999; Metz, 2000; Finestone, Marshall, Rosenberg, Moussa, Hunt, & Greene-Finestone, 2009; Age Concern, 2010; Bartley & O'Neill, 2010; Johansson & Stromberg, 2010; Musselwhite & Haddad, 2010; Webber, Porter, & Menec, 2010; Pons-Villanueva, Rodríguez de Armenta, Martínez-González, & SeguíGómez, 2011; Golisz, 2014; and American Journal of Occupational Therapy, 2016).

Over the past decade and a half (2001-2016) the number of New Zealand (NZ) drivers-licence holders aged 75 years plus has doubled in number, growing from 98,808 to now 197,417. This population group accounting for around 5.64% of the total number of New Zealanders who have held a driver license as of 31 December 2016. During this period, it is also interesting to note that there has also been a change in the gender balance with the number of older New Zealand females who hold a license having grown by 2 percent and a similar reduction in the number of licensed older males (New Zealand Transport Agency - NZTA, 2016).

Similarly, in the driver licensing review conducted by the Ministry of Transport results indicated that the percentage of 75 year-plus drivers' who hold a full licence has continued to climb over the past twenty-five years (1989-2014). This number having grown from 45% in 1989/90 to 73% in 2013/14 (Ministry of Transport (2016).

Use of a vehicle such as a car is often seen as a prime source of transport in Western countries, including New Zealand. Driving itself being considered as an 'enabling occupation'. One that supports older people's ability to transport themselves, family or friends throughout their community, obtain goods and

have access to services. To evaluate older people's continued use or not of a vehicle by it is important to also understand the possible influences this may have upon older drivers' and their lives when they may find it necessary to give up driving. This being especially relevant to those who has been heavily relied upon by others within their social environment and they are no longer able to provide such support. The concept of mobility is therefore an important part in the framework of an older person's life, no matter in what form such travel may occur. (O'Connor, Edwards, Wadley, & Crowe 2010; Webber, Porter, & Menec, 2010; Kulikov, 2011; Ball, Owsley, Stavey, Roenker, Sloane, & Graves, 1998; Pawson, 2011; Berg, 2015; Shergold, Lyons, & Hubers, 2015; Stav, 2015; and Pristavec, 2016).

The ability to travel plays an important role in the quality of older people's lives. However, identifying journeys made solely in terms of the number trips made, distance travelled and/or what type of transport was used, present only part of the picture. Travel should therefore also be recognised in view of its possible economic influence, enabling older people to continue contributing and being part of society, maintaining of independence, continuing involvement in social and leisure activities; improved mental and health benefits; cognitive functioning, and being physically active (Banister & Bowling, 2004; Stav, Arbesman, & Lieberman, 2008; Carmel, Rechavi, & Ben-Moshe, 2014; Horner, Duncan, Wood, Valdez-Torres, & Stansbury, 2015; and O'Hern & Oxley, 2015).

Several authors have also identified the measure self-efficacy may play in an older drivers' life. By continuity of driving they have demonstrated their ability to succeed and accomplish goals (Berkman, 2000; Banister & Bowling, 2004; Barnes, Wilson, Bienias, de Leon, & Kim, 2007; and Bartley & O'Neill, 2010) This being in comparison to those who have decided to cease driving and, as a consequence, can often exhibit a much narrower life space (Hakamies-Blomqvist & Wahlstron, 1998; Keeling, 1999; Stacey et al., 1999; Statistics New Zealand – Tataurangi Aotearoa 2000; Rosenbloom, 2001; George, Clark, & Crotty, 2005; Age Concern, 2007; Davey, 2007; Campbell, 2008; Grant, 2008; Age Concern, 2010b; Dyal & Kerse, 2010; Taylor, Alpass, Stephens, & Towers, 2011; Hoggarth, Innes, Dairymple-Alford, Croucher, Severinsen, Gray, ... Jones, 2011; and Moták, Huet, Gabaude, & Bougeant, 2012).

However, before analysing any possible predictors in relation to driver cessation, a broader understanding of the nature of driving itself should firstly be considered. The action of driving involves many interrelating factors: adequate vision and mobility (driver's ability to turn the wheel, move their head/upper body, transferring of oneself in and out of their vehicle). Driving instead should also be recognised from a multifaceted skill base, thus employing a more comprehensive model. One that marries a sensory baseline, motor skills, physical functioning variables and a driver's cognitive capability. An understanding that correspondingly relates to likely influences upon an older person's decision to cease driving and may similarly be multifactorial in their makeup. For example such a decision may be due to relevant cognitive factors, sensory function, physical performance, medical condition, social environment or family influences (Anstey, Lord, & Walker, 2005; Wood, Anstey, Kerr, Lacherez, & Lord, 2008; Hoffman & McDowd, 2010; Adrian, Postal, Moessinger Rasclé, & Charles, 2011; Clapp, Olsen, Danoff-Burg, Houston-Hagewood, Hickling, Hwang, & Gayle-Beck, 2011; Uc, Rizzo, Johnson, Emerson, Liu,

Mills, ... Dawson, 2010; and Coxon, Chevalier, Lo, Ivers, Brown, & Keay, 2015).

Along with the question of driving is also the one about how safe are older people to drive? An issue that is often considered by both the drivers themselves as well as society at large; and is similarly proposed through the media following particularly a serious road accident involving older drivers (Middleton, 2012; Sheppard, 2012; Age Concern, 2010a; Automobile Association and Driver Education Foundation, 2010; Carpenter, Pugin, & Stephenson, 2010; and Di Stefano & Macdonald, 2012). However, the answer to such a question may be considered loaded or biased, and with that may present further difficulties in the defining of driver safety and method of assessment used for older drivers (Wood et al., 2008). Perhaps therefore the question needs to be re-phrased: what is the driver's present level of ability? (Guo, Fang, & Antin, 2015; Nef, Bieri, Müri, & Mosimann, 2015; and Allan, 2016; Song, Lee, & Han, 2016).

Examples of research concerning older drivers and safer driving behaviour have included investigations into older drivers' general capability of making a reasonable judgment about their driving abilities (Marottoli, Ostfeld, Merrill, Perlman, Foley, & Cooney Jr., 1993), the influence driver self-monitoring belief has on their decision to cease driving (Anstey, Wood, Lord, & Walker, 2005), the use of a sequence of tests and self-reported measure of driving experience to accurately make safe driving predictions (Wood, Anstey, Kerr, Lacherez, & Lord, 2008). Finestone et al. (2009) found that stroke survivors were conscientious about their ability to drive, consistent with Marottoli et al. (1993) earlier findings. Johansson and Stromberg's (2010) investigation into the experience of driving restrictions on recipients with an implantable cardioverter defibrillator identified from a patient's perspective the unique role driving was to the individuals. Three major categories and sub-categories were recorded: (i) adherence to driving restrictions, (ii) emotional influence of driving restrictions and (iii) drivers altered view on driving and information needs, individual interpretation, adaption to the restrictions, loss of independence, changes in self-image, significance of networks and the influence of driving behaviour (Hassan, King, & Watt, 2015) and Cuenen et al. (2016).

Driving assessment is an exercise in risk evaluation/management, but for it to proceed as a constructive process - one that serves both the driver and the community - it also needs to be multifactorial in its nature and understanding, (NZ Association of Occupational Therapists: Senior Drivers Seminar, Wellington, 1-2 March 2010). Providing, therefore a system that interlinks driver functional assessment, medical analysis, driver self-awareness, licencing evaluation and policy development. The functional assessment aspect should include an objective review of a driver's mobility, transfer skills and ADLs. The Driver Evaluation Programme used at the Ottawa Hospital Rehabilitation Centre, Ontario, Canada (Finestone, Marshall, Rozenberg, Moussa, Hunt, & Greene-Finestone, 2009) assesses demographics, medical, pre-morbid driving history and transportation use characteristic of post-stroke drivers and non-driver stroke survivors. Three types of assessment are employed; questionnaires (including telephone survey), clinical evaluation and simulated driving experience with an OT along and on-road testing with a driving instructor. Driver visual perception, attention and reaction time are included

(Cuenen, Jongen, Brijs, T., Brijs, K., Lutin, Van Vlierden, & Wets, 2015; Guo, Fang, & Antin, 2016; Hassan, King, & Watt, 2015; Nef, Bieri, Müri, & Mosimann, 2015; Allan, 2016; Eramudugoalla, Chopra, Li, & Anstey, 2016; Kim, Song, & Lee, 2016; and Song, Lee, & Han, 2016).

One of the primary aspects associated with a driver's decision to cease driving is the possible change in their role within both themselves and their environment, whether this as an independent individual, their family position or as a member of the broader community. Following such a change in role, drivers may become dependent upon external support (family, friends, local community, public or private transport and professional services): with possible negative consequences (Finestone et al., 2009; and Freeman, Gange, Munoz, & West, 2006; and Hassan, King, & Watt, 2015).

Research into effects of driving cessation identifies reduced access and use of healthcare services, increased depression, greater risk of nursing home entry and a decreased out-of-home activity (Freeman et al., 2006; Bartley & O'Neill, 2010; and Clapp et al., 2011). The act of driving to many is an expression of autonomy and contributes to quality of life (QoL). Cessation may in turn place hardships upon older people. Social isolation is linked many negative outcomes including depression, reduced self-esteem, reduced community interaction and declined physical health levels (Anstey, Windsor, Luszcz, & Andrews, 2006; Freeman et al., 2006; Finestone et al., 2009; Bartley & O'Neill, 2010; Edwards, Bart, O'Connor, & Cissell, 2010; Yazdan-Ashoori & ten Hove, 2010; O'Connor, Edwards, Small, & Ansel, 2012; Chacko, Wright, Worrall, Adamson, & Cheung, 2015; Nef, Bieri, Müri, & Mosimann, 2015; O'Bryne, Naughton, & O'Neill, 2015; and Song, Lee, & Han, 2016).

In view of this advanced age group of drivers and whether they decide to maintain their drivers licence deliberation by authorities should be directed towards not only to their holding of a licence and with that their entitlement to drive but also should include a wider spectrum of concerns all of which may play some part in advancing our understanding as to why this age group decide to maintain their license and continue driving, or not. Consideration should therefore also be directed towards the possible influence of social factors, to what degree and how they exercise their driving privileges, the existence of psychosocial concerns such as anxiety, depression, and a feeling of 'loss of control' in their lives if they decide to give-up driving. Factors which could all have some relevancy in older people's driving behaviour. Similarly, the likely effect that driving restrictions and any associated recommendations may have upon the older driver themselves, their daily life, family and continued inclusion as part of their community (Levy, Vernick, & Ammann, 1995; Chipman, Payne, & McDonough, 1998; Lyman, Fergusson, Braver, & Williams, 2002; Anstey et al., 2005; Bartley & O'Neill, 2010; Edwards et al., 2010; Johansson & Stromber, 2010; Nef, Bieri, Müri, & Mosimann, 2015; and O'Bryne, Naughton, & O'Neill, 2015).

Ott, Heindel, Papandonatos, Festa, Davis, Daiello and Morris (2008) in their study of drivers with Alzheimer's disease concluded that lack of national standards in the United States and deficient standardisation of cognitive testing that has been validated for driving skills, presented a quandary for both neurologists and other professionals in the role of evaluation and treatment. This is an important issue when it comes to ensuring public road safety for the future as well as 'the establishment'

recognising the possible future impact of this growing mobile older population (Walsh & Schub, 2016). Research has, not surprisingly, looked for predictors of driving cessation behavior in older people. Driving cessation as associated with advanced aged drivers needs to be considered through several independent predicting variables. Predicting variables that together form a multivariate decision making model rather than the more commonly used relicensing model which is bi-variate in nature and also the linking specifically of vision and physical ability with driving skill (Odenheimer, Beaudet, Jette, Albert, Grande, & Minaker, 1994; Dubinsky, Stein, & Lyons, 2000; Withaar, Brouwer, & van Zomeren, 2000; Adler, Rottunda, & Dysken, 2005; Uc, Rizzo, Andersen, Sparks, Rodnitzky, & Dawson, 2006; Molna, Marshall, Man-Son-Hing, Wilson, Byszewski, & Stiell, 2007; Dawson, Anderson, Uc, Dastrup, & Rizzo, 2009; Johnson, Deary, McGue, & Christensen, 2009; Mathias & Lucas, 2009; Dawson, Uc, Anderson, Johnson, & Rizzo, 2010; Edwards, Bart, O'Connor, & Cissell, 2010; Desapriva, Wijeratne, Subzwari, Babul-Wellar, Turcotte, Rajabali, ... Pike, 2011; Sümer & Turkey, 2011; Uc, Rizzo, Johnson, Emerson, Liu, Mills, ... Dawson, 2011; Aksan, Anderson, Dawson, Johnson, Uc, & Rizzo, 2012; Beglinger, Prest, Mills, Pailsen, Smith, Gonzalea-Algre, ... Uc, 2012; Di Stefano & Macdonald, 2012; Emerson, Johnson, Dawson, Uc, Anderson, & Rizzo, 2012; and Morbidity and Mortality Weekly Report, 2013). In consideration of probable influencing factors behind an older driver's decision to either continue driving or to cease, this research aims to evaluate such identified predictors as: (i) levels of pain, (ii) social, (iii) health, (iv) vision, (v) cognition, (vi) diabetes-2 and (vii) road safety.

Pain and its relationship with older drivers may primarily relate to the action of driving but it also relevant to movement in and out of their vehicle, medical conditions and disabilities. Therefore, the issue of pain to older drivers requires a wider recognition including for example back pain, arthritis, foot abnormalities, cardiovascular disease, and stiffness of joints (Wang & Carr, 2004; Johnson et al., 2009; Middleton, 2012; Age Concern, 2013). The degree to which an older person may be involved with their community may present them with enabling tools. Social interaction reduces the likelihood of loneliness for older people. It also enables them to attend classes introducing new skills as well as maintenance of existing ones, enabling them to expand both their social and physical environments (Langenburg, Kuh, Wadsworth, Brunner, & Hardy, 2006; Stockdale, Tang, Zhang, Belin, & Wells, 2007; Dodge, Kita, Takechi, Hayakawa, Ganguli, & Ueshima, 2008; Voas & Fell, 2011; and Walsh & Schub, 2016).

The issue of health to the older population similarly needs to be considered from two standpoints: firstly the maintenance of their health and secondly, their ease of use of healthcare facilities, both of which have a sequential relationship with one another. Without being able to utilize either one of these, and their associated services by the older driver, their long-term level health may be reduced (Stockdale, Tang, Zhang, Belin, & Wells, 2007; Dodge, Kita, Takechi, Hayakawa, Ganguli, & Ueshima, 2008; and Helpguide.org, 2013; and Walsh & Schub, 2016).

Glaucoma also known as the 'silent thief' because its effects are usually not readily noticeable until late in its progress and it thus presents a problem to older drivers. This is particularly because it is believed that the brain 'fills in the blanks' by blending-in small visual defects using signals from any surrounding

healthy retinal nerves (Rinalducci, Mouloua, & Smither, 2001; Hoste, 2003; Dawson, Anderson, Uc, Dastrup, & Rizzo, 2009; and Helpguide.org, 2013).

Cataracts are another common condition and usually develops as people age. In line with its effect upon society, it has been identified as the most common cause of blindness (Health Navigator New Zealand, 2015; and Ministry of Health, 2015).

Macular degeneration which results through a progressive loss of central vision, although a person's peripheral vision is not affected (Worsley and Worsley, 2015; and Muscular Degeneration New Zealand, 2015).

Long-term cognitive impairment (dementia) affects executive functioning. Independent of age and gender, some executive functions are related to driving ability (However, in this same study, no cognitive score was predictive of driving performance. In addition, extraversion presented a negative connection to driving performance and made the only contribution among the psychological factors to the prediction of driving performance (Dubinsky, Stein, & Lyons, 2000; Withaar, Brouwer, & van Zomeren, 2000; Alder, Rottunda, & Dysken, 2005; N.I.C.E., 2008; Dawson et al., 2009; Mathias & Lucas, 2009; Adler, 2010; Aksan et al., 2012; Di Stefano & Macdonald, 2012; Moták et al., 2012; and Lincoln, Taylor, & Radford, 2012).

There is an 'epidemic' in type 2 diabetes occurring in New Zealand, as with other developed countries. This epidemic is particularly noticeable with the Māori and Pacific ethnic groups. There has been a considerable debate over the extent to which diabetes may be a relevant factor in determining a diabetic's ability and/or eligibility to drive: a debate which could involve motor vehicle administrators, pedestrians, drivers, other road users and employers, who may all associate diabetes with unsafe driving due to the possibility of them experiencing a hypoglycemia attack (Johnson, Dreary, McGue, & Christensen, 2009; Horswill, Kemala, Scialfa, & Pachana, 2010; and Johansson & Stromberg, 2010).

Safety levels that need to be recognised from not only the driver's perspective but also in relation to their passengers and those of the other road users. Similarly, driver education, the licensing process, on-road decision making and the results of vehicle impact upon older people (New Zealand Transport Agency, 2017).

So to understand older drivers and their decision to either cease or continue driving consideration both of themselves and their surrounding environment need to be recognised from two important standpoints. Firstly, to evaluate those possible forecasting factors that may have an influence upon this decision as to whether to continue with their driving. Secondly, to improve our understanding of those processes employed by older drivers when making their own conclusion.

With the present and projected growth in the number of advanced aged driver's mobility plays a prime role in their ability to maintain their personal daily activities and involvement in the family. Travel is an important element in the quality of the older person's life, demonstrating the wider 'automobility' of the advanced age group. Studies of the possible consequences resulting from driving cessation have indicated an increase in the level of specific health conditions including depression and decreased out-of-home

activities. This is particularly relevant in New Zealand with its poor public transport network.

Driving assessment is an exercise in risk evaluation and management, but for it to proceed productively, servicing both that of the driver as well as that of the associated authorities, it similarly needs to be comprehensive in both its composition and understanding. More support for the advanced age group in their decision to either maintain their licence or to cease driving is essential.

Older drivers are a growing population group who have already and will continue to contribute to society. Confidence exists in older drivers' ability to make decisions in their daily living so why is not a similar recognition apparent with regards to driver cessation and the associated system? Licensing evaluation procedures and associated governmental legislation should now acknowledge the important contribution of older drivers themselves as well as their environmental concerns in both the design and administration of the licensing evaluation system.

Using results from the from the LiLAC study four pieces of research have been conducted directed primarily towards continued driving by an advanced age group of New Zealand Māori and non-Māori. Consideration in the first piece of research has been directed towards whether older people drive a car. Following this research questions will then be directed towards those within this population age group who have continued to drive or have decided to cease driving; the availability of public transport and of this group who has been driven by someone else? (The LiLAC Study New Zealand, Te Pu āwaitanga o Ng ā Tapuwae Kia Ora Tonu, 2010; Dyall, Kēpa, Hayman, The, Moyes, Broad, & Kerse, 2013; Dyall & Kerse, 2010).

## 2. Method

The LiLAC study is both a quantitative and longitudinal cohort study that considers the lives of advanced aged Māori and non-Māori New Zealanders.

The present data has been obtained through sub-sections (i) Nottingham Extended Activities of Daily Living from chapter 3 relating to Physical Health and (ii) Transport which were part of Everyday Interests and Activities, chapter 11 of the LiLAC study. Questions revolved primarily around driving itself, asking whether the participants were still driving, had ever driven, weekly use of a vehicle and distance driven. Although not specifically asked Why do you drive? respondents did provide useful material for this question through their personal written replies often shown in the other provision Data overall was inclusive of both drivers and non-drivers.

<i>Number</i>	<i>Question</i>
BC4f	Do you drive a car?
JB3	Have you ever driven a car?
JB1	How often do you drive yourself in a typical week?
JB2	How far do you drive yourself in a typical week?
*	<i>Why do you drive?</i>

### 2.1 Recruitment of Participants

Participants were recruited from both the Bay of Plenty District Health Board and Lakes District Health Board regions. All those New Zealand Māori were aged between 80-90 (born between 1<sup>st</sup> January 1920 and 31<sup>st</sup> December 1930), while all the non-Māori New Zealanders were aged 85 years, having been born in the calendar year of 1925. This group was identified through the use of multiple overlapping strategies including the general and Māori electoral roll, primary care databases, word of mouth, Māori tribal networks; and from these sources contacted and invited to participate.

By the time the first wave (Dyall, Kepa, Hayman, Teh, Moyes, Broad and Kerse, 2013) was run numbers had reduced slightly to 421 (45.22%) New Zealand Māori and 510 (54.78%) New Zealand non-Māori totaling 931 subjects involved in the study.

### 2.2 Measures

Five methods of statistical analysis were used in assessment of the results: (i) Binomial Logistic Regression, (ii) Chi-Square Test for Association, (iii) Ordinal Logistic Regression, (iv) Mann-Whitney U Test and (v) Descriptive Analysis. Results from this analysis will be presented in either tabular or graphical format along with written assessment. IBM Statistical Package for the Social Sciences 20 (SPSS) was used to generate descriptive statistics and post-hoc comparative analysis.

## 3. Results

### 3.1 Physical Health

#### **Nottingham Extended Activities of Daily Living**

The Nottingham Extended Activities of Daily Living is divided into five sections: mobility, in the kitchen, domestic tasks, leisure activities and other; asking first whether they complete the activity and next if they receive help from someone in the same household, family outside of the household and others. Initially the interviewer asks all questions of the respondent giving them one of three choices (refer to Table 1).

**Table 1.**

Score	
0	No
1	With Help
2	On My Own; On My Own with Difficulty

Following this the interviewer then goes back to the activities that the person said they needed help to do and enquiring who provided them with support (refer to Table 2).

**Table 2.**

Help received from....
Someone in the same household
Family outside the household
Others

**Question BC4f** *Do you drive a car?**New Zealand Māori*

Two hundred fifty-four New Zealand Māori aged between 83-93 years responded to question BC4f asking whether they drove a car. Within that figure there was a relatively even distribution between the number of female New Zealand Māori (153) and male New Zealand Māori (101) who provided an answer.

Initially for New Zealand Māori females their results presented a figure that was closely divided between those who said no to the question of driving a car (77) and those who either drove on their own or with difficulty (76). New Zealand Māori males however in comparison showed that the greater majority of them did drive or with difficulty (71), with only 28 not driving. Another two males also indicated that they drove with help, (BC4f column in Table 3).

Following these results most of New Zealand Māori females who had said that they did not drive also went on to say that they made a comparable use of one of the other three options presented (same household BC4f\_h), outside household (BC4f\_f) and/or other (BC4f\_o)). Also, although not initially indicating that they did drive 'with help' (1) on examination six respondents also said that they did make use of the help of other drivers, internal or external.

In comparison, the results of New Zealand Māori male saying no to driving increased slightly in number and utilised the services of household, family and external members. One male who had previously said that they drove with help (1) went on to say that their help came from a household member (refer to Table 3).

**Table 3.**

New Zealand Māori - Female	BC4f	BC4f_h	BC4f_f	BC4f_o	
-	0	77	75	74	76
1	0	0	2	3	1
2	76	0	0	0	0
New Zealand Māori - Male	BC4f	BC4f_h	BC4f_f	BC4f_o	
-	0	28	29	30	30
1	2	2	1	0	0
2	71	0	0	0	0

***Question BC4f*** *Do you drive a car?****New Zealand non-Māori***

New Zealand non-Māori reply to question BC4f indicated that a slightly higher number New Zealand non-Māori males (140) drove either on their own or with difficulty in comparison to New Zealand non-Māori females (124).

However, of those who had said no to the question it was New Zealand non-Māori females who were more noticeable in number with 65 in contrast to the 29 for New Zealand non-Māori males.

With the follow-up conversation both male and female New Zealand non-Māori non-driver results were equally distributed across household, external family and/or others (refer to Table 4).

**Table 4.**

New Zealand non-Māori - Male		BC4f	BC4f_h	BC4f_f	BC4f_o
-	0	29	29	29	29
	1	0	0	0	0
	2	140	0	0	0
New Zealand non-Māori - Female		BC4f	BC4f_h	BC4f_f	BC4f_o
-	0	65	65	65	65
	1	0	0	0	0
	2	124	0	0	0

***Question JB3*** *Have you ever driven a car?****New Zealand Māori***

Of the 123 who answered question JB3 enquiring whether New Zealand Māori had ever driven female Māori provided the highest number, resulting in a 2:1 response. In comparison, New Zealand Māori males presented a highly-weighted distribution (9:1) when asked whether they had or had never driven (refer to Figure 1).

The age of those driving covered a ten-year age span (83-93 years) with the highest number being in the 83-86 year's age group. In line with the dropping aged population the number of drivers reduced except for slight increase in the 88-year age group.

Analysis ascertained the effects of gender and age on the likelihood of New Zealand Māori having ever driven a car. The logistic regression was shown to be not statistically significant,  $X^2(2) = 2.812, p > 0.05$ . The model explained 1.0% (Nagelkerke  $R^2$ ) of the variance in older old New Zealand Māori males having ever driven a car and correctly classified 78.2% of the cases. New Zealand Māori females had 1.028 times higher odds of exhibiting having ever driven a car compared to male New Zealand Māori. An increase in age was associated with a reduction in the likelihood (0.688) of having ever driven a car (refer to Table 5).

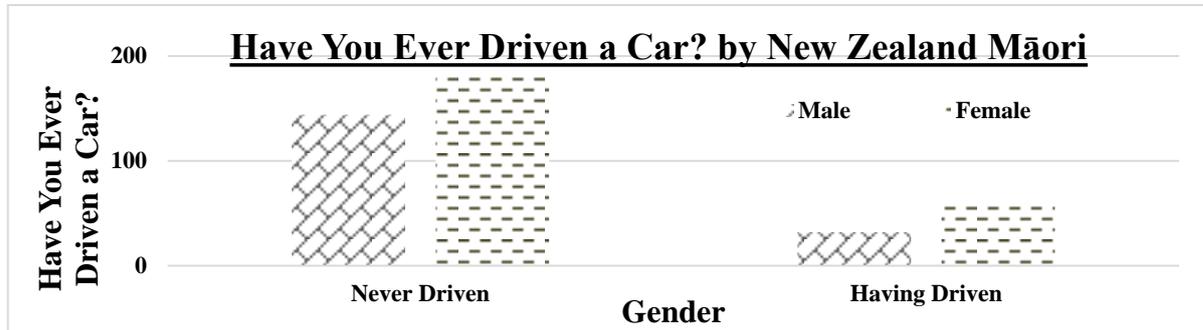


Figure 1.

Table 5.

Variables in the Equation									
		B	S.E.	Wald	df	95% Confidence Interval			
						Sig.	Exp(B)	Lower	Upper
Step 1	New Zealand Māori	0.028	0.043	0.416	1	0.519	1.028	0.945	1.118
	AgeMāori	0.375	0.246	2.31	1	0.129	0.688	0.424	1.115
	Constant	-3.513	3.703	0.9	1	0.343	0.03		

**Question JB3** *Have you ever driven a car?*

*New Zealand non-Māori*

Just under a quarter of the total New Zealand non-Māori population involved in the LiLAC study answered question JB3 enquiring whether they had ever driven a car. The results indicated that New Zealand non-Māori males observed frequency was lower than the expected frequency for not having ever driven and somewhat greater than that expected for those who have ever driven (refer to Figure 2). In comparison, female New Zealand non-Māori results indicated that those not driving was greater than those expected to be driving. These figures therefore provide some consideration that there is an association between these two variables driving of a car and gender.

Just over eighty-six percent of all expected cell frequencies were greater than five. Results were statistically significant association between gender and preference for driving,  $X^2(1) = 7.226, p = 0.007$  (refer to Table 6).

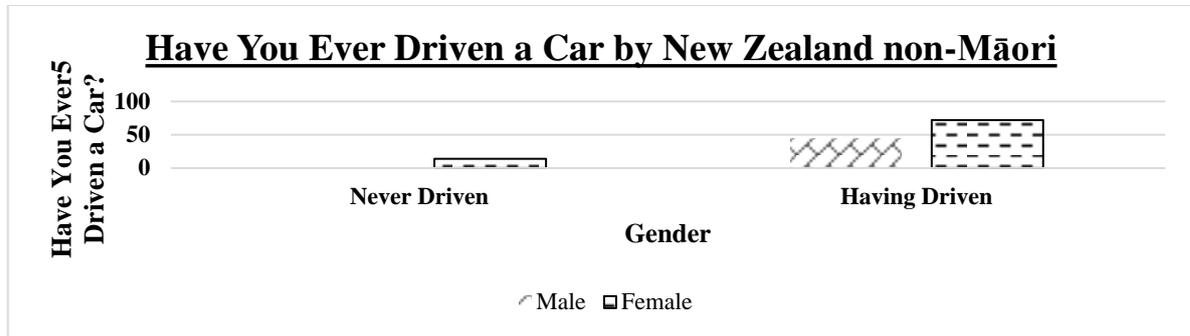


Figure 2.

Table 6.

Chi-Square Tests							
	Value	Df	Asymp. Sig. (2-sided)	Sig. (2-sided)	Exact Sig. (1-sided)	Exact Sig. (1-sided)	Sig.
Pearson Chi-square	7.226 <sup>a</sup>	1	0.007				
Continuity Correction <sup>a</sup>	6.752	1	0.009				
Likelihood Ratio	7.251	1	0.007				
Fisher's Exact test					0.007	0.005	
N of Valid Cases	505						

a. 0 cells (0.0%) have expected count less than 5 minimum expected count is 5.23.

b. Completed only for a 2x2 table.

### **Question JB1** How often do you drive yourself in a typical week?

#### New Zealand Māori

Ninety-one out of total number of New Zealand Māori answered question JB1 indicating how often they drove themselves in a typical week. Due to the small number responding overall it was decided to place the ages into three groups (83-86, 87-89 and 90-93) before analyzing the data. From these results, it was apparent that New Zealand Māori males aged between 87-89 years made the greatest number of trips ranging from 4, 7 and 3 times in the week; whereas in comparison not only did New Zealand Māori females aged 87-89 years drive regularly in the week but also those aged between 90-93 years. In looking at the results it was apparent that within both age groups Māori females took their vehicle out a similar number of times in the week with seven being the most predominant (refer to Figures 3 and 4).

The odds ratio of how often New Zealand Māori males drove themselves in a typical week versus New Zealand Māori females was 0.602 (95% CI, 0.353 to 1.027), Wald  $X^2(1) = 3.463$ ,  $p = 0.063$ . An increase in age (expressed in years) was not associated with an increase in how often New Zealand Māori drive in a typical week with an odds ratio of 0.943 (95% CI, 0.607 to 1.464), Wald  $X^2(1) = 0.069$ ,  $p > 0.793$  (refer to Table 7).

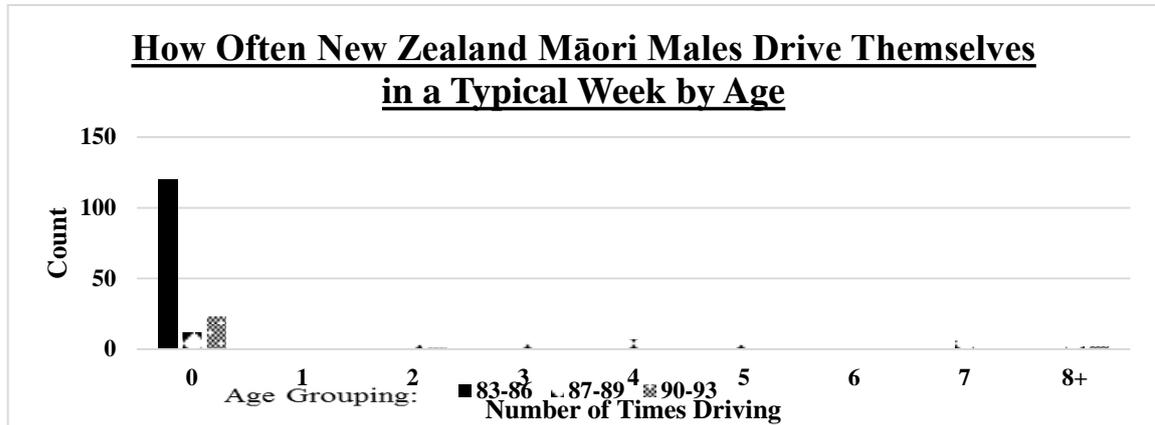


Figure 3.

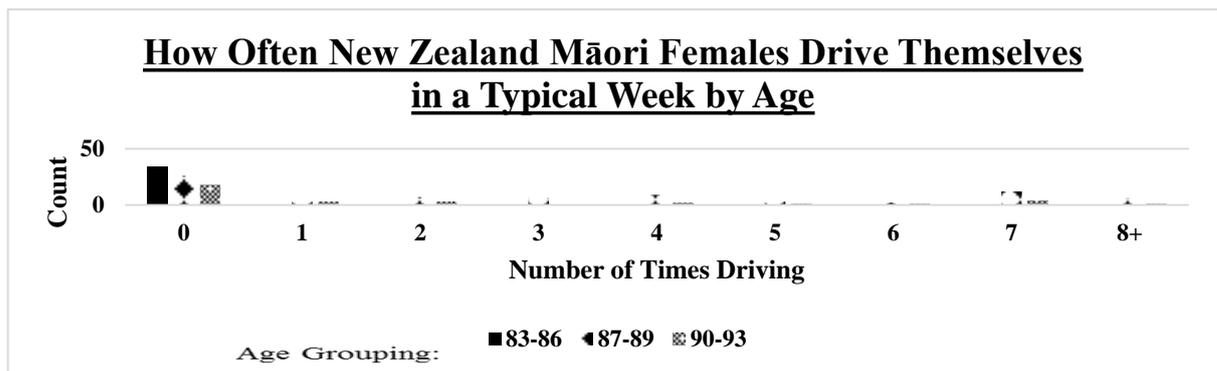


Figure 4.

Table 7.

Parameter Estimates										
Var2	Estimate	Std.Error	Wald	df	Sig	Lower Bound	Upper Bound	Exp_B	Lower	Upper
0 time in a week	1.298	0.425	9.307	1	0.002	0.464	2.131	3.662	1.59	8.423
1 time in a week	1.889	0.435	18.828	1	0	1.036	2.742	6.613	2.818	15.518
2 times in a week	2.741	0.466	34.566	1	0	1.828	3.655	15.502	6.221	38.668
3 times in a week	3.219	0.498	41.815	1	0	2.243	4.194	25.003	9.422	66.287
4 times in a week	3.407	0.514	43.889	1	0	2.399	4.414	30.175	11.012	82.599
5 times in a week	3.635	0.538	45.685	1	0	2.581	4.689	37.902	13.21	108.744
6 times in a week	3.772	0.554	46.324	1	0	2.685	4.858	43.467	14.658	128.766
7 times in a week	5.734	1.079	28.261		0	3.62	7.848	309.204	37.338	2560.608
Age	-0.059	0.225	0.069	1	0.793	-0.499	0.381	0.943	0.607	1.464
NZMāori Male = 1	-0.507	0.273	3.463	1	0.063	-1.042	0.027	0.602	0.353	1.027
NZMāori Female = 2	0 <sup>a</sup>	.	.	0	.	.	.	1	.	.

**Question JB1** How often do you drive yourself in a typical week?

New Zealand non-Māori

Initial analysis indicated that a for both male and female New Zealand non-Māori a third made no trips at all during their typical week. Within the remaining two-thirds both male and female New Zealand non-Māori generally drove primarily twice followed by once a week. Of those drivers, New Zealand non-Māori females were seen to drive more often than New Zealand non-Māori males during a typical week (refer to Figure 5).

Distributions of the driving scores for non-Māori males and non-Māori females were comparable as assessed by visual inspection, along with analysis. Driving scores were not statistically significant different between non-Māori males and non-Māori females,  $z = 1.278, p = 0.201$  (refer to Table 8).

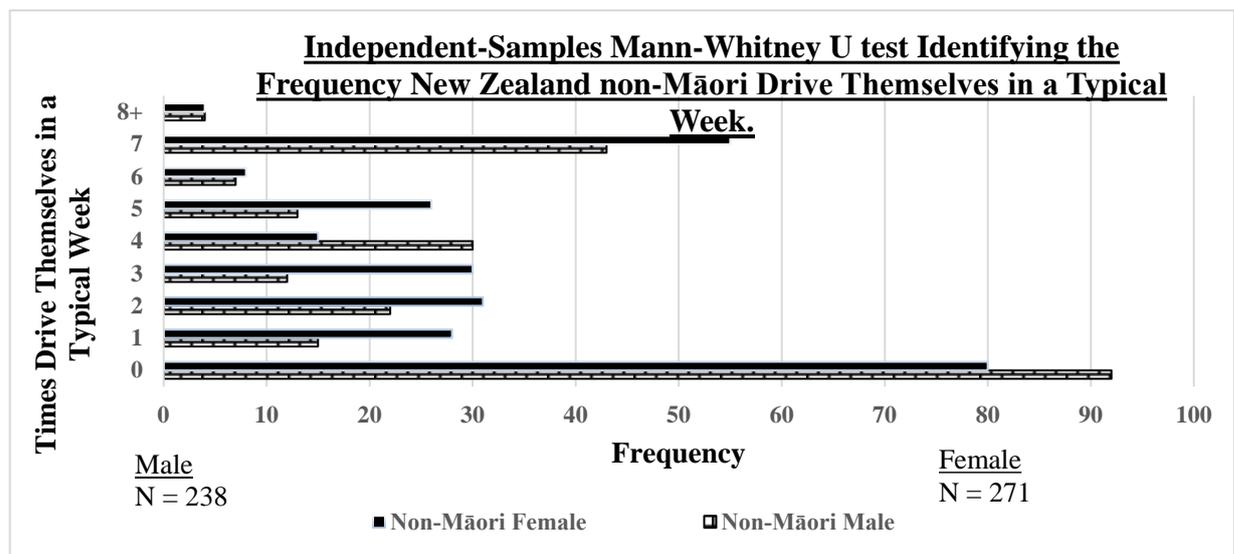


Figure 5.

Table 8.

<b>Total N</b>	<b>509</b>
<b>Standardized Test Statistic</b>	<b>1.278</b>
<b>Asymptotic Sig. (2-sided test)</b>	<b>0.201</b>

**Question JB2** How far do you drive yourself in a typical week?

New Zealand Māori

It was apparent that results presented a similar picture by both gender and age for New Zealand Māori. Most drove between 1.5 to 25.5 kilometers in the week and were aged between 83-84 years. Of those still driving in the greater 90's it was New Zealand Māori males who were predominantly seen to be on the road. varying location parameters,  $X^2(6) = 12.537, p = 0.051$ . The Deviance goodness-of-fit

indicated that the model was a good fit to the observed data,  $\chi^2(70) = 58.420, p = 0.837$ . However, the final model was not statistically significant, independent variables not predicting the dependent variable over and above the independent-only-model,  $\chi^2(2) = 4.158, p > 0.05 (0.125)$ . The odds ratio of New Zealand Māori males driving distance to be greater was like that of New Zealand Māori females is 0.787 (95% CI, 0.415 to 1.493), Wald  $\chi^2(1) = 0.539, p > 0.05 (0.463)$ . An indication in age (expressed in years) was associated with an increase in the odds of considering driving distances with an odds ratio of 0.87 (95% CI, 0.763 to 0.995), Wald  $\chi^2(1) 4.137, p > 0.05 (0.192)$  (refer to Figures 6a/b and Table 9).

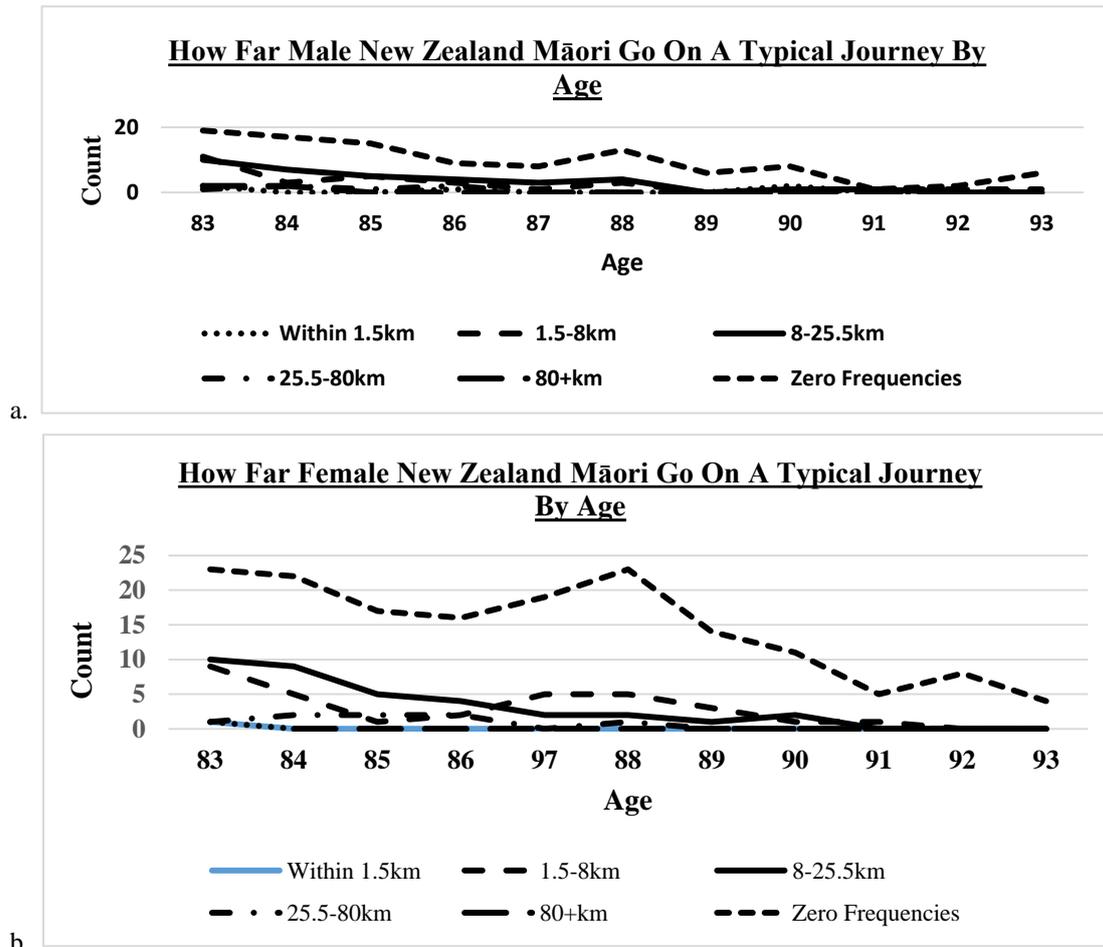


Figure 6.

**Question JB2** How far do you drive yourself in a typical week?

New Zealand Māori

**Table 9.**

Var2	Estimate	Std. Error	Wald	df	Sig.	95% Confidence Intervals				
						Lower Bound	Upper Bound	Exp_B	Lower	Upper
Within 1.5 Kilometres	-13.001	5.847	4.944	1	0.026	-24.461	-1.541	0	0	0.214
1.5 to 8.25 Kilometres	-10.087	5.831	2.992	1	0.084	-21.516	-1.342	0	0	3.826
8.25 -to 25.5 Kilometres	-7.607	5.824	1.706	1	0.192	-19.023	3.809	0	0	45.086
25.5 to 80 Kilometres	-6.131	5.829	1.106	1	0.293	-17.555	5.293	0.002	0	198.927
Age	-0.113	0.069	2.668	1	0.192	-0.248	0.023	0.893	0.78	1.023
Missed	0.231	0.368	0.393	1	0.531	-0.491	0.952	1.26	0.612	2.502
New Zealand Māori Male	-0.24	0.327	0.539	1	0.463	-0.881	0.401	0.787	0.415	1.493
New Zealand Māori Female	0			0				1		

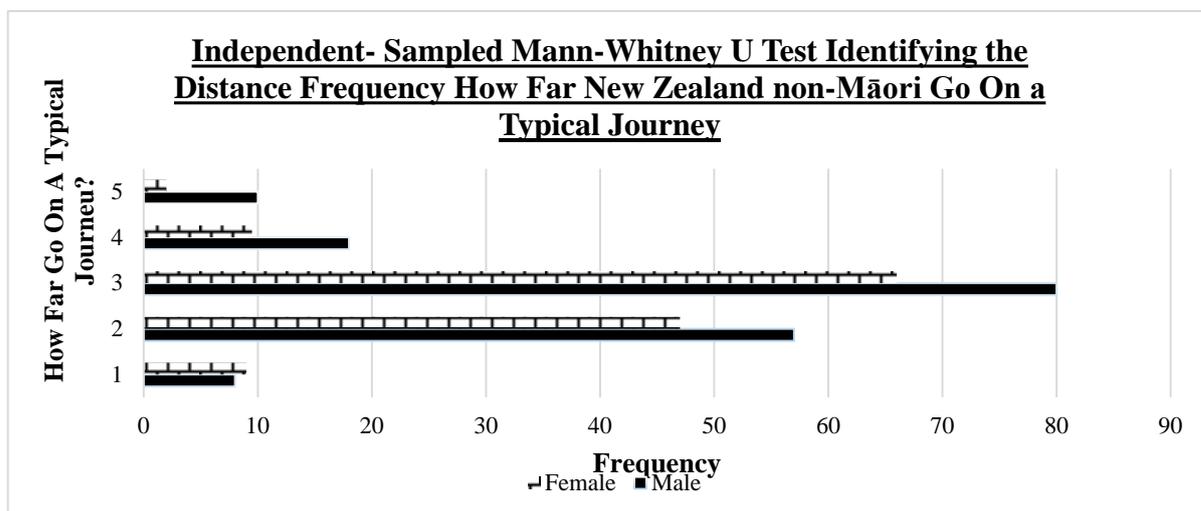
**Question JB2** *How far do you drive yourself in a typical week?***New Zealand non-Māori**

A third of the New Zealand non-Māori population group answered question JB2 with a near 50:50 divisions between males and females New Zealand non-Māori responding to the question. This similarity in driving pattern was also supported by the median results for both male and female New Zealand non-Māori (refer to Figure 7).

It was apparent that distribution scores for New Zealand non-Māori males and females were similar, as assessed by visual inspection. Median driving distances for New Zealand non-Māori males (3.00) and New Zealand non-Māori females (3.00) indicated weak evidence against the null hypothesis,  $z = -1.344$ ,  $p = 0.179$  (refer to Table 10).

**Table 10.**

<b>Total N</b>	287
<b>Standardized Test Statistic</b>	-1.344
<b>Asymptotic Sig. (2-sided test)</b>	0.179



Male  
 N = 157  
 Mean Rank = 149.44

Female  
 N = 130

Figure 7.

**Question** Why do you drive?

New Zealand Māori and New Zealand Non-Māori

When asked why do they drive both older New Zealand Māori and New Zealand non-Māori supplied a wide spectrum in response. In appraising their reply, you can see that the car plays an important role in maintaining their independence, enabling them to remain connected with both family and friends; attend a variety of events planned or otherwise; continue to educate themselves, contribute to society and their surrounding environment. Below is a combined list in no order of responses by contributors to the LiLAC study (refer to Table 11).

Table 11.

Maintaining independence.
Visiting Marae re. for example: tūtaki(meeting), whānau (family), tangi (funeral), hapori/hapu (tribe), pureitanga (event), takatāpui (friends).
Health, for example: doctor, nurses, hospital, specialist appointments.
Family re. for example: visiting, baby-sitting, helping in house developments.
Shopping, for example: food, house related items, gardening, gifts.
Service clubs e.g. Lions/Lioness, karapu.
Continuing Education.
Fitness, for example: attending gyms, going for walks with family/friends.
Movies.

Visiting events, for example: local, council, regional or national.
Attending shows.
Just going for a drive.
Dancing.
Going on holiday.
Council.
Library.

#### 4. Discussion

The theme for the first analysis of the transport section of the LiLAC study was directed towards driving by New Zealand Māori and Non-Māori of an advanced age. Issues relevant to this research inquired into whether the advanced aged people had ever driven and asking were they presently driving a car. Also, how often and how far they drove themselves in a typical week. Results identified that gender for both New Zealand Māori and Non-Māori and specifically age for New Zealand Māori could be related to advanced age driving.

##### New Zealand Māori

In total both male and female New Zealand Māori indicated that the majority had driven a car. However, results for New Zealand Māori females also suggested that a comparable number had similarly never driven. They were also the group that made greater use of other family members and external facilities to help them with their transportation. When asked about their driving New Zealand Māori females who were seen to cover the entire eleven-year age span. Although females aged between 87-89 years were more predominant in having used their car daily. New Zealand Māori females were similarly more involved in offering the service of driving, whether it be other household members, family or another person. Both male and female New Zealand Māori covering the entire age range drove distances of 1.5-80+ kilometres; although trips taken between 1.5-25 kilometres were the most common. Finally, the car for the New Zealand Māori plays an important role in their lives and their overall freedom. Whether it be for them to be able to attend tūtaki (meetings) at their Marae with whānau (family), tangi (funeral), hāpori/hapu (tribe), pureitanga (event), and/or takatāpui (friends); health related appointments, shopping, service club (karapu) membership, utilising local services, going for a walk, or going to a movie/show.

##### New Zealand Non-Māori

Results New Zealand non-Māori revealed that a slightly higher number of males drove a car compared to that of New Zealand non-Māori females. Where-as for New Zealand non-Māori females, like that as of the New Zealand Māori females, they also presented the greater numbers in those who had never driven along with those similarly utilising other sources for help and transportation.

However, New Zealand non-Māori females did take their vehicle out more often in the week. With the

most notable number of trips being on a possible daily basis. Nonetheless when the number of trips made as well as the total distance travelled were combined New Zealand non-Māori males were shown to drive the greater distance in a typical week, particularly those made between 8-25.5 kilometres. New Zealand non-Māori provided similar reasons to that of New Zealand Māori as to why they drove; with maintaining their independence being their upmost concern. Examples as to why they used their vehicle included: health related appointments, family, shopping, service clubs or continuing education; fitness groups, a performance, using local services, dancing or going to the theatre.

With the present and projected growth in the number of advanced aged driver's mobility plays a primary role in their ability to fulfil life's practicalities, along with, enhancing both social interaction and the maintaining of networks. Travel being an important element in the quality of the older person's life, demonstrating the wider automobility of the advanced age group. Generating therefore a sense of self control and independence for the older people as well as enabling continued exercising of their cognitive abilities (Musselwhite & Haddad, 2010; and Stav, 2015).

The skill of driving is multifactorial in its nature, employing a more comprehensive model that marries a driver's sensory baseline, motor skills, physical functioning variables and cognitive ability. As a result, enabling people to maintain their independence and contribute to their quality of life. Furthermore, factors that may influence this advanced age groups decision to cease their driving are similarly multifaceted in nature involving a complex number of variables.

Driving assessment is an exercise in risk evaluation and management, but for it to proceed productively; servicing both that of the driver as well as that of the associated authorities it similarly needs to be comprehensive in both its composition and understanding. More support for the advanced age group in their decision to either maintain their license or to cease driving is essential. Functional assessment should include an objective review of a driver's mobility, the transferring of skills and daily living activities which in turn would provide baseline results from which driver evaluation may be more feasibly administered.

For assessment, therefore of older person's driving practices to be conducted in a constructive manner, it is apparent that a more complex method of approach should be developed; an assessment that moves beyond that commonly-believed approach of driver vision and physical agility. Consequently, enabling the establishment of an integrated process that recognises the correlation between the older drivers and their self-awareness; their assessor and the type of procedures employed for their driving evaluation. Alongside such a development, and particularly because of the expanding number of older drivers, the re-examination of the presently employed method of driver licence appraisal, and existing road safety legislation should also be considered.

The Driver Evaluation Programme used at the Ottawa Hospital Rehabilitation Centre, Ontario, Canada from Finestone, Marshall, Rosenberg, Moussa, Hunt and Greene-Finestone (2009) assessed the demographic, medical, pre-morbid driving history and transportation use characteristic of post-stroke driver and non-driver stroke survivors. They determined which of those factors could be used to

identify survivors who would resume driving and those who would not. With such analysis, they also assessed driver community needs. Three types of assessment were employed; these came in the form of questionnaires (including telephone survey), clinical evaluation and simulated driving experience conducted by an OT along with an on-road testing with a certified driving instructor. Driver visual perception, attention and reaction time was also included as part of the assessment procedure. Results from Finestone et al. (2009) indicated that those drivers who successfully resumed driving were younger, had a smaller number of medical problems, were less disabled and did receive supportive advice. However, within this group, 44% of those who returned to driving did limit their driving and relied on others for their transportation. Of those who were initially unsuccessful on on-road testing it was apparent that through some re-training they could make an improvement which would permit them to re-take the test later. Results that were comparable to those found in earlier research conducted by Fisk, Owlsey and Mennemeir (2002).

Yazdan-Ashoori and ten Hove's (2010) pointed out that functional (on-the-road) assessment was only included by the Canadian Medical Association in 2004. Adding functional assessment to their present visual standards enabled those with reduced visual function to demonstrate that they could drive safely. In 2009, the New Zealand Transport Agency produced a guide (Medical aspects of fitness to drive) aimed to assist medical practitioners in their assessment of any individual driver, setting out their responsibilities and obligations. In the guide, changes in medical assessment practices are recognized, noting that technology and knowledge associated with the assessment of fitness to drive may change over time - allowing medical practitioners therefore to implement another test or form of examination that is subsequently generally used and achieves a similar level of assessment outside of those recommended in the guide. Medical practitioners, optometrists and occupational therapists are expected to keep themselves up to date with changes in medical knowledge that may also influence their decision making.

Driver hazard perception response latency has been investigated using video-based tests measuring their reaction time to traffic events. Horswill and McKenna (2004) results indicated that the initial age-and- experience-related decrease in response times occurred as drivers gain experience in the road environment, and from this learn how to better anticipate possible dangerous situations. Drivers therefore learned how to anticipate hazards rather than simply reacting to unexpected events as is commonly associated with younger drivers. Later in the same decade, research by Horswill, Kemata, Wetton, Scialfa and Pachana (2010) identified that drivers aged between 64 and 94 years, trained in using a video-based hazard perception system, reacted significantly faster at anticipating hazardous traffic events and that the benefit of this training continued. This was even after Horswill et al. (2010) controlled for the drivers' pre-training ability. Although, in conclusion Horswill et al. (2010) did observe that although they had improved older drivers' hazard perception latencies by a significant degree there were still several caveats that needed to be considered. Secondly, they noted that further investigation was required into the transferring of ability and use of this knowledge from testing

environment to the real-world and thirdly that the effects of their research could similarly be translated into meaningful road safety advantages.

Finestone et al (2009) found that stroke survivors who had held a valid licence seemed to be conscientious about their ability to drive, consistent with Marottoli et al. (1993) earlier findings. Johansson and Stromberg's (2010) investigation into the experience of driving restrictions on recipients with an implantable cardioverter defibrillator identified from a patient's perspective the unique role driving was to the individuals. Three major categories and sub-categories were recorded: (i) adherence to driving restrictions, (ii) emotional influence of driving restrictions and (iii) drivers altered view on driving and information needs, individual interpretation, adaption to the restrictions, loss of independence, changes in self-image, significance of networks and the influence of driving behaviour. Through examination of vision and driving within the United States, Johnson and Wilkinson (2010) identified the use of self-restriction by drivers with ocular or neurologic disorders. Correspondingly Bartley and O'Neill (2010 Sep.) observed the use of driving efficacy as a scale to reveal internal consistency and construct validity with stroke and non-stroke populations. Hoffman and McDowd (2010) employed a low-level driving simulator that could predict self-reported automobile accidents 5 years later providing evidence towards a possible link between driver hazard perception detection accuracy (HPDA), self-reporting and identification of road accidents. Summer and Tukey (2011) spoke about reported measures of aberrant driver behaviour and reported accidents at the Sixth International Driving Symposium on Human Factors in Driving Assessment Training and Vehicle Design and finally Clapp, Olsen, Danoff-Burg, Houston-Hagewood, Hickling, Hwang and Gayle-Beck (2011) correlated the interactive effects of accident distress and self-reported stress history with all three dimensions of anxious driving behaviour (dislike of driving, aggression & fatigue proneness). In all the role of driver decision-making with regards to maintaining a licence was recognised by the researchers. However, this was rather as an influencing factor but not necessarily, as Marottoli et al. (1993) noted in their research on stroke survivors, as a concrete measure.

Older drivers are a growing population group who have already and will continue to contribute to society. Confidence exists in older driver's ability to make decisions in their daily living. Licensing evaluation procedures and associated governmental legislation should now acknowledge the important contribution of older drivers themselves as well as their environmental concerns in both the design and administration of the licensing evaluation system. In line with such development probable predictors should not be considered from a simple black and white standpoint. Through re-training as is already offered in the assessment of younger drivers applying for a license this should also become a natural cog in the wheel of older drivers, their independence and continued position within society. Results having already indicated that through such training improvements have resulted in them being able to re-take their test. As already noted earlier on by the researcher, in line with the implementation processors used by older drivers, the connection with licensing evaluation procedure and governmental legislation also needs to be recognised as part of decision making jig-saw.

Unless there is an understanding and recognition of older drivers as part of the driving community such a change in the assessment procedure seems unlikely. Being able to drive for an older person exists beyond the movement from point A-to-point B. To them it incorporates a wider spectrum of ideals as should similarly be included as part of any assessment procedure in the future.

Results from a United Kingdom policy brief on legislation regarding older drivers indicated that there does not appear to be a self-restricted licensing system in place anywhere throughout the world (ILC-UK, 2011). There are course systems that do impose some licence restrictions upon older drivers whether these are reducing length of time older driver's licence remains valid or restrictions are placed on the circumstances in which an older person may drive. Generally, however they may involve two approaches (i) medical checks and/or (ii) driving assessment.

The former approach is generally adopted by European countries. In Denmark the length of time covered by a licence gradually decreases from four to one year between the ages of 70 to 80 years. After 80 the licence must renew their licence yearly. Spain reduces licence validity from ten to five years at the age of 45, and to two years at the age of 70. Ireland allows for 1-3-year renewals after the age 70, with the period being predetermined by medical examination. Finland requires a medical check an age of 45, 60, 70 and five years thereafter. Whereas the latter approach (graduated licensing) is common in North America and Australia with it being determined at regional levels (Griffith, 2007; Berry, 2011).

In New Zealand a new system for older driver licensing was introduced towards the end of 2006. In this new system the previous mandatory on-road test that was required by 80-year old's and two yearly afterwards to re-licence was removed. However, the medical certificate of fitness to drive, with a referral and support systems for medical practitioners remains, along with education and information for not only the medical practitioner but also other health practitioners and for the older drivers.

For the assessment of older person's driving practices to be conducted in a constructive manner, it is apparent that a more complex method of approach should be developed; an assessment that moves beyond that commonly-believed approach of driver vision and physical agility. Consequently, enabling the establishment of an integrated process that recognises the correlation between the older drivers and their self-awareness; their assessor and the type of procedures employed for their driving evaluation. Alongside such a development, and particularly because of the expanding number of older drivers, the re-examination of the presently employed method of driver licence appraisal, and existing road safety legislation should also be considered.

## **5. Conclusion**

Driving is an important component of an aged person's life and is apparent in both the New Zealand Māori and non-Māori population groups. However, unlike the common belief that older males are the predominant driver, females in both the New Zealand Māori and non-Māori grouping present comparable numbers in all areas. Also, with future demographic growth an expansion in older

non-Māori females is expected. Therefore, to enable this growing aged population to remain independent, fully utilise their faculties, live a healthy life and for society to recognise their capabilities it is essential that further research is conducted into the licensing procedure, along with family and external support amenities.

On behalf of all authors, the corresponding author states that there is no conflict of interest.

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