Prevalence of nutrition risk and associated social risk factors in community living older adults in the New Zealand Health, Work and Retirement Study

A thesis presented in partial fulfillment of the
requirements for the degree of

Master of Science in Nutrition and Dietetics

at Massey University, Auckland, New Zealand

Melaney Tema Tkatch
2017

Abstract

Background: The New Zealand population is ageing as a result of declining mortality and birth rates. In order for older adults to remain in optimal health, good nutrition is vital. Previous research indicates approximately 50% of New Zealand's community living older adult population are at some degree of nutrition risk. Understanding nutrition risk prevalence and factors associated with increased nutrition risk is vital to reduce healthcare spending. This study aims to determine nutrition risk prevalence and associated health and social risk factors amongst community-living older adults across New Zealand.

Methods: A total of 3050 community-living older adults were invited to respond to the 2014 Health, Work and Retirement (HWR) postal survey. This included a nutrition risk assessment using the Seniors in the Community: Risk Evaluation for Eating and Nutrition, abbreviated version (SCREENII-AB) as well as demographic, social and health characteristic measures. Social provisions were determined with the 24-item Social Provisions Scale, and Social and Emotional loneliness were assessed with the 6-item De Jong Gierveld Loneliness Scale. Alcohol intake was determined by using the Alcohol Use Disorders Identification Test (AUDIT-C), and living standards assessed with the Economic Living Standards Index Short Form (ELSI-SF). **Overall,** 136 participants did not complete one or more of the SCREENII-AB items, reducing the sample size to 2914.

Results: Of the 2914 participants, 37.2% were found to be at nutrition risk. Half (51.2%) of Māori participants were at nutritional risk compared to a 32.7% of non-Māori. Independent risk factors for Māori were being un-partnered (OR 1.87) and rating general health as fair (OR 4.83). Independent risk factors for non-Māori were being un-partnered (OR 1.94), rating general health as good, fair or poor (OR 2.03, 3.18, 4.39), life satisfaction (OR 0.40), as well as increased total health conditions counts (OR 1.11), and emotional loneliness (OR 1.35).

Conclusions: These findings suggest that social eating is required to reduce nutrition risk amongst older adults. Those who are un-partnered may benefit from public health intervention promoting social eating. As Māori had a higher prevalence of

nutrition risk than non-Māori, culturally appropriate strategies are needed to encourage healthy eating practices.

Acknowledgements

I would like to acknowledge a few people who have provided both support and assistance making this thesis possible.

My supervisors, Associate Professor Carol Wham and Dr Andy Towers, for their positive encouragement, support and breadth of experience.

The HWR team for allowing me to be a part of this research, and the participants of the 2014 study for their time and efforts in filling out and returning the questionnaire.

My sisters and parents for their support and encouragement despite the odd meltdown. Elana, Sabrina, and Briar you continue to inspire me to do great things, and I am glad to have this opportunity to acknowledge your help with this submission and your kindness over the last year.

Lastly, to all those close friends who were able to support me from near and far, and offer words of encouragement as needed over the last year.

Table of Contents

List of Tables

Abbreviations

Abbreviation	Definition
AUDIT	Alcohol Use Disorders Identification Test
AUDIT-C	Alcohol Use Disorders Identification Test (Short Form)
AMDR	Average Macronutrient Distribution Range
ANSI	Australian Nutrition Screening Initiative
BMI	Body Mass Index
BMR	Basal Metabolic Rate
DALY	Daily Adjusted Life Year
ELSI-SF	Economic Living Standard Index Short Form
LiLACS NZ	Life and Living in Advanced Age: a Cohort Study in New Zealand
HWR	Health, Work and Retirement
NZ	New Zealand
NZANS	New Zealand Adult Nutrition Survey
MNA-SF	Mini Nutritional Assessment Short Form
MUST	Malnutrition Universal Screening Tool
MPR	Multiple Pass Recall
NSI	Nutrition Screening Initiative
OR	Odds Ratio
SCREENI	Seniors in the Community; Risk Evaluation for Eating and Nutrition, version I
SCREENII	Seniors in the Community; Risk Evaluation for Eating and Nutrition, version II
SCREENII-AB	Seniors in the Community; Risk Evaluation for Eating and Nutrition, version II, Abbreviated Version
SNAQ	Simplified Nutritional Assessment Questionnaire
WHO	World Health Organization

Chapter 1: Introduction, Aims and Objectives

1.1 Introduction

New Zealand, (and the world) have been experiencing population ageing over the past 50 years; resulting in a large proportion of the total population being over 65 years (Statistics New Zealand, 2015; United Nations Department of Economic and Social Affairs Population Division, 2013). This population change is expected to continue for the next 50 years, with the older adult population of New Zealand projected to double in the next 25 years (Statistics New Zealand, 2015). Alongside an ageing New Zealand population there are increased costs of healthcare (Guest et al., 2011).

As individuals age, frailty and functional decline become more common, reducing an individual's ability to participate (to their full capacity) in life (Payette, 2005). In order to prevent the progression to frailty, adequate nutrition is key. Of particular consequence is provision of adequate energy intake and a nutrient-dense diet. Without these, weight loss and muscle loss in particular may occur. While weight and BMI may tend to decrease with age, weight loss should not be seen as the 'norm' with ageing. Weight maintenance is associated with improved health outcomes when compared to weight loss or gain (Payette, 2005). For older adults, weight loss – intentional or not – is associated with mortality and morbidity, while holding extra weight is protective (Alibhai, Greenwood, & Payette, 2005; Tiggemann, 2004). Among adult New Zealanders dietary risks are the leading cause of health loss; diets low in fruit and vegetables contribute to 2.5% of the daily adjusted life years (DALYs) lost (Ministry of Health, 2013b). In terms of specific issues related to nutrition, sarcopenia, a decline in muscle mass and strength, is the major physical alteration noted with age (Goodpaster et al., 2006). This may be linked to changes to protein intake, and metabolism, and lack of muscle use, and has been associated with falls and disability as well as early mortality (Goodpaster et al., 2006). To encourage weight maintenance, and to ensure maximal health, wellness and participation in life, it is important to ensure dietary intakes are adequate.

When the phenomenon of population ageing is compounded with inadequate dietary intake, the risk of malnutrition increases. Malnutrition in older adults is associated

with poorer health outcomes and reduced quality of life (Locher et al., 2005a). This can increase the costs associated with hospitalisation, as it increases both care needs and length of hospital stay (Braunschweig, Gomez, & Sheean, 2000). By reducing the number of malnourished older adults in the community and associated adverse health outcomes, healthcare costs can be reduced; reducing the burden on both the individual and the healthcare system (Kubrak & Jensen, 2007). Being able to detect malnutrition risk factors before an individual needs acute care or becomes heavily burdened by the adverse effects can help improve quality of life (Locher et al., 2005a).

Malnutrition is related to both physical and social factors, and results in both physical (muscle loss and impaired muscle function) and psychological (fatigue, and lack of enthusiasm) symptoms (Kubrak & Jensen, 2007). Physical factors contributing to malnutrition may include disease states causing increased energy needs, or functional (swallowing or chewing) difficulties (Kubrak & Jensen, 2007). Social factors may include the ability to procure, prepare and cook nutritious foods, and the factors influencing this ability, including the motivation to eat which may be affected by depression, bereavement or loneliness (Kubrak & Jensen, 2007). Persons who are well nourished and in good health remain in their own homes longer, and cost less in terms of healthcare spending. Continued research which investigates risk of malnutrition and associated risk factors amongst those living in the community is essential to inform targeted interventions to lessen the rates of malnutrition and to improve health outcomes.

There are a variety of community-appropriate malnutrition screening tools available which identify those individuals at nutrition risk (Phillips, Foley, Barnard, Isenring, & Miller, 2010). In New Zealand the validated Seniors in the Community; Risk Evaluation for Eating and Nutrition, version II (SCREENII) tool has been widely used. SCREENII was developed in Canada for use amongst community-living older adults and is designed for self-administration (Keller, Goy, & Kane, 2005). New Zealand studies suggest at least half of community-living older adults have been found to be at nutrition risk, with approximately half of those at high nutrition risk (McElnay et al., 2012; Watson, Zhang, & Wilkinson, 2010; Wham et al., 2014a; Wham, Redwood, & Kerse, 2014b; Wham et al., 2015b; Wham, Teh, Robinson, &

Kerse, 2011c). Amongst octogenarians recruited to the Life and Living in Advanced Age: Cohort Study in New Zealand (LiLACS NZ) half (49.4%) of Māori and 38.3% of non-Māori participants were found to be at high nutrition risk (Wham et al., 2015b). Similarly, 62.5% of Māori and 30.0% of non-Māori were found to be at high nutrition risk in the Hawkes Bay (McElnay et al., 2012). These studies suggest that Māori and non-Māori older adults have different nutrition risk prevalence, which warrants further investigation. Social factors such as living alone have also been identified as increasing nutrition risk across the older adult population (McElnay et al., 2012; Wham et al., 2014a; Wham et al., 2015b). Living alone and depression were noted to increase nutrition risk by Wham et al. (2014a) in a study of older adults (aged 75+ or 65+ for Māori participants). Similarly, in LiLACS NZ, living alone and depression were found to increase nutrition risk among octogenarians but only among non-Māori participants (Wham et al., 2015b). These findings support the role of social factors as an important influence on nutrition risk status.

This study will investigate the risk factors for malnutrition amongst community-living adults over 50 years old participating in the Heath, Retirement and Work (HWR) study. The SCREENII-AB tool is an abbreviated version of SCREENII and will be used to assess nutrition risk. SCREENII-AB has been successfully used for a large country-wide study in Canada and can be self-administered, excluding the need for a face-to-face interview with a dietitian or other trained healthcare professional (Keller et al., 2005). Canadian research using this tool in 2008/2009 found 34% of participants to be at nutrition risk, with most participants completing a computer-assisted personal interview including SCREENII-AB (Ramage-Morin & Garriguet, 2013). This Canadian study of over 15,000 respondents found nutrition risk was associated with female gender, living alone, being depressed, being moderately or severely disabled or taking more than five medications daily (Ramage-Morin & Garriguet, 2013). The current study seeks to evaluate the prevalence of nutrition risk as well as associated health and social risk factors including healthcare usage, alcohol use, social network connections, loneliness, and perception of ageing among approximately 3000 adults over the age of 50 participating in the 2014 Health, Retirement and Work (HWR) study. Ongoing since 2002, the HWR study has recruited participants from the electoral roll using equal probability random sampling. A follow-up postal survey is sent out every two years and more participants are

recruited. The 2014 HWR study represents Wave Six of this longitudinal study. Identifying those who are at nutrition risk and associated health and social risk factors is important to understand successful ageing and to inform public health interventions.

1.2 Aims and Objectives

1.2.1 Aims

To determine the prevalence of nutrition risk and associated risk factors amongst community-living older adults participating in the 2014 Health, Work and Retirement Study.

1.2.2 Objectives

- To identify the prevalence of nutrition risk among community-living older adults aged 50 plus using SCREENII-AB
- To identify factors associated with nutrition risk; healthcare usage, alcohol use, social network connections, mobility, loneliness and perception of ageing

1.2.3 Hypotheses

That high healthcare usage, high alcohol consumption, few social network connections, loneliness, poor self-rated health and poor perception of ageing are risk factors for malnutrition in community-living older adults, which will be seen through high nutrition risk.

1.3 Thesis Structure

This thesis begins with an introduction and overview in Chapter One, with a literature review in Chapter Two. This begins with an assessment of the health of older adults in New Zealand, including a discussion of the factors thought to contribute to nutrition risk. Chapter Three is the thesis manuscript formatted for the Journal of Nutrition, Health and Ageing including results for nutrition risk prevalence and associated factors. Chapter Four concludes the research and includes

recommendations, including postulations as to how the findings of this thesis may benefit policy makers.

1.4 Researcher's contributions

Researcher	Contributions
Melaney Tkatch	Student researcher. Researched and prepared literature review, analysed data, and prepared thesis manuscript including tabulating results and forming discussion and recommendations.
A/Prof Carol Wham	Dr. Wham provided the study concept, advised methodology for inclusion of SCREENII-AB in 2014 questionnaire, proofread and gave feedback on the literature review and thesis manuscript.
Dr. Andy Towers	A senior research officer on the HWR study. Dr. Towers proofread and gave feedback on the thesis manuscript, and provided statistical guidance regarding SPSS use and syntax creation.

Chapter 2: Literature Review

2.1 Ageing in New Zealand

There is a transition occurring across the world where those who are aged 60 plus, are growing as a proportion of the population, at the expense of those below aged 18 (United Nations Department of Economic and Social Affairs Population Division, 2013). This phenomenon is referred to as population ageing, and is due to both decreased mortality rates and decreased birth rates (below replacement) (United Nations Department of Economic and Social Affairs Population Division, 2013; United Nations Second World Assembly on Ageing, 2002). This population trend is notable in New Zealand, where census data shows the median age increased from 35.9 to 38.0 over a 7-year period (2006 to 2013) (Statistics New Zealand, 2013). Those 65 and older continue to grow in number, from 12.3% in 2006 to 14.3% in 2013 (Statistics New Zealand, 2013). This is especially true for those aged 50-69, who saw a 21.5% increase in the 7 years between the 2006 and 2013 censuses, though all five-year age groups in the 50+ age range demonstrated a population increase (Statistics New Zealand, 2013). At the time of the 2013 census there were 607, 032 people in New Zealand over the age of 65; this group has doubled over the last 25 years and is projected to double again, to over a million people in the next 25 years (Statistics New Zealand, 2015).

To truly evaluate New Zealand's ageing population there are two considerations: how this group lives and the makeup of that group**.** Over two thirds (77%) of those over 65 live in private residences with half (51.1%) living in couple-only dwellings and a third (28.8%) living in a one-person home (Statistics New Zealand, 2015). Of those aged 65+, over a third (37.9%) are non-partnered, meaning they are widowed, are the surviving civil union partner or were never married (Statistics New Zealand, 2015). Māori (the indigenous peoples of New Zealand) account for 16.5% of the under 65 population, but amongst the over 65s this drops to 5.6% (Statistics New Zealand, 2015). The over 65 age-group is less ethnically diverse than younger groups; those who identify as European account for 87.8% of people according to the 2013 Census versus 71.7% in those under 65 (Statistics New Zealand, 2015). This disparity could be related to three factors other than lower life expectancy amongst Māori people; a

media campaign encouraging self-identification as New Zealander on the census, lower rates of Māori self-identification amongst ageing Māori and higher rates of identification with more than one ethnicity – more than half (53.5%) of the population that identified as Māori also identified as another ethnicity, with 48.9% also identifying as European (Statistics New Zealand, 2014). Though these factors mean that Māori-identifying people form a small proportion of the older adult population, the median age of this population group has increased from previous years, indicating that Māori are experiencing a shift towards older age in a manner similar to the total New Zealand population (Statistics New Zealand, 2015). Māori men's life expectancy at birth is 73.0 years and for women it is 77.1 years, falling short of the general New Zealand life expectancies and demonstrating the need to improve health related outcomes for Māori to positively impact life expectancy and reduce disparities and inequities (Salomon et al., 2013). In New Zealand, the total population's life expectancy is 79.5 for men and 83.2 for women; with female life expectancy greater than male life expectancy (Statistics New Zealand, 2015). This disparity often results in loss of a partner over a lifetime. In order to positively affect these differences in life expectancy, the intervention of the healthcare system is needed to keep individuals in full health. As the population ages, costs associated with preventative care and hospital admissions will increase in parallel. The healthcare and social assistance industries have expanded 19.6% since the 2006 census, representing the higher needs an older population has from the public healthcare system (Statistics New Zealand, 2013).

2.2 Health of older adults

With age come social, lifestyle and body composition changes. A common belief amongst older adults is that with age, weight changes, in particular weight loss, is natural and unavoidable (Tiggemann, 2004). Both weight and body mass index (BMI) show a decrease after the age of 60 (Donini et al., 2013). However, losing weight either intentionally or unintentionally is associated with increased mortality and morbidity (Alibhai et al., 2005). Prevalence of weight loss across the elderly age group is estimated to be approximately 27% in some studies, but much is un-reported as weight loss is either sought-after or unnoticed by many (Alibhai et al., 2005).

Involuntary weight loss can be caused by any number of factors, including disease state, appetite, social factors or psychological factors (Ahmed & Haboubi, 2010). However, issues arise when looking at weight loss statistics, which require either accurate measurement or recollection of weight, and also require an individual to recognize any weight changes. Weight loss must also be considered alongside the fact that many in the population experience an increase in weight throughout adulthood, which can be to an unhealthy point; meaning a loss may be seen as improving to overall health (Alibhai et al., 2005). This is however contradicted with the fact that extra weight in older age is protective (Miller & Wolfe, 2008). In older age it is important to maintain a healthy weight; while high rates of mortality are associated with high BMI measures, similarly high rates of mortality are also associated with low BMI measures; creating a J-shaped association (Ahmed & Haboubi, 2010).

To this end, the population's health loss (a measure of healthy life lost to early death, illness or disability) can be impacted through nutrition and diet (Ministry of Health, 2013b). DALYs (disability-adjusted life year) highlight the gap between an ideal population that is free from illness and disability, and the real picture (Ministry of Health, 2013b). One DALY is equal to one year (of healthy) life lost (Ministry of Health, 2013b). Alongside its population ageing, New Zealand is also experiencing a shift in the main cause of its health loss from mortality to morbidity, known as the disability transition (Ministry of Health, 2013b). New Zealanders may be living longer, but are doing so in ill-health. Dietary risks are the leading cause of the health loss experienced across New Zealand; diets low in fruit and vegetables contribute to 2.5% of DALYs, while other dietary factors are not a significant influence if considered on their own (Ministry of Health, 2013b). Overall, diet accounts for 9.4% of total health losses in New Zealand (Ministry of Health, 2013b). If dietary factors can be impacted through nutrition policies encouraging a healthy weight, health loss and morbidity associated with diet may be reduced.

2.3 Changes in body composition with age

All older adults experience a decline in muscle mass and a consequent loss in muscle strength (Goodpaster et al., 2006). Losses have been shown to be approximately 1%

per year in terms of leg muscle loss, but this statistic is marred by studies of low participant numbers and use of adults with functional ability (Goodpaster et al., 2006). In addition, loss of muscle strength may not only be related to muscle loss; approximately 5% of strength loss may be attributed to reduced muscle quality (Goodpaster et al., 2006). Muscle may become infiltrated by fat cells, further reducing muscle strength (Visser et al., 2005). Sarcopenia is the major physical change noted with age (Payette, 2005). This decline in muscle mass and strength is thought to be associated with age-related changes in hormones and tissue secretions, changes to protein intakes and metabolism and lack of muscle use, and has been linked to falls and disability (Morley, Anker, & von Haehling, 2014). Sarcopenia-related weight loss leading to an increased risk of falls, disability and institutionalisation is an independent predictor of early mortality, and it has been determined that approximately 35% of deaths amongst elderly populations may be postponed if a healthy weight is maintained (Payette, 2005). Sarcopenia-related weight loss can also increase the likelihood of an individual's admission to a care facility; a five kg loss can increase the chance of admission by 70% (Payette, 2005). To this end, preventing malnutrition may be an important solution to improve quality of life (reducing morbidity), prevent deaths (mortality) as well as reduce social care reliance and healthcare costs by keeping community-living older adults healthy and in their own homes longer.

2.4 Changing nutritional requirement with age

Overall food intake and energy requirements are reduced with increasing age (Winter, McNaughton, & Nowson, 2016). Dietary intakes may decrease by up to 1200kcal/day between the ages of 25 and 70, this may contribute not only to weight loss but also to protein and micronutrient deficiencies (Drewnowski, 2000). Ageing may also be associated with changing thirst, hunger and satiety sensations which means that older adults may get less enjoyment from food, leading to further restrictions in intake (Drewnowski & Evans, 2001). This anorexia of ageing can lead to diminished food intake, reduced muscle mass and lower metabolic rate, and frailty (Drewnowski & Evans, 2001). Overall the more malnourished an individual becomes, the higher the degree of frailty is noted (Boulos, Salameh, & Barberger-Gateau, 2016). Frailty is not defined as a specific state, it is a advancement to poorer

overall health where an individual has decreased reserves and immunological resistance, leading to an inability to stave off disease (Sutton et al., 2016). Older adults who reduce their intake and are unable to meet nutritional needs have an increased likelihood of frailty. Overall energy requirements are decreased with increased age, due to a reduction in energy required for metabolic processes (Ministry of Health, 2013a). However, many older adults still find it difficult to meet an adequate energy intake. The reduction in overall energy requirements with age is related to both basal metabolic rate (BMR) and physical activity (Ministry of Health, 2013a). BMR is postulated to decrease by 1-2% every decade alongside body composition changes, thus reducing energy requirements (Ministry of Health, 2013a). As older adults become less physically active with age due to various disease states or functional limitations, energy requirements will further decrease (Ministry of Health, 2013a). With reductions in overall intake it can become harder to meet micronutrient requirements, though it is recommended the average macronutrient distribution range (AMDR) in the diet should stay the same in terms of a percentage of total energy intake; protein 15-25%, carbohydrates 45-65% and fat 20-35% (Ministry of Health, 2013a) to meet micronutrient requirements.

2.3 Nutritional status of older adults in New Zealand

The nutritional status of New Zealand older adults was investigated in the 2008/2009 New Zealand Adult Nutrition Survey (NZANS), however data was aggregated over age 55 years for Māori and over 70 years for non-Māori populations (University of Otago & Ministry of Health, 2011). This survey used a 24-hour recall to determine dietary intake of individuals (University of Otago & Ministry of Health, 2011). The NZANS found that bread was the main energy source for most older adults in New Zealand; it was also a major source of protein and carbohydrate (Ministry of Health, 2013a). Median intakes of fibre for older men and women were below the estimated average requirement which suggests older people may need to consume more wholegrain cereals, legumes, fruit and vegetables alongside fluid intake for healthy gut function (Ministry of Health, 2013a). Fibre and fluid may relieve constipation, a common ailment of older adults who tend to be less physically active and who take multiple medications (Hsieh, 2005). Maintaining an adequate energy intake, even if based on a diet of carbohydrate-rich foods, can be protective of muscle mass, as

muscle may be used as an energy source in times of depleted energy intake. The NZANS found most older adults receive 15 to 16% of total energy from protein, at the lower end of the AMDR (Ministry of Health, 2013a). Meeting protein requirements is especially important to preserve muscle mass (Houston et al., 2008). Fat intake was noted to make up 31 to 33% of total energy intake; with most sources of fat in the diet from butter/margarine/spreads and meat (Ministry of Health, 2013a). Overall older adults in the NZANS showed a higher estimated prevalence of calcium, zinc, selenium, ribloflavin and vitamin B_6 deficiencies compared with younger age groups (Ministry of Health, 2013a). As micronutrient deficiencies tend to arise because of a reduction in food intake in response to a decline in energy needs with age, this highlights the importance of encouraging older adults to eat a wide variety of foods.

Adequacy of food intake of adults of advanced age has been reported from the Life and Living in Advanced Age: A Cohort Study in New Zealand (LiLACS NZ), a longitudinal study of ageing in New Zealand (NZ) (Wham et al., 2016a; Wham et al., 2016b). Using a repeat multiple-pass dietary recall (2x24 h recalls) among 216 Māori and 362 non-Māori from the Bay of Plenty and Rotorua regions of New Zealand this study demonstrated that for both ethnic groups median energy intakes were similar, percentage carbohydrate intakes were lower and percentage fat intakes higher compared with adults >70 years in the NZANS (Wham et al., 2016a). Calcium, magnesium and selenium were the micronutrients with the highest prevalence of low intake among this octogenarian population, which again highlights the need for educational efforts to focus on improving dietary variety (Wham et al., 2016b).

Efforts to improve the opportunity for older people to eat with others has been shown to improve dietary intake and may help to diminish nutrition-related health problems as a result (Donini et al., 2013; Locher, Robinson, Roth, Ritchie, & Burgio, 2005b). By improving the nutritional status of the older adult population, the population may live in better health, and a proportion of health expenditure may be able to be re-shuffled towards non-preventable health problems.

2.4 Malnutrition screening tools for use in the community setting

Screening for nutrition risk is a process which can identify factors related to nutritional status that could lead to malnutrition, thus acting as a preventative health measure. Validated nutrition screening tools provide a reliable method to identify those at high risk of malnutrition. Early identification and intervention can improve clinical outcomes and reduce healthcare use and spending; a Spanish study found over six months malnourished patients cost 47% more in terms of health expenditure (Martínez-Reig et al., 2017).

There are a variety of malnutrition screening tools available for use across different accommodation sectors; tools used should be able to both identify individuals at nutrition risk as well as identify those who are malnourished. In the community sector screening tools can be used to determine nutrition risk, for needs assessment, to advise dietetic intervention, and to prioritize resource use (Keller et al., 2005). Tools used should be easy to understand, quick to complete, acceptable to subjects, reliable, valid, and evidence based, as well as specific and sensitive (Elia, 2003; Keller et al., 2005; Rubenstein, Harker, Salvà, Guigoz, & Vellas, 2001).

From a systematic review, it was determined that the most appropriate tools to use in the community setting are the Mini Nutritional Assessment Short-form (MNA-SF), Malnutrition Universal Screening Tool (MUST) and Seniors in the Community Risk Evaluation for Eating and Nutrition (SCREEN II) (Phillips et al., 2010). Each of these tools is able to assess nutrition risk accurately; they have been validated and are thus accurate to dietetic or healthcare professional judgment of nutritional status (Phillips et al., 2010).

The MNA-SF assesses anthropometry, food security/access, and disease state in order to determine nutrition risk, has been cross-validated in different countries, and has internal consistency (Phillips et al., 2010). The MNA-SF has also been found to have the highest construct validity of ten malnutrition screening tools appropriate for use with older adults (Phillips et al., 2010). The MUST tool measures anthropometry and factors affecting food intake in assessing malnutrition risk (Elia, 2003). However, this tool was developed to note both under-nutrition and obesity; considering only weight based measures (BMI and change in weight) and dietary

intake, excluding food access, disease state and social factors; and requires a trained administrator (Elia, 2003).

2.4.1 The Seniors in the Community Risk Evaluation for Eating and Nutrition (SCREENII) screening tool

The Seniors in the Community Risk Evaluation for Eating and Nutrition (SCREENII) questionnaire has been developed specifically for use in the community setting, and can be self-administered (Keller et al., 2005). It identifies varying grades of nutrition risk, and opens up talks of preventative nutrition action in 'well subjects' (Keller et al., 2005). SCREENII is a 14-item questionnaire which examines anthropometry, dietary intake, factors affecting food intake, food security/access, and social factors in order to assess nutrition risk of individuals (Keller et al., 2005). It is scored from 0-64 with questionnaire items scored from 0-4, (Keller et al., 2005). Scores below 50 are deemed to be high risk for malnutrition, scores from 50-53 are moderate risk and scores 54 and higher are low risk (Keller et al., 2005). SCREEN II was developed specifically for use in community-living older adults (Keller et al., 2005). At a cut-off score of 50, 90% of those identified as at high nutrition risk will actually be at high nutrition risk (Keller et al., 2005). Of the community tools available, SCREEN II may be the most appropriate for use in a postal questionnaire amongst the New Zealand older adult population.

For a comparison of the malnutrition screening tools available for use in the community see Appendix 1 (Table 6).

2.4.2 The abbreviated version of Seniors in the Community Risk Evaluation for Eating and Nutrition (SCREENII-AB)

An abbreviated version of SCREENII was developed by Canadian dietitians with older adult nutrition expertise by ranking the 14 items for prediction of nutrition risk (Keller et al., 2005). Items that ranked the highest were included in a regression to predict nutrition risk, and the results of the regression created the abbreviated SCREENII (SCREENII-AB) (Keller et al., 2005). This shorter version of the SCREENII questionnaire contains 8 items; weight change, meal skipping, appetite, dysphagia, fruit and vegetable servings, fluid intake, meal sharing and meal

preparation (Keller et al., 2005). For SCREENII-AB each questionnaire item is scored between 0 and 8 (Keller et al., 2005). The maximum score is 48, a score of less than 38 is indicative of nutrition risk, with scores of 38 and above indicating an individual is not at nutrition risk (Keller et al., 2005).

2.4.3 Validation of the abbreviated version of Seniors in the Community Risk Evaluation for Eating and Nutrition (SCREENII-AB)

Both the original 14-item SCREENII and 8 item SCREENII-AB questionnaires can reliably determine individuals who require nutrition intervention before the involvement of specialist healthcare professionals (Keller et al., 2005). Questionnaire validation was undertaken in comparison to a dietitian's assessment of an individual's nutrition risk amongst 193 seniors aged 55+ recruited from a geriatrician's clinic (Keller et al., 2005). As part of the dietitian nutritional risk rating, three day 24-hour multiple pass recalls (MPRs) were undertaken alongside anthropometric, biochemical and relevant medical information to assess nutrition risk status (Keller et al., 2005). The research dietitian scored each individual's assessment between one to ten with one being low nutrition risk and ten being high nutrition risk (Keller et al., 2005). Scores from the dietitian assessment were compared to those determined by the SCREENII questionnaire as well as the SCREENII-AB. Scoring of the questionnaires were found to be significantly correlated to the dietitian assessment (Keller et al., 2005).

SCREENII and the SCREENII-AB have also been validated for re-test reliability, whereby 49 of the above-mentioned seniors and an additional 100 seniors were assessed firstly in-person and secondly with a follow-up postal assessment (Keller et al., 2005). This determined the ability of the SCREENII questionnaire (full and abbreviated versions) to score the same individual at different times assuming circumstances remained similar (Keller et al., 2005). SCREENII was then evaluated amongst 97 older adults for inter-rater reliability. Seniors responded to the questionnaire in a face to face interview and over the phone (different interviewer) each time to determine the ability of the questionnaire to be used repeatedly by different interviewers (Keller et al., 2005). This test and retest reliability study found that the full and abbreviated SCREENII were both significant and highly correlated

(Keller et al., 2005). The inter-rater reliability analyses, meaning the ability of the SCREENII questions to result in the same score with different interviewers, showed adequate correlations (Keller et al., 2005). Overall this research demonstrates the usefulness of SCREENII-AB in determining nutrition risk amongst community-living older adults, providing an easy to administer screening tool which is both accurate and reliable.

2.5 Malnutrition risk in older adults in New Zealand

Using the Seniors in the Community Risk Evaluation for Eating and Nutrition (SCREENII), several studies have investigated the prevalence of malnutrition risk amongst community-living older adults in New Zealand (Appendix 2, Table 7). On the whole most studies found at least a quarter of participants were at high nutrition risk, with similar numbers at nutrition risk (McElnay et al., 2012; Watson et al., 2010; Wham et al., 2014a; Wham et al., 2014b; Wham et al., 2015b; Wham et al., 2011c). Using SCREEN II a study of 152 older adults over the age of 70 in Christchurch found 23% of participants to be at nutrition risk with another 31% at high nutrition risk (Watson et al., 2010). The mean age of participants in this study was 79.5 years, and suggests this study may not be representative of nutrition risk prevalence in younger older adults (Watson et al., 2010). In the feasibility study of Life and Living in Advanced Age: Cohort Study in New Zealand (LiLACS NZ) which recruited participants from three locations across the North Island of New Zealand (Māori aged 75+, and non-Māori 85+ years), over half (52%) of the participants were found to be at nutrition risk (Wham et al., 2011c). Furthermore, in a study of 473 older adults living in the Hawkes Bay 23.7% were at risk with a further 32.8% at high nutrition risk (McElnay et al., 2012). Within LiLACs NZ, the baseline study which engaged 937 octogenarians (421 Māori, and 516 non-Māori) found 49.4% of Māori participants and 38.3% of non-Māori participants were at high nutrition risk (Wham et al., 2015b). Overall these New Zealand studies suggest there is a high prevalence of nutrition risk among adults of advanced age. The current study will add to this body of knowledge by an investigation of nutrition risk across a wide age range and in a large sample of community-living older adults with diverse health and social characteristics.

2.6 Factors affecting nutritional status of older adults

2.6.1 Perceived health and wellbeing

Successful ageing can be affected by both health and social factors. However, it is also important to consider how people feel, and how they rate their own ageing, as this may impact how an older adult eats. Self-perception of health with ageing is important to consider, including both the perception of the usefulness of taking an action (e.g. preventative care) and the importance of maintaining good health in respect to prolonging life (i.e. the desire to continue living in full health). Health and functional capabilities are not the only influence on ageing with success; stability, appreciation, relevance and support are important considerations (Hörder, Frändin, & Larsson, 2013). The usefulness of preventative action, for example good nutrition and its link to good health, alongside the desire of older adults to act preventatively in terms of their health is important to understand (Levy & Myers, 2004). A Spanish study determined that self-perception of health was one of the two main predictors of nutrition risk (Ruiz-López et al., 2003). Self-rated health measures can also be used to determine how an older adult views their own ageing. In LiLACS NZ a lower health related quality of life was independently associated with high nutrition risk in non-Māori octogenarians (Wham et al., 2015b) . If an individual rates their health quality of life as low, they may lack interest in maintaining/improving health. However, self-rated health does not present the full picture of how an older adult may be ageing; we must also consider a true count of disease burden. Total health conditions and medication may also be used to determine health status. Amongst a group of 3,480 older adults aged 75+ in New Zealand, health status (as determined by both medication use and functional ability) was shown to independently predict nutrition risk (Wham et al., 2014a). In particular cardiovascular disease and diabetes were shown to predict nutrition risk (Wham et al., 2014a). Considering how an older adult is burdened with disease as well as how the individual feels about this are vital to consider for perception of health. In order to positively influence quality of life for older adults, as well as reduce nutrition risk, consideration of what older adults believe they need to age successfully is needed**.** Looking at self-perception of value through life satisfaction ratings may lead to recognition of areas for intervention in order to reduce the incidence of malnutrition in older adults. Life satisfaction is

important to consider, and to date no study has considered this particular aspect of perceived health and wellbeing in relation to nutrition risk in New Zealand.

2.6.2 Social support, participation and engagement

To be healthy throughout all life stages, public health messages encourage involvement in community and social activities (Hodge, English, Giles, & Flicker, 2013). Older adults who are isolated socially are more likely to be malnourished (Hickson, 2006). Differences in energy intake can be seen between older adults who are married and those who are widowed or divorced (Hickson, 2006). Those who are married skip fewer meals, suggesting that marriage may confer a nutritional benefit to health (Locher et al., 2005a). Those who become widowed, especially older males who may be inexperienced in both shopping for and cooking food, are more at risk nutritionally (Locher et al., 2005a). This can be seen in the New Zealand context; where eating alone was recognised as a risk factor contributing to increased nutrition risk amongst Māori participants in the Hawkes Bay (McElnay et al., 2012). Living alone was subsequently noted to be a risk factor for nutrition risk in two further studies. Wham et al. (2014a) found living alone to be a nutrition risk factor for the entire population, whereas Wham et al. (2015b) found living alone to only be associated with nutrition risk amongst non-Māori participants.

Living alone is not the only way an individual may be socially isolated. The sense of community offered through neighbourhoods and the feeling of safety within a neighborhood can all contribute to social network building. An area with abundant supports (neighbours, family, friends) for an individual can be very advantageous, as these people may be able to be called upon for assistance with both shopping and meal preparation (Locher et al., 2005a). Those who spend time either with relatives, in the community, or have a locally based support-system are more likely to age successfully (Hodge et al., 2013). While neighborhoods can be an opportunity for social networking and a source of positive health messages and nutrition support, some people do not see their communities this way. Those who do not get to choose where they live may not reap the benefits of their community and they may self-isolate (Locher et al., 2005a). Fear of community may further restrict movement of older adults within the community; older women in particular often fear victimisation

(Locher et al., 2005a). Those who do not involve themselves in their communities may miss out on the benefits available to them. In this respect lack of community involvement may contribute to nutrition risk. Those who feel isolated may not prioritize their health and as a result may not see the importance in ensuring adequate nutrition, nor have the means to procure foods that are nutritious and safe.

Within the wider community, there can be sub-communities such as religious communities or veterans' services which may increase social network opportunities. Studies in the USA have found these services are especially important in terms of nutritional support as it is not uncommon to eat together as part of a social event (Locher et al., 2005a). This is achieved by encouraging food consumption on the days of events, as well as offering support that individuals may call upon for assistance (Hickson, 2006). Older adults' use of such services may encourage better nutrition status through involvement in events where food may be provided, as well as offering a social network for individuals to rely on should they require assistance with food procurement or assembly. It can be postulated that those involved with marae, religious groups or returned service organisations may have a better nutritional status than less-involved counterparts. This may mean that those of Māori descent are less likely to be at nutrition risk based on cultural social supports available.

However, in the New Zealand context, Māori participants have been noted to be at higher nutrition risk than their non-Māori counterparts (McElnay et al., 2012; Wham et al., 2015b). Risk factors for malnutrition noted amongst Māori include lower levels of education, being of a younger age, low vegetable intake, skipping meals, living alone, and being a woman (McElnay et al., 2012; Wham et al., 2015b). However, these pieces of research, do not consider social factors other than marital status and depression, e.g. marae supports, or the quality of such supports and the effect of these on nutrition risk.

2.6.3 Loneliness

Depression is the major cause of weight loss; bereavement and depression are common amongst the aged and are known to be main contributors to malnutrition in

the older adult group (Hickson, 2006). Depression amongst the aged is linked to age-related losses of social networks, and increased loneliness (Singh & Misra, 2009). Loneliness is not however guaranteed by loss of a partner or social network, as some obligatory relationships provide less enjoyment and there may even be a sense of relief with someone's death (Singh & Misra, 2009). In addition, with age, the social connections that support an individual will decrease and social activity decreases, to the point where loneliness begins to feel natural (Singh & Misra, 2009). Loneliness is a major contributor to depression and depressive symptoms in older adults, and a passive attitude or lack of interest (manifestations of depression) lead to feelings of futility in terms of nutrition, causing a drop in nutritional status (Donini et al., 2013; Singh & Misra, 2009). In the New Zealand context, living alone and depression were noted to increase nutrition risk by Wham et al. (2014a) in both Māori and non-Māori participants. Similarly, in the LiLACS NZ study living alone and depression were again noted to increase an individual's nutrition risk, but only amongst non-Māori individuals (Wham et al., 2015b).

Loneliness is multifaceted and does not necessarily depend on an individual living alone or being a widow(er). Loneliness can be broken down into two distinct sub-categories: social and emotional loneliness. Social loneliness addresses the involvement of an individual in a social network (DiTommaso & Spinner, 1993), whereas emotional loneliness addresses the quality of relationships; a person may have abundant social supports but can still feel alone (DiTommaso & Spinner, 1993). Emotional loneliness has yet to be investigated in relation to nutrition risk among older adults. There are also difficulties identifying low mood amongst older adults clinically; healthcare professionals may miss symptoms or interpret them differently (Saka, Kaya, Ozturk, Erten, & Karan, 2010). If low mood symptoms are undetected, nutrition risk may worsen, which is a cause for concern if we wish for older adults to stay in their own homes longer. If unable to adequately self-nourish, older adults may require institutionalisation or hospitalisation, requiring more funding to be directed to the healthcare and assisted-living sectors.

2.6.4 Alcohol Consumption

While most public health messages are for reductions in alcohol intake, in the older adult population this message may not require adherence. A study of those aged over 70 in Melbourne, Australia found trends for successful ageing in parallel with alcohol intake (Hodge et al., 2013). This is in line with English research in adults over 50, which demonstrated that those who had one to two drinks a day exhibited fewer symptoms associated with depression than those having less than one drink a day (Lang, Wallace, Huppert, & Melzer, 2007). Those who abstained from drinking alcohol were found to exhibit the most symptoms associated with depression and had the lowest levels of wellbeing (Lang et al., 2007). On the other hand, some studies have considered binge-drinking consumption of alcohol (more than nine drinks in a single day and found the risk of malnutrition greatly increased with increased daily alcohol consumption (McCaul et al., 2010). However, the incidence of binge drinking is low in older adults compared to younger age groups (Serdula, Brewer, Gillespie, Denny, & Mokdad, 2004). True intakes amongst the population are likely to be higher than reported as under-reporting is common, so the true benefit according to consumption may be inaccurately estimated (Serdula et al., 2004). In order to obtain a true picture as to the role of alcohol consumption in health in the older adult population, other factors require controlling, e.g. socioeconomic status (Towers, Philipp, Dulin, & Allen, 2016). Emerging research demonstrates that the beneficial relationship between alcohol consumption and health may be false, as the health benefit of alcohol consumption disappears when controlling for socioeconomic status (Towers et al., 2016). As such, the proposed health benefits associated with alcohol may simply be a benefit conferred from being of a higher socioeconomic status and may not have an impact on nutrition risk.

2.6.5 Lack of Mobility

Transportation contributes to social fluidity; it physically allows an individual to participate in the community and access resources available to them (Locher et al., 2005a). The ability of an individual to move about their community contributes to their social insertion. Those with impaired mobility are restricted in the activities they may be able to join in on and the supports they can access, as well as influencing the ability of the individual to prepare foods, thus altering food use. Limited access to a car or not being able to drive can reduce wellbeing and is a predictor of nutrition

risk amongst this group (Burns, Bentley, Thornton, & Kavanagh, 2011). Research also shows lack of access to a vehicle or inability to drive impacts older adult males more than older adult females; as women tend to have larger social networks and be more home-based, as well as be used to not being a driver (Davey, 2007). Men can find loss of transport ability demeaning, leading to feelings of inadequacy and depression (Davey, 2007). However, women may have higher needs in terms of car use with women more likely to experience co-morbidities and require more healthcare (Davey, 2007). Women are also generally more likely to be malnourished with age, and with limited access to transport this may worsen. In order to positively impact nutritional status in older adults, access to vehicles or access to communities where mobility is not an issue may be key. The option to procure foods (not requiring preparation) from food outlets within a community may positively influence nutritional status in the aged, and so the layout of a community can impact nutritional status. Those living rurally must rely on home cooked foods, as there may be no other options close by, and are thus at a higher risk for malnutrition, as their preparation ability may be affected by any number of problems (Locher et al., 2005a).

The Health, Work and Retirement Study (HWR) 2014 seeks to explore the relationship between nutrition risk and a variety of social factors across a wide participant base covering the whole of New Zealand. Nutrition risk and its relation to gender, marital status, age, education level, household composition, residence type and ethnicity, will be evaluated in order to understand the makeup of the population that is at nutrition risk in New Zealand. Nutrition risk is then to be evaluated against loneliness, social participation and engagement, participant perception of ageing, mobility, and health behaviours (including alcohol consumption, smoking and illness burden) to determine the significant independent predictors for nutrition risk.

Chapter 3: Research Manuscript

NUTRITION RISK PREVALENCE AND ASSOCIATED RISK FACTORS: RESULTS FROM THE 2014 HEALTH, WORK AND RETIREMENT STUDY

M.T. TKATCH, A.J. TOWERS, C.A. WHAM,
Corresponding Author: C. Wham, School of Sport, Exercise and Nutrition, College of Health, Massey University, Albany Campus, Private Bag 102904, North Shore Mail Centre, Auckland 105, New Zealand. Email: c.a.wham@massey.ac.nz

Abstract: *Objectives:* To determine the prevalence of nutrition risk and associated social risk factors amongst community-living Māori and non-Māori older adults in New Zealand. *Design:* A cross-sectional analysis of the 2014 HWR cohort. *Setting:* New Zealand. *Participants:* 2914 adults aged 49-87. *Measurements:* Nutrition risk was assessed using the validated Seniors in the Community: Risk Evaluation for Eating and Nutrition, abbreviated version (SCREENII-AB) sent by postal survey. Other measures including demographic, social and health characteristics were included. Social provisions were determined with the 24-item Social Provisions Scale, and social and emotional loneliness were assessed with the 6-item De Jong Gierveld Loneliness Scale. Alcohol intake was determined by using the Alcohol Use Disorders Identification Test (AUDIT-C), and living standards assessed with the Economic Living Standards Index Short Form (ELSI-SF). *Results:* 37.2% of participants were found to be at nutrition risk (SCREENII-AB score <38). Half (51.2%) of Māori participants were at nutritional risk compared to a third (32.7%) of non-Māori. Independent risk factors for Māori were being un-partnered and rating general health as fair. Independent risk factors for non-Māori were being un-partnered, rating general health as fair or poor, life satisfaction, as well as increased total health conditions counts, and emotional loneliness. *Conclusion:* Being un-partnered is an independent risk factor for both Māori and non-Māori, suggesting that social eating is required to improve nutrition risk amongst older adults. Those who are un-partnered are a key identifiable group who would benefit from a strategy that encourages older adults to eat with others. Māori are also a key group who may require intervention as this research suggests they are at higher nutrition risk than non-Māori.

Key words: Nutrition risk, SCREENII-AB, New Zealand, older adults, community.

Introduction

As per other developed nations worldwide, New Zealand (NZ) is experiencing population ageing (United Nations Department of Economic and Social Affairs Population Division, 2013). The population aged 65 and over has doubled in the last 25 years, to over 600 000 at the time of the 2013 Census (Statistics New Zealand, 2015). This group is projected to again double in the next 25 years, to over a million people (Statistics New Zealand, 2015).

This population is vulnerable in terms of nutrition status; they are more likely to be at nutrition risk and become malnourished (Donini et al., 2013). Older age is associated with reductions in intake, which may seem inevitable, for various functional, economic or social reasons.

While it is understood that adequate nutrition is important for health, most older adults acknowledge a reduction in their overall intake with increasing age (Winter et al., 2016). Both weight and body mass index (BMI) show a decrease after the age of 60, which is associated with increased mortality (Ahmed & Haboubi, 2010; Donini et al., 2013). If dietary factors can be impacted through nutrition policies encouraging a healthy weight, health loss and morbidity associated with diet may be reduced.

Use of a validated nutrition screening tool allows for identification of those at risk of malnutrition. The Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREENII) questionnaire was developed in Canada specifically for use in the community, and can be self-administered (Keller et al., 2005). From the SCREENII, an abbreviated version (SCREENII-AB) was developed by Canadian dietitians with older adult nutrition expertise who reviewed the original SCREENII questionnaire and ranked the items for prediction of nutrition risk (Keller et al., 2005). SCREENII-AB is a shorter questionnaire, but still touches on weight change, meal skipping, appetite, dysphagia, fruit and vegetable servings, fluid intake, meal sharing and meal preparation (Keller et al., 2005).

Several studies have investigated the prevalence of nutrition risk amongst community-living older adults in New Zealand with the SCREENII. These studies

found at least half of the population to be at some nutrition risk (approximately a quarter at risk, and a quarter at high risk) (McElnay et al., 2012; Watson et al., 2010; Wham et al., 2014a; Wham et al., 2014b; Wham et al., 2015b; Wham et al., 2011c). The aim of this paper is to determine the prevalence of and risk factors contributing to increased nutrition risk amongst community-living older adults in New Zealand.

Methods

Study Design

This study is a cross-sectional analysis of data from the 2014 collection of the Health, Work & Retirement Longitudinal Study (HWR). The HWR was established in 2006 and is a government-funded longitudinal study of the determinants of healthy ageing in older New Zealanders. Using a postal survey, the 2014 HWR questionnaire explored how health, wealth and social needs impact on successful ageing (Towers, Stevenson, Breheny, & Allen, 2015). A nutrition screening tool was included in the 2014 questionnaire to evaluate nutrition risk and associated risk factors. The aim of this study was to explore the relationship between quality of life, engagement, mental well-being, health behaviours and nutrition risk in older New Zealanders.

Participant Recruitment

At baseline, New Zealand adults aged between 55 to 70 years were selected from the electoral roll in 2006 using equal probability random sampling (Towers et al., 2015). The first sample of the electoral roll provided a participant pool of 13,040, which was reduced to 12,489 once ineligible individuals were removed from the sample; ineligibility was determined by inability to be contacted, institutionalisation or being deceased (Towers et al., 2015). Of the eligible participants, 6,657 responded to the baseline survey (2006) and approximately 3,200 participated in the follow-up survey (Towers et al., 2015). In subsequent follow-ups (2008, 2010, 2012 and 2014), additional recruitment was undertaken to expand the participant age range and to ensure the longitudinal study remained representative of the gender and ethnic breakdown of the New Zealand population aged 50+ (Towers et al., 2015). Additional recruitment was achieved through the same methods as the initial recruitment – an equal probability random sampling of the New Zealand Electoral Roll, which resulted in an expanded age range (49-87) in 2014.

Recruitment of Māori participants was based on the Māori-descent indicator on the electoral roll, and Māori were over-sampled in order to increase the chances of recruiting a sample representative of the population. Oversampling of Māori in the population is needed to facilitate meaningful assessments as the study focuses on the different experiences between Māori and non-Māori during ageing (Towers et al., 2015). The total number of respondents to the HWR 2014 data collection (both longitudinal participants and new recruits) was 3,050. Of 3,050 eligible participants a total of 2,914 completed the nutrition screening questionnaire with 136 excluded due to missing questionnaire items.

Ethical statement

The HWR 2014 data collection wave was approved by the Massey University Human Ethics Committee (MUHEC) as a Low-Risk Research Project using quality assured techniques already approved in previous HWR data collection waves. Specifically, the 2014 data collection re-surveyed an existing core sample and selected new participants using a sample framework that had received approval in prior MUHEC evaluations (HEC PN-05/90; HEC Southern A–09/17; HEC Southern B-10/43; HEC Southern B-13/30).

Measures

Demographic characteristics: Participant age was identified through self-report of birth date. Key sociodemographic characteristics were categorised as follows based on response to survey questions: gender (male/female), Māori ancestry (Māori/non-Māori), marital status (partnered/not), education qualifications (none/secondary/post-secondary), household composition (living alone/with others), and residential description (Standalone or detached/Joined to one or more other household/Unit-or-villa in a Retirement village/Other including moveable dwelling, or rest home).

Health: Participant perceptions of their health status were assessed on response to a 5-point Likert scale (1='Poor' and 5='Excellent') to the single item 'In general would you say your health is…'. A 'Total health conditions' scale was also derived based on participant indications that they had been diagnosed by a health professional as

having any of 12 conditions (e.g., diabetes, heart trouble, high blood pressure). Past year hospital admission was assessed using dichotomous response (Yes/No) to the question 'In the last 12 months have you used a service at, or been admitted to, a hospital?'. Participant drinking was assessed using the WHO Alcohol Use Disorders Identification Test – Consumption sub-scale (AUDIT-C): (Bush, Kivlahan, McDonell, Fihn, & Bradley, 1998) with an added item 'Have you ever drunk alcohol in the past?' helping distinguish two non-drinking groups: non-drinkers with a history of consumption, and lifetime non-drinkers. Drinking-related classifications were thus: lifetime abstainer, current non-drinker, light drinker (AUDIT-C score: 0-3), moderate drinker (AUDIT-C score: 4-7), and heavy drinker (AUDIT-C score: 8-12). Participant smoking status (non-smoker or smoker) was identified through a single item assessing regularity of current smoking.

Socioeconomic status: Participant 'life satisfaction' was assessed based on a 5-point Likert scale (1 'Very dissatisfied' to 5 'Very satisfied') in response to the single item "All things considered, how satisfied are you with your life as a whole these days?" (Inglehart, Basáñez, Díez-Medrano, Halman, & Luijkx, 2004). Participants' self-perception of their own 'successful ageing' was assessed with the question "How successfully do you consider yourself to be ageing?" which was also assessed on a 5 point Likert Scale (1 'Extremely unsuccessfully' to 5 'Extremely successfully'). Social and emotional loneliness were assessed with the representative sub-scales on the 6-item De Jong Gierveld Loneliness Scale (Gierveld & Tilburg, 2006). Responses (Yes/No) to the item 'Do you currently drive?' were used to identify participant access to community mobility. Participants' overall score on the 24-item Social Provisions Scale (Cutrona, Russell, & Rose, 1986) was used to assess the existence of meaningful social connectedness. Participant economic living standard was assessed using the Economic Living Standards Index-Short Form (ELSI-SF) (Jensen, Spittal, & Krishnan, 2005). Using 25 items it assesses participants' self-reports of restrictions in material ownership, social participation, and economising. The resulting scale score was categorised into three groups reflecting broad living standard for analysis: hardship/comfortable/good.

Nutrition: Participant nutrition status was assessed using the abbreviated Seniors in the Community Risk Evaluation for Eating and Nutrition questionnaire (SCREENII-

AB (Keller et al., 2005). The SCREENII-AB is an 8-item version of the 14-item SCREENII which was developed specifically for use amongst community-living older adults and can be self-administered (Keller et al., 2005). The SCREENII-AB questionnaire examines weight change, meal skipping, appetite, dysphagia, fruit and vegetable servings, fluid intake, meal sharing and meal preparation (Keller et al., 2005). Each item is scored between 0-8 with an overall scale score ranging from 0-48, scores below and equal to 38 are indicative of nutrition risk and scores above 38 deem an individual not at risk (Keller et al., 2005).

Statistical analysis

IBM SPSS statistics (v21 for Mac) was used to analyse the data. Descriptive statistics were used to describe the following variables: age group, gender, ethnicity, relationship status and retirement status (Table 1). Nutrition risk (SCREENII) was categorized as not at risk (>38), and at risk (≤38). Prior to the final regression analysis multicollinearity was assessed using Pearson's 'r', and between categorical variables by using Kendall's tau-b, with correlations approximating 0.7 identified as reflecting 'collinearity'. The results indicated that no multicollinearity was present between any of the predictor variables. Subsequent to multicollinearity checks the two nutrition risk groups were compared on each of the predictor variables to ascertain whether between-groups differences existed. Univariate analysis (Tables 2, 3 and 4) assessed each postulated risk factor for its impact on nutrition risk: age, total health conditions, social and emotional loneliness, social provisions, gender, marital status, educational qualifications, residence type, mobility, ELSI, hospitalisations, general health, alcohol use, smoking status, life satisfaction, and successful ageing. Significant results ($p<0.05$) for each predictor were used as the basis for inclusion in the subsequent logistic regression to identify the critical predictors of nutrition risk (Table 5).

Results

From a total of 3050 participants who completed the 2014 HWR questionnaire, the SCREEN II tool was completed by 2914 participants, with missing data for 136 participants for one or more of the SCREENII questionnaire items. Of the 2914 participants (1312 men and 1602 women) the age range was 49 to 87 years. 749 were

Māori with a mean age of 67 (SD 6) years and 2165 were non-Māori with a mean age of 65 (SD 6) years. Approximately half of the participants (49.5%) were aged between 49 to 64 years and 50.5% were aged between 65 to 87 years. The majority (73.4%) of the participants were partnered (including married/civil union/de facto/partnered relationships). Non-Māori (57.9%) were more likely to hold a post-secondary qualification (university degree or post-secondary certificate, diploma, or trade diploma) than Māori participants (43.7%). Most participants (80.5%) lived in a household with another person: either a partner, child(ren), grandchild(ren), flatmate or boarder and most (86.7%) lived in a standalone or detached house or townhouse.

Nutrition risk

Overall 37.2% of the participants were at nutritional risk (SCREEN II-AB score ≤38). The mean SCREEN II-AB score was 38.7 SD 6.4 (range 6-48, out of a maximum of 48). Half (51.2%) of Māori participants were at nutritional risk compared to a third (32.7%) of non-Māori. An overview of the participants' sociodemographic characteristics and nutrition risk status for Māori and non-Māori is provided in Table 1.

Table 1: Participants' sociodemographic characteristics and nutrition risk status

	Total sample			Māori			Non Māori		
	All n = 2914	**Men n = 1312**	**Women n = 1602**	**All n = 749**	**Men n = 322**	**Women n = 427**	**All n = 2165**	**Men n = 990**	**Women n = 1175**
Age (49-87) years ŧ	66 (6)	66 (6)	65 (6)	67 (6)	67 (6)	67 (6)	65 (6)	66 (6)	65 (6)
Relationship status									
Partnered	2123 (74.3%)	1063 (82.3%)	1060 (67.7%)	476 (65.4%)	232 (73.7%)	244 (59.1%)	1647 (77.4%)	831 (85.1)	816 (70.8%)
Un- partnered	733 (25.7%)	228 (17.7%)	505 (32.3%)	252 (34.6%)	83 (26.3%)	169 (40.9%)	481 (22.6%)	145 (14.9%)	336 (29.2%)
Educational qualifications									
No qualifications	653 (22.9%)	300 (23.3%)	353 (22.6%)	244 (33.5%)	116 (36.8%)	128 (31.0%)	409 (19.3%)	184 (18.9%)	225 (19.5%)
Secondary school qualifications	651 (22.8%)	253 (19.7%)	398 (35.4%)	166 (22.8%)	67 (21.3%)	99 (24.0%)	485 (22.8%)	186 (19.1%)	299 (26.0%)
Post secondary qualification	1548 (54.3%)	734 (57.0%)	814 (52.0%)	318 (43.7%)	132 (41.9%)	186 (45.0%)	1230 (57.9%)	602 (61.9%)	628 (54.5%)
Household composition									
Living alone	546 (19.1%)	173 (13.4%)	373 (23.8%)	181 (24.7%)	63 (20.0%)	118 (28.2%)	365 (17.2%)	110 (11.3%)	255 (22.2%)
Living with others	2315 (80.9%)	1118 (86.6%)	1197 (76.2%)	553 (75.3%)	252 (80.0%)	301 (71.8%)	1762 (82.8%)	866 (88.7%)	896 (77.8%)
Residence type									
House/townhouse (detached)	2459 (86.7%)	1120 (87.8%)	1339 (85.8%)	580 (81.6%)	251 (81.8%)	329 (81.4%)	1879 (88.5%)	869 (89.8%)	1010 (87.4%)
House/townhouse (semi-detached/terraced)	260 (9.2%)	107 (8.4%)	153 (9.8%)	93 (13.1%)	39 (12.7%)	54 (13.4%)	167 (7.9%)	68 (7.0%)	99 (8.6%)
Unit in a Retirement village	43 (1.5%)	16 (1.3%)	27 (1.7%)	11 (1.5%)	3 (1.0%)	8 (2.0%)	32 (1.5%)	13 (1.3%)	19 (1.6%)
Other	73 (2.6%)	32 (2.5%)	41 (2.6%)	27 (3.8%)	14 (4.6%)	13 (3.2%)	46 (2.2%)	18 (1.9%)	28 (2.4%)
Nutritional risk									
Not at risk: SCREENII-AB≥38	1830 (62.8%)	860 (65.5%)	970 (60.5%)	373 (49.8%)	166 (51.6%)	207 (48.5%)	1457 (67.3%)	694 (70.1%)	763 (64.9%)
At risk: SCREENII-AB<38	1084 (37.2%)	452 (34.5%)	632 (39.5%)	376 (50.2%)	156 (48.4%)	220 (51.5%)	708 (32.7%)	296 (29.9%)	412 (35.1%)
Total	2914 (100.0%)	1312 (100.0%)	1602 (100.0%)	749 (100.0%)	322 (100.0%)	427 (100.0%)	2165 (100.0%)	990 (100.0%)	1175 (100.0%)

Values are count (percent); ŧ mean (standard deviation); Missing data: Percentages may not always add up to 100% for each column as there is missing data for approximately 7% of subjects across various questions/sub sections within the 2014 HWR questionnaire

Table 2 shows that for both Māori and non-Māori, those at nutritional risk are likely to have more health conditions, experience more social and emotional loneliness, and have fewer social supports than those not at nutritional risk.

Table 2: The association between participant nutritional risk status and age, health and social factors for Māori and non-Māori.

	SCREENII-AB Categorization		Test for Group Differences	
	Not at risk (SCREENII-AB≥38) n = 1830 (62.8%)	**At risk (SCREENII-AB<38) n = 1084 (37.2%)**	**t (df)**	***d***
Age:				
Māori	67.32 (5.78)	66.80 (5.96)	1.21 (747)	0.09
Non-Māori	65.22 (6.38)	64.79 (6.58)	1.45 (2163)	0.07
Total health conditions				
Māori	2.34 (1.43)	3.14 (1.88)	-6.18 (626.99) ***	0.48
Non-Māori	2.09 (1.20)	2.70 (1.64)	-7.95 (955.15) ***	0.44
Social Loneliness				
Māori	0.92 (1.13)	1.43 (1.25)	-5.80 (715.62) ***	0.43
Non-Māori	1.09 (1.16)	1.46 (1.24)	-6.50 (1269.95)***	0.31
Emotional Loneliness				
Māori	0.54 (0.71)	0.89 (1.02)	-5.34 (645.73) ***	0.40
Non-Māori	0.49 (0.77)	0.98 (1.04)	-6.50 (1269.95) ***	0.57
Social provisions				
Māori	81.67 (8.88)	75.32 (10.26)	8.89 (721) ***	0.66
Non-Māori	81.26 (9.23)	75.77 (10.50)	11.71 (1208.50) ***	0.57

* p<.05; **p<.01; ***p<.001
Significant differences between the 2 nutritional risk groups as determined by Independent samples t-Test (2-tailed)
Cohen's *d* values around 0.2 indicate a small effect size, values around 0.5 indicate a medium effect size, and values around 0.8 indicate a large effect size.
SCREEN II-AB, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, abbreviated. Total Health Conditions, higher score indicates higher number of co-morbidities (maximum of 12). Social Loneliness, higher score indicates more social loneliness. Emotional loneliness, higher score indicates more emotional loneliness. Social provisions, higher score indicates more provisions.

Table 3 reports the demographic and lifestyle characteristics of the Māori participants by nutrition risk status. Those at nutritional risk tended to be un-partnered, have lower educational qualifications, were less likely to live in a detached/standalone property, and less likely to drive, more likely to be experiencing hardship (ELSI score), more likely to have been hospitalised in the past 12 months, be in poorer health, more likely to drink, smoke and rate their experience of ageing poorly (appear more dissatisfied with life and believe themselves to be more unsuccessfully ageing). Most of the effects seen are moderate.

Table 3: Association between nutrition risk and participants demographic and lifestyle characteristics for Māori

	SCREENII-AB Categorization	Test for group difference

	Not at risk (SCREENIIAB≥38) n = 373 (49.8%)	At risk (SCREENIIAB<38) n = 376 (50.2%)	χ^2 (df)	ϕ
Gender				
Men	166 (51.6%)	156 (48.4%)	0.69 (1)	0.03
Women	207 (48.5%)	220 (51.5%)		
Marital status				
Partnered	273 (57.4%)	203 (42.6%)	32.00 (1)***	0.21
Un-partnered	89 (35.3%)	163 (64.7%)		
Educational qualifications				
No qualifications	107 (43.9%)	137 (56.1%)	10.36 (2)**	0.12
Secondary school qualifications	78 (47.0%)	88 (53.0%)		
Post secondary qualification	181 (56.9%)	137 (43.1%)		
Residence type				
House/townhouse (detached)	304 (52.4%)	276 (47.6%)	9.03 (3)*	0.11
House/townhouse (semi-detached/terraced)	38 (40.9%)	55 (59.1%)		
Unit/villa in a Retirement village	6 (54.5%)	5 (45.5%)		
Other	8 (29.6%)	19 (70.4%)		
Currently drive				
Yes	341 (51.8%)	317 (48.2%)	7.41 (1)**	0.10
No	29 (35.8%)	52 (64.2%)		
ELSI				
Hardship	17 (18.9%)	73 (81.1%)	61.61(2)***	0.30
Comfortable	84 (44.0%)	107 (56.0%)		
Good	241 (62.6%)	144 (37.4%)		
Hospitalisations in last 12 months				
No	228 (54.9%)	187 (45.1%)	12.11 (1)**	0.13
Yes	128 (41.8%)	178 (58.2%)		
General health				
Poor	3 (14.3%)	18 (85.7%)	77.58 (4)***	0.32
Fair	18 (20.7%)	69 (79.3%)		
Good	127 (43.8%)	163 (56.2%)		
Very good	171 (61.7%)	106 (38.3%)		
Excellent	53 (74.6%)	18 (25.4%)		
Alcohol use				
Lifetime abstainer	21 (36.2%)	37 (63.8%)	27.80 (4)***	0.20
Current non drinker	41 (33.6%)	81 (66.4%)		
Light drinker	143 (54.8%)	118 (45.2%)		
Moderate drinker	116 (59.5%)	79 (40.5%)		
Heavy drinker	25 (43.9%)	32 (56.1%)		
Smoking status (ever having smoked)				
Smoker	202 (46.0%)	237 (54.0%)	5.06 (1)*	0.08
Non smoker	155 (54.6%)	129 (45.4%)		
Life Satisfaction				
Dissatisfied	16 (30.2%)	37 (69.8%)	32.93 (2)***	0.21
Neither satisfied nor dissatisfied	20 (25.3%)	59 (74.7%)		
Satisfied	331 (54.7%)	274 (45.3%)		
Successful ageing				
Unsuccessfully	3 (11.1%)	24 (88.9%)	37.37 (2)***	0.23
Neither successful not unsuccessfully	58 (35.8%)	104 (64.2%)		
Successfully	306 (56.0%)	240 (44.0%)		

* p<.05; **p<.01; ***p<.001

Significant differences between the 2 nutrition risk groups as determined by Chi-square (χ^2) test; Effect size for between-group difference indicated by ϕ (Phi coefficient)**:** values around 0.1 indicate a small effect size, values around 0.3 indicate a medium effect size, and values around 0.5 indicate a large effect size; Missing data: Percentages may not always add up to 100% for each column as there is missing data for approximately7% of subjects across various questions/sub sections within the HWR questionnaire

SCREEN II-AB, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, abbreviated.

ELSI, Economic Living Standards Index.

Table 4 reports the demographic and lifestyle characteristics of the non-Māori participants by nutritional risk status. Those at nutritional risk tended to be women, were less likely to drive, more likely to be experiencing hardship, more likely to have been hospitalised in the past 12 months, be in poorer health, less likely to be satisfied with life, and more likely to rate themselves as having unsuccessfully aged.

Table 4: Association between nutritional risk and participants' demographic and lifestyle characteristics for non-Māori.

	SCREENII-AB Categorization		Test for group difference	
	Not at risk (SCREENIIAB≥38) n = 1457 (67.3%)	At risk (SCREENIIAB<38) n = 708 (32.7%)	χ^2 (df)	ϕ
Gender				
Men	694 (70.1%)	296 (29.9%)	6.51 (1)*	0.06
Women	763 (64.9%)	412 (35.1%)		
Marital status				
Partnered	1202 (73.0%)	445 (27.0%)	98.81 (1)***	0.22
Un-partnered	235 (48.9%)	246 (51.1%)		
Educational qualifications				
No qualifications	234 (57.2%)	175 (42.8%)		
Secondary school qualifications	333 (68.7%)	152 (31.3%)	25.33 (2)***	0.11
Post secondary qualification	868 (70.6%)	362 (29.4%)		
Residence type				
House/townhouse (detached)	1280 (68.1%)	599 (31.9%)		
House/townhouse (semi-detached/terraced)	103 (61.7%)	64 (38.3%)	3.35 (3)	0.04
Unit/villa in a Retirement village	22 (68.8%)	10 (31.3%)		
Other	29 (63.0%)	17 (37.0%)		
Currently drive				
Yes	1395 (68.8%)	634 (31.2%)	33.43 (1)***	0.13
No	41 (41.0%)	59 (59.0%)		
ELSI				
Hardship	62 (36.0%)	110 (64.0%)		
Comfortable	265 (57.4%)	197 (42.6%)	144.03 (2)***	0.27
Good	1070 (75.7%)	343 (24.3%)		
Hospitalisations in last 12 months				
No	961 (70.0%)	411 (30.0%)	12.83 (1)***	0.08
Yes	461 (62.4%)	278 (37.6%)		
General health				
Poor	5 (22.7%)	17 (77.3%)		
Fair	71 (36.6%)	123 (63.4%)		
Good	388 (59.3%)	266 (40.7%)	184.52(4)***	0.29
Very good	709 (74.2%)	247 (25.8%)		
Excellent	279 (84.0%)	53 (16.0%)		
Alcohol use				
Lifetime abstainer	70 (65.4%)	37 (34.6%)		
Current non drinker	109 (54.0%)	93 (46.0%)		
Light drinker	622 (67.5%)	299 (32.5%)	32.30 (4)***	0.13
Moderate drinker	528 (73.5%)	190 (26.5%)		
Heavy drinker	68 (59.6%)	46 (40.4%)		
Smoking status (ever having smoked)				
Smoker	530 (62.2%)	322 (37.8%)	16.13 (1)***	0.09
Non smoker	894 (70.6%)	373 (29.4%)		
Life Satisfaction				
Dissatisfied	32 (32.7%)	66 (67.3%)	131.05	0.25

Neither satisfied nor dissatisfied	104 (44.1%)	132 (55.9%)	(2)***		
Satisfied	1304 (72.2%)	502 (27.8%)			
Successful ageing					
Unsuccessfully	17 (29.8%)	40 (70.2%)	133.23 (2)***		0.25
Neither successful not unsuccessfully	200 (48.3%)	214 (51.7%)			
Successfully	1219 (73.5%)	440 (26.5%)			

* p<.05; **p<.01; ***p<.001

Significant differences between the 2 nutrition risk groups as determined by Chi-square (χ^2) test; Effect size for between-group difference indicated by ϕ (Phi coefficient)**:** values around 0.1 indicate a small effect size, values around 0.3 indicate a medium effect size, and values around 0.5 indicate a large effect size; Missing data: Percentages may not always add up to 100% for each column as there is missing data for approximately7% of subjects across various questions/sub sections within the HWR questionnaire

SCREEN II-AB, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, abbreviated.

ELSI, Economic Living Standards Index.

In a binomial logistic regression model adjusting for all other variables (Table 5), factors independently associated with nutritional risk for Māori were being un-partnered and rating general health as fair. For non-Māori participants, independent nutritional risk factors were being un-partnered and rating general health as fair or poor. Non-Māori participants who rated their life satisfaction as satisfied had lower odds of being at nutritional risk. Higher scores for total health conditions and emotional loneliness were associated with higher odds for nutritional risk.

Table 5: Factors associated with nutritional risk for Māori and non- Māori using binomial logistic regression, adjusting for all other variables in the model.

	Māori			Non-Māori		
	OR	**Lower 95 CI**	**Upper 95 CI**	**OR**	**Lower 95 CI**	**Upper 95 CI**
Categorical Variables						
Marital status						
Partnered	1			1		
Un-partnered	1.87**	1.17	2.97	1.94***	1.45	2.60
Educational qualifications						
No qualifications	1			1		
Secondary school qualifications	1.30	0.74	2.29	0.83	0.57	1.22
Post secondary qualification	0.82	0.50	1.35	0.86	0.62	1.19
Currently drive						
Yes	1			1		
No	0.73	0.34	1.57	1.16	0.61	2.22
ELSI						
Hardship	1			1		
Comfortable	0.71	0.30	1.70	0.88	0.54	1.44
Good	0.55	0.23	1.30	0.63	0.39	1.03
Hospitalisations in last 12 months						
No	1			1		
Yes	0.96	0.62	1.47	0.96	0.74	1.24
General health						
Excellent	1			1		
Very Good	1.43	0.58	3.51	1.47	0.91	2.35
Good	2.35	0.92	5.99	2.03*	1.23	3.33
Fair	4.83*	1.53	15.19	3.18***	1.67	6.05

Poor	2.30	0.28	19.16	4.39*	1.17	16.50
Alcohol use						
Lifetime abstainer	1			1		
Current non drinker	0.99	0.38	2.58	1.17	0.58	2.13
Light drinker	0.57	0.24	1.31	0.86	0.50	1.48
Moderate drinker	0.50	0.21	1.24	0.85	0.48	1.50
Heavy drinker	0.84	0.30	2.40	1.37	0.67	2.80
Smoking status (ever having smoked)						
Smoker	1			1		
Non smoker	1.13	0.72	1.77	0.86	0.67	2.80
Life Satisfaction						
Dissatisfied	1			1		
Neither satisfied nor dissatisfied	2.00	0.62	6.48	0.47	0.24	0.94
Satisfied	1.04	0.37	2.93	0.40**	0.21	0.75
Successful ageing						
Unsuccessfully	1			1		
Neither successful not unsuccessfully	0.26	0.05	1.46	1.06	0.45	2.47
Successfully	0.28	0.54	1.53	0.89	0.37	2.12
Scale variables						
Total health conditions	1.13	0.97	1.32	1.11*	1.07	1.287
Social loneliness	1.09	0.88	1.32	1.04	0.92	1.17
Emotional loneliness	0.96	0.73	1.26	1.35***	1.15	1.58
Social provisions	0.97	0.95	1.00	0.99	0.98	1.00

* p<.05; **p<.01; ***p<.001

Significant differences between the predicted nutritional risk variables and their impact on nutrition risk as determined by Binomial Logistic Regression

SCREEN II-AB, Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, abbreviated. ELSI, Economic Living Standards Index. Total Health Conditions, higher score indicates higher number of co-morbidities (maximum of 12). Social Loneliness, higher score indicates more social loneliness. Emotional Loneliness, higher score indicates more emotional loneliness. Social Provisions, higher score indicates more provisions.

Discussion

Overall more than a third (37.2%) of the participants in this study were identified as at nutrition risk using SCREENII-AB. These findings are similar to previous NZ studies in community-living older adults using SCREENII. In 2010 a study based in Christchurch found 31% of 152 older adults were 'at high nutrition risk' and 23% 'at nutrition risk' (Watson et al., 2010). Similar results were noted by McElnay et al. (2012) in a study of 473 adults in the Hawkes Bay where 32.8% of participants were 'at high nutrition risk' and 23.7% of participants were 'at risk'. Amongst 255 Māori and 400 non-Māori octogenarians participating in the longitudinal study Life and Living in Advanced Age: a Cohort Study in New Zealand (LiLACS NZ) in the Bay of Plenty 49.4 % of Māori and 38.3% of non-Māori were at high nutrition risk (Wham et al., 2015b).

A 2008/2009 Canadian study that recruited over 30,000 community-living older adults aged 65 plus found 34% to be at nutrition risk using SCREENII-AB, which is comparable to the prevalence in the current study (37.2%) (Ramage-Morin & Garriguet, 2013). Most of the Canadian participants completed a computer-assisted personal interview using SCREENII-AB or if non-English speaking, a telephone interview to meet language requirements and to allow for an increased participation rate (Ramage-Morin & Garriguet, 2013). Using SCREENII a further study in Canada found that among 522 community-living older adults aged 78 to 98 years, 44% were at 'high nutrition risk', 24% 'at moderate risk', and 32% 'at low risk' (Broeska, Lengyel, & Tate, 2013). These findings are similar to the aforementioned New Zealand studies using the SCREENII to identify nutrition risk, which found approximately half of participants to be at some degree of nutrition risk.

In the current study over half (50.2%) of Māori were at nutrition risk compared to a third of non-Māori (32.7%). Similarly, among community-living adults in the Hawkes Bay, 62.5% of Māori participants were found to be 'at high nutrition risk', with 7.5% 'at risk' compared to 30.0% of non-Māori 'at high nutrition risk' and 25.2% 'at risk' (McElnay et al., 2012). This difference in prevalence observed might be due to different experiences of older Māori adults compared to non-Māori older adults. Traditionally, Māori choose different foods to meet their nutritional needs than non-Māori; rewena bread, raw fish, and use of local produce (puha, piko piko, watercress) and follow manaakitanga (rule/customs) to ensure food preparation aligns with Māori cultural principles. These principles are part of the wider tikanga, which are a set of guidelines for those in the Māori culture.

Māori culture is rooted in food (Kai), and loss of traditional foods may contribute to nutrition risk (Wham et al., 2015b). With a move to the current New Zealand diet that tends to rely on highly processed and packaged foods, older Māori may consume less traditional items potentially leading to a lower quality diet.

In the current study Māori were less likely to be partnered than non-Māori, with 65.4% of Māori being partnered versus 77.4% of non-Māori. This may be due to loss of a partner as Māori people have a lower life expectancy than non-Māori individuals (Salomon et al., 2013; Statistics New Zealand, 2015). Loss of a partner is a well-

known contributor to nutrition risk, as eating is a social activity. As such, without someone to share a meal with, older adults may be less motivated to prepare, cook and eat and may therefore skip meals or choose less nutritious options, contributing to nutrition risk.

As observed in the current study increased nutrition risk may also be related to the educational background of the participants. Findings showed more non-Māori (57.9%) than Māori (41.9%) held a post-secondary qualification. Amongst Māori participants in LiLACS NZ, lower education was found to be an independent nutrition risk factor; Māori participants with only a primary level education were threefold more likely to be at nutrition risk than those with a higher education (Wham et al., 2015a). Differences in nutrition risk status between Māori and non-Māori may be traced to Te Tiriti o Waitangi, which contributed greatly to both a decline in the Māori population and a loss of land owned by Māori through land confiscation (Ellison-Loschmann & Pearce, 2006). The basis of Te Tiriti o Waitangi was to protect the interests of Māori, but with land loss and discrimination there has been cultural decay and poor health outcomes (Williams & Mohammed, 2013). Land loss in particular has contributed to a larger proportion of Māori being in lower socioeconomic groups, further contributing to inequality in health, as socioeconomic mobility is limited through access to schools and quality education (Williams & Mohammed, 2013). With this comes poorer access to resources that may enhance well-being and encourage healthful behaviours, for example access to nutritious and personally acceptable foods.

Overall slightly more women (39.5%) in the current study were at nutrition risk than men (34.5%). Within the dichotomous ethnicity groups this pattern is repeated; slightly more Māori women (51.5%) were at nutrition risk than Māori men (48.4%) as were non-Māori women (35.1% compared to 29.9% of non-Māori men). This gender difference may be related to life expectancy and partner loss. Women have a longer life expectancy than men, which results in loss of a partner over the lifetime (Statistics New Zealand, 2015). This may contribute to nutrition risk as eating is a social experience, and lack of a partner may decrease eating opportunities. Previously, in a New Zealand study of 3480 community-living older adults, women were found be at increased nutrition risk compared to men, which may be linked to food insecurity and

difficulty accessing food (Wham et al., 2014a). In the current study being un-partnered was an independent risk factor for both Māori and non-Māori participants. With a partner meal-sharing opportunities increase; this is associated with increased overall energy intake as well as increased nutritional quality of meals (de Castro, 2002; Locher et al., 2005b). Without a partner, lack of companionship may decrease the motivation to prepare meals as eating is socially facilitated, leading to increased nutrition risk (de Castro, 2002). The current study shows being an un-partnered versus partnered person increased the odds ratio for nutrition risk for Māori by 1.87, and for non-Māori by 1.94. Meal sharing opportunities thus cannot be discounted in the promotion of improved nutrition outcomes. This is reflected in the New Zealand Food and Nutrition Guidelines for Healthy Older People which include a recommendation to 'take opportunities to eat meals with others' (Ministry of Health, 2013a).

For Māori, those with a poor self-rating of health had an increased likelihood of nutrition risk. Poor self-rated health may be due to the incidence of chronic health conditions, which can affect overall perception of health and can also impact functional ability in terms of food-intake related activities such as shopping, cooking, or eating, which has been shown to increase the likelihood of nutrition risk (Payette, 2005).

Self-rating health as either poor, fair or good; rating life satisfaction as satisfactory; having an increased number of health conditions; and increased emotional loneliness scores were independent nutrition risk factors for non-Māori. Poor self-rated health may relate to decreased functional ability as a result of chronic health conditions e.g. arthritis, a disorder of the neck or back, or respiratory conditions, which lead to reduced ability to either shop or cook/prepare foods reducing overall food intake and leading to nutrition risk (Payette, 2005). Loss of functional ability may lead to frailty and weight loss, resulting in a vicious circle where health conditions may increase in severity if an individual experiences weight loss; e.g. pressure ulcers (Payette, 2005). Weight loss may also mean an individual experiences poorer physical and emotion health, leading to increasingly poor perception of health (Payette, 2005).

Life satisfaction was also independently associated with nutrition risk (odds ratio 0.40) for non-Māori. Greater life satisfaction may lower an individual's nutrition risk because of the ability to self-manage and possibly eat more socially. Meals add pleasure, as well as order and structure to an older adult's day, as well as increasing chances for social interaction – so an individual not at nutrition risk is likely to have higher life satisfaction (Amarantos, Martinez, & Dwyer, 2001). Those who are less satisfied with their life, may be less enthused with meal preparation, and may also find less joy in a meal, thus reducing their intake leading to an increased nutrition risk.

For non-Māori, emotional loneliness, which describes an individual's quality of personal relationships, was also an independent nutrition risk factor (odds ratio 1.35). For Māori the lack of an association between emotional loneliness and nutrition risk may be related to the positive aspects of Tikanga. Māori culture not only places importance on whānau (family), hapu (community) and iwi (tribes), but also looks to elders for guidance. Older Māori (Kaumatua) are seen as valuable to younger generations, providing wisdom and teaching from their experiences, leading fruitful lives with increased age (Waldon, 2004). This positive experience is not shared by non-Māori, who may perceive a lack of camaraderie from those around them, may not be able to rely on family and friends for social supports, or experience relationships that are meaningful. Although non-Māori individuals may have a nuclear family support system as opposed to whānau and a wide-reaching Māori community, the support style may reduce the opportunity for emotional support, and impact the social importance of food and meals.

A major strength of this research is the large sample size and the use of a community validated nutrition risk screening tool. However, the SCREENII-AB considers fewer variables than SCREENII and as such direct comparisons of nutrition risk prevalence may not be able to be made. The abbreviated SCREENII questionnaire has also not been validated in New Zealand, or for a Māori population. The LiLACS NZ feasibility study demonstrated that there were different interpretations of questionnaire items of SCREENII amongst Māori, so results may need to be interpreted with caution (Wham, Dyall, Teh, & Kerse, 2011b). This study is also limited by the study population, which does not extend beyond age 80, thus missing

out on the experiences an octogenarian or nonagenarian may have. With the self-completed questionnaire there may be inaccuracies in people's self-reports, as these rely on memory and accurate recollection. Those with poor literacy skills, visual impairments, or functional limitations may have required a scribe, which may increase response bias.

In conclusion, as one of the largest studies to date reporting the nutrition risk status of community-living older adults in New Zealand, we were able to identify and stratify independent nutrition risk factors for both Māori and non-Māori. When controlling for other variables, independent predictors for nutrition risk for Māori and non-Māori were being un-partnered and self-rating health as poor. For non-Māori, additional risk factors noted were self-rating health as fair or good, being satisfied with life, increased number of total health conditions and increased emotional loneliness scores. With a wide breadth of participants, the findings suggest that opportunities for social eating are necessary to reduce nutrition risk amongst the ageing New Zealand population. Those who are un-partnered are a key identifiable group who would benefit from strategies that encourage older adults to eat with others.

Acknowledgements: The HWR team for including the SCREENII questionnaire in their research, and the participants of the 2014 study, for their time and efforts in filling out and returning the questionnaire.
Conflict of Interest: none

Chapter 4: Conclusion and Recommendations

4.1 Brief overview

This study aimed to determine the prevalence of nutrition risk and associated risk factors amongst community-living older adults in New Zealand based on a postal survey. The SCREENII-AB questionnaire was used to determine the prevalence of nutrition risk, and findings showed 37.2% of the participants were at nutrition risk, with half of the Māori participants at nutrition risk. Assessing overall health, living standards, loneliness, social participation and engagement, alcohol consumption, smoking status and mobility in terms of their relationship to nutrition risk we found that when controlling for other variables, independent predictors for nutrition risk were being un-partnered and rating health as poor for Māori and non-Māori, and rating health as fair or good, life satisfaction, increased number of total health conditions and increased emotional loneliness scores for non-Māori. There was no association between nutrition risk and living standards, mobility, alcohol use, hospitalisations or social provisions though it was originally postulated that high healthcare usage (hospitalisations), high alcohol consumption, few social network connections, and poor perception of ageing would be nutrition risk factors for community-living older adults. In the univariate analysis, each of these aforementioned factors was seen to increase nutrition risk, but when controlling for other influences, hospitalisations, alcohol consumption, social provisions, and perception of successful ageing had no effect on nutrition risk. It is key to understand predictors of nutrition risk in order to positively affect nutrition risk prior to development of malnutrition, and to create public health policies to improve nutrition quality of life amongst this population.

4.2 Contribution to health

This study aligns with previous research of the subject of nutrition risk amongst older adults, noting a similar prevalence of nutrition risk with different risk factors noted between Māori and non-Māori participants. This research highlights the importance of socialised eating and the importance of social supports (especially partners) in reducing nutrition risk amongst community-living older adults in New Zealand.

4.3 Strengths

A major strength of this research is the large sample size and the inclusion of older adults from across New Zealand, representing the experiences of ageing adults across the country. The study also oversampled Māori people to identify the prevalence and risk factors among our indigenous population. With oversampling this study was able to replicate previous research results, demonstrating half of the Māori population to be at nutrition risk, amongst a younger age group to previous research by LiLACS NZ.

This study also includes the use of the SCREENII-AB, which has been both designed for and validated for use in predicting nutrition risk amongst community-living older adults.

4.4 Limitations

The study is a cross-sectional look at the ageing New Zealand population, and as such is limited in its ability to make causative statements. With the self-completed questionnaire there may be inaccuracies in people's self-reports of disease state or any other number of variables, as these reports rely on memory and accurate recollection. Those with poor literacy skills, those with visual impairments or those with difficulty writing/using a pen may have required a scribe which may have led to bias in the responses. The study and research is based on self-reported questions; though the questions used in the study have been independently validated, literacy is central to the ability to accurately understand the questions asked and answer accurately. This factor may contribute to poorer rates of response in lower socioeconomic groups. To best limit this we must ensure the amount of those in low socioeconomic circumstances is accurately represented when stratifying the sample population.

Caution should be used when comparing this study to previous research, which use the full SCREENII questionnaire, as this considers and includes different variables to the abbreviated SCREENII. The abbreviated SCREENII questionnaire has also not been validated in New Zealand, and the SCREENII-AB has not been validated for a Māori population. The feasibility study of LiLACS NZ demonstrated that items of SCREENII (full version) were interpreted differently amongst Māori, this should be

kept in mind when evaluating the results as they may not represent the true Māori participants' nutrition risk (Wham et al., 2011b).

This study is also limited by the study population, which does not extend beyond age 80; missing out on the experiences an octogenarian or nonagenarian may have. As a study of older ageing, the fact that approximately half of the participants were under 64 means the experiences described may not translate to the older adult (over 65) population.

4.5 Recommendations for further research

This research with its wide breadth of participants identifies that opportunities for social eating are still required to reduce nutrition risk amongst the ageing New Zealand population. Those who are un-partnered are a key identifiable group who would benefit from a strategy that encourages older adults to eat with others.

Māori are also a key group who may require intervention, looking at culturally specific public policy recommendations and interventions working with whānau and iwi to implement social eating strategies.

Investigations of social eating strategies, their implementation in the community, and their effect on nutrition risk prevalence are also required to ensure public health policies are meeting the needs of un-partnered older adults.

Chapter 5: Appendices

Appendix 1: Malnutrition screening tools available for use in the community

Screening tool	Country of Origin	Number of questions	Themes of questions	Scoring	Concerns with the tool
ANSI (Cobiac & Syrette, 1995)	Australia	12	Anthropometry, dietary intake, factors affecting food intake, food security/access, disease condition, social factors	Total between 0 and 29 0-3 = low risk 3-5 = moderate risk >6 = high risk	Addresses both overall health status as well as nutritional risk
Malaysian Tool (Shahar, Dixon, & Earland, 1999)	Malaysia	11	Dietary intake, factors affecting food intake, food security/access, disease state	Total between 0 and 11 Section A –nutrition risk (total score available is 7) ≤ 4 = well nourished ≥ 4 = nutrition risk Section B –diet adequacy (total score available is 4) ≤ 2 = adequate intake ≥ 2 = inadequate diet	Addresses both under nutrition and diet adequacy, which confuses the purpose of the tool Requires further validation Designed for use in developing countries, may not be applicable to Western nations
MNA-SF (Mini nutritional assessment, short form) (Rubenstein et al., 2001)	Switzerland	6	Anthropometry, food security/access, disease state	Total between 0 and 14 ≤ 10 = well nourished ≥ 11 = nutrition risk	Administering the full MNA may be more applicable in some populations, for example in a residential care facility
MUST (Malnutrition Universal Screening tool) (Elia, 2003)	UK	3	Anthropometry, factors affecting food intake	Total between 0 and 6 0 = low risk 1 = moderate risk >2 = high risk	Requires administrator
NSI (Nutrition screening initiative) /DETERMINE	USA	10	Anthropometry, dietary intake, factors affecting	Total between 0 and 21 0-2 = well nourished	Not designed to replace healthcare professionals, or comprehensive, but to give insight into the individual's

(Rubenstein et al., 2001)			food intake, food security/access, social factors	3-5 = moderate risk >6 =high risk	status Criticized for lack of validity (Elia, 2003)
SCREEN I (Seniors in the community risk evaluation for eating and nutrition version 1) (Keller, Hedley, & Brownlee, 2000)	Canada	15	Anthropometry, dietary intake, factors affecting food intake, food security/access, social factors	Total 0-60	Some questions have 5 response options, some 4, which may be confusing for administrators, it was also not as encompassing as desired after testing Self completed indice, subject to response biases
SCREEN II (Seniors in the community risk evaluation for eating and nutrition version 2) (Keller et al., 2005)	Canada	14	Anthropometry, dietary intake, factors affecting food intake, food security/access, social factors	Total 0-64 <50 = high risk 50-53 = moderate risk >54 = low risk	Self completed indice, subject to response biases
SNAQ (short nutritional assessment questionnaire) (Kruizenga, Seidell, De Vet, & Wierdsma, 2005)	Netherlands	4	Anthropometry, appetite, dietary intake	Total between 0 and 7 <2 = well nourished 2 = at nutritional risk ≥3 = malnourished	Nurse-nurse reproducibility tests resulted in 15% of patients being categorised differently, so may not be reproducible
South African tool (Phillips et al., 2010)	South Africa	14	Anthropometry, dietary intake, food habits, food security/access, medical history, medication usage, cognitive impairment, social activities	Total between 0 and 42 <u>Males:</u> <9.5 = malnourished 9.5-14.5 = at nutritional risk >14.5 = well nourished <u>Females:</u> <9.5 = malnourished 9.5-16.0 = at nutritional risk >16.0 = well nourished	The elderly population is heterogeneous with Western countries' elderly populations, so tool would require validation for use in other countries (Kruizenga et al., 2005)

Table 6: Malnutrition screening tools available for use in the community

Appendix 2: Previous nutrition risk research amongst community-living older adults in New Zealand

Reference	Sample size	Age range studied	Location in New Zealand	Method of Nutrition Assessment	Nutrition risk findings	Risk factors associated with higher nutrition risk
(Watson et al., 2010)	n = 152 Female: 95 Male: 57	70 years plus	Christchurch	SCREEN II	31.0% = High nutrition risk 23.0% = At nutrition risk 46.0% = Not at nutrition risk	Unintentional weight change of more than 2kg Eating alone Perception of own weight (more/less than it should be) Low milk product intake
(Wham et al., 2011c)	n = 108 Female: 60 Male: 48	Māori: 75-79 years Non-Māori: 85 years plus	North Island	SCREEN II	52.0% = High nutrition risk	Widows/widowers Living alone Eating alone Lower body fat mass percentage
(Wham, Carr, & Heller, 2011a)	n = 51 Female: 36 Male: 15	80-85 years	Auckland	SCREEN II	31.0% = High nutrition risk	Eating alone Low milk product intake Meal preparation difficulties Low meat and alternative intake Weight perception (more/less than it should be) Skipping of meals Poor self rated health Disability Depression Loneliness
(McElnay et al., 2012)	n = 473 Female: 263 Male: 207 Unknown: 30	65 years plus	Hawkes Bay	SCREEN II	32.8% = High nutrition risk 23.7% = At nutrition risk	Living alone Weight perception Eating alone Low milk product intake Low meat and alternative intake Most frequent risk factors amongst Māori: Low fruit and vegetable intake Low milk product intake

						Low meat and alternative protein intake Skipping meals Perception of weight (more/less than it should be)
(Wham et al., 2014a)	n = 3480 Female: 1872 Male: 1600	Māori: 65 years and older Non Māori: 75 years and older	3 DHB's located in New Zealand	ANSI	62% = moderate or high nutrition risk	Medication use correlating to health status of the participant (3+ OTC medications), Altered food consumption (type or amount) due to illness, Fluid consumption below 6-8 cups a day Women Those who are of older age Those with depressive symptoms Those with many comorbidities
(Wham et al., 2014b)	n = 45 Female: 21 Male: 24	85 – 86 years	Bay of Plenty	SCREEN II	33.0% = High risk of malnutrition 27.0% = Medium risk of malnutrition 40.0 % = Low risk of malnutrition	Living alone Eating alone Low meat and alternative intake Low milk product intake Unintentional weight change
(Wham et al., 2015b)	n = 655 Female: 367 Male: 288	Māori: 82.3 ± 2.6 years Non-Māori: 84.6 ± 0.5 years	Bay of Plenty and Lakes Region	SCREEN II	High nutrition risk: Māori = 49.0% Non-Māori = 35.0%	Risk factors amongst the Māori ethnic group: Being a widow/widower or single Living alone Lower level of education Younger age Exhibiting depressive symptoms Risk factors amongst the non-Māori group: Being female Being widowed/single Never consuming alcohol (abstinence)

Table 7: New Zealand research into nutrition risk amongst community-living older adults

Appendix 3: Supplementary Methods

Statistical Analysis

Normality was assessed using the Komogorov-Smirnov and Shapiro-Wilk tests. Data that was not-normally distributed was tested for homogeneity of variance with a Levenes test. Normally distributed data is expressed as mean ± SD (standard deviation). Based on the large sample size used for this study, data is treated as normal, even though based on the Komogorov-Smirnov and Shapiro-Wilk tests it appears as not-normal. This is as large sample sizes are likely to show the true distribution of scores in the population and represent the population, therefore even while not-normal, the sample is normal (Pallant, 2005).

A one-way Anova test was used to determine if any statistically significant differences exist between the means of the independent nutrition risk groups (Pallant, 2005). In order to complete the Anova test six assumptions were met; dependent variables are continuous, the independent variable (nutrition risk) consists of three categorical, independent groups, there is independence of observations, there are no significant outliers, variables are normally distributed, and variance in the groups needs to be homogenous (Pallant, 2005). The eta squared (η^2) coefficient describes the effect size of the given associations as outlined by a p-value of less than 0.05; effect size values around 0.01 indicate a small effect size, values around 0.059 indicate a medium effect size, and values around 0.138 indicate a large effect size (Pallant, 2005).

A chi square test for independence was used to determine if any statistically significant differences exist between categorical variables and the independent nutrition risk groups. To undertake this test three assumptions were met: dependent variables measured are categorical not numerical, variables have two or more groups within them and the expected frequency in any cell was at least 5 (Pallant, 2005). The phi coefficient (φ) describes the effect size of the association, values may range from 0 to 1 and the higher the number, the stronger the association (Pallant, 2005).

A binomial logistic regression was undertaken where all variables from the univariate analysis which demonstrated a significant ($p<0.05$) impact on nutrition risk were included for both Māori and non-Māori. This test was done to determine independent risk factors associated with increased nutritional risk amongst both ethnic groups. The OR is the odds ratio for each individual variable, it describes a change in odds of being either at nutrition risk or not, when the value of the predictor variable changes by a single unit (Pallant, 2005). The 95% CI represents the 95% confidence interval, where we are 95% confident that between the upper and lower values the true odds ratio will lie (Pallant, 2005).

Chapter 6: References

Ahmed, T., & Haboubi, N. (2010). Assessment and management of nutrition in older people and its importance to health. *Clin Interv Aging, 5*(1), 207-216.

Alibhai, S. M., Greenwood, C., & Payette, H. (2005). An approach to the management of unintentional weight loss in elderly people. *Canadian Medical Association Journal, 172*(6), 773-780.

Amarantos, E., Martinez, A., & Dwyer, J. (2001). Nutrition and quality of life in older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 56*(suppl_2), 54-64.

Boulos, C., Salameh, P., & Barberger-Gateau, P. (2016). Malnutrition and frailty in community dwelling older adults living in a rural setting. *Clinical Nutrition, 35*(1), 138-143. doi: 10.1016/j.clnu.2015.01.008

Braunschweig, C., Gomez, S., & Sheean, P. M. (2000). Impact of Declines in Nutritional Status on Outcomes in Adult Patients Hospitalized for More Than 7 days. *Journal of the American Dietetic Association, 100*(11), 1316-1322. http://www.sciencedirect.com/science/article/pii/S0002822300003734 doi:http://dx.doi.org/10.1016/S0002-8223(00)00373-4

Broeska, V. E., Lengyel, C. O., & Tate, R. B. (2013). Nutritional risk and 5-year mortality of older community-dwelling Canadian men: the Manitoba follow-up study. *Journal of nutrition in gerontology and geriatrics, 32*(4), 317-329.

Burns, C., Bentley, R., Thornton, L., & Kavanagh, A. (2011). Reduced food access due to a lack of money, inability to lift and lack of access to a car for food shopping: a multilevel study in Melbourne, Victoria. *Public Health Nutrition, 14*(6), 1017-1023.

Bush, K., Kivlahan, D. R., McDonell, M. B., Fihn, S. D., & Bradley, K. A. (1998). The AUDIT alcohol consumption questions (AUDIT-C): an effective brief screening test for problem drinking. *Archives of internal medicine, 158*(16), 1789-1795.

Cobiac, L., & Syrette, J. (1995). *What is the nutritional status of older Australians?* Paper presented at the PROCEEDINGS-NUTRITION SOCIETY OF AUSTRALIA.

Cutrona, C., Russell, D., & Rose, J. (1986). Social support and adaptation to stress by the elderly. *Psychology and aging, 1*(1), 47.

Davey, J. A. (2007). Older people and transport: coping without a car. *Ageing and Society, 27*(01), 49-65.

de Castro, J. M. (2002). Age-related changes in the social, psychological, and temporal influences on food intake in free-living, healthy, adult humans. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 57*(6), M368-M377.

DiTommaso, E., & Spinner, B. (1993). The development and initial validation of the Social and Emotional Loneliness Scale for Adults (SELSA). *Personality and Individual Differences, 14*(1), 127-134.

Donini, L. M., Scardella, P., Piombo, L., Neri, B., Asprino, R., Proietti, A., . . . Cucinotta, D. (2013). Malnutrition in elderly: social and economic determinants. *The Journal of Nutrition, Health & Aging, 17*(1), 9-15.

Drewnowski, A. (2000). Sensory control of energy density at different life stages. *The Proceedings of the Nutrition Society, 59*(2), 239-244.

Drewnowski, A., & Evans, W. J. (2001). Nutrition, physical activity, and quality of life in older adults summary. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 56*(suppl 2), 89-94.

Elia, M. (2003). *The 'MUST' report. Nutritional screening for adults: a multidisciplinary responsibility. Development and use of the'Malnutrition Universal Screening Tool'(MUST) for adults*: British Association for Parenteral and Enteral Nutrition (BAPEN).

Ellison-Loschmann, L., & Pearce, N. (2006). Improving access to health care among New Zealand's Maori population. *American journal of public health, 96*(4), 612-617.

Gierveld, J. D. J., & Tilburg, T. V. (2006). A 6-item scale for overall, emotional, and social loneliness: Confirmatory tests on survey data. *Research on aging, 28*(5), 582-598.

Goodpaster, B. H., Park, S. W., Harris, T. B., Kritchevsky, S. B., Nevitt, M., Schwartz, A. V., . . . Newman, A. B. (2006). The Loss of Skeletal Muscle Strength, Mass, and Quality in Older Adults: The Health, Aging and Body Composition Study. *The Journals of Gerontology: Series A, 61*(10), 1059-1064. doi: 10.1093/gerona/61.10.1059

Guest, J. F., Panca, M., Baeyens, J.-P., de Man, F., Ljungqvist, O., Pichard, C., . . . Wilson, L. (2011). Health economic impact of managing patients following a community-based diagnosis of malnutrition in the UK. *Clinical Nutrition, 30*(4), 422-429.

Hickson, M. (2006). Malnutrition and ageing. *Postgraduate Medical Journal, 82*(963), 2-8.

Hodge, A. M., English, D. R., Giles, G. G., & Flicker, L. (2013). Social connectedness and predictors of successful ageing. *Maturitas, 75*(4), 361-366.

Hörder, H. M., Frändin, K., & Larsson, M. E. (2013). Self-respect through ability to keep fear of frailty at a distance: Successful ageing from the perspective of community-dwelling older people. *International journal of qualitative studies on health and well-being, 8*.

Houston, D. K., Nicklas, B. J., Ding, J., Harris, T. B., Tylavsky, F. A., Newman, A. B., . . . Kritchevsky, S. B. (2008). Dietary protein intake is associated with

lean mass change in older, community-dwelling adults: the Health, Aging, and Body Composition (Health ABC) Study. *The American journal of clinical nutrition, 87*(1), 150-155.

Hsieh, C. (2005). Treatment of constipation in older adults. *American Family Physician, 72*(11), 2277-2284.

Inglehart, R., Basáñez, M., Díez-Medrano, J., Halman, L., & Luijkx, R. (2004). *World Values Surveys and European Values Surveys, 1999-2001*.

Jensen, J., Spittal, M., & Krishnan, V. (2005). *ELSI short form: User manual for a direct measure of living standards* (047818347X). Ministry of Social Development Wellington, New Zealand.

Keller, H., Goy, R., & Kane, S. L. (2005). Validity and reliability of SCREEN II (Seniors in the Community: risk evaluation for eating and nutrition, Version II). *European Journal of Clinical Nutrition,* (10). http://ezproxy.massey.ac.nz/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsagr&AN=edsagr.US201301040490&site=eds-live&scope=site

Keller, H., Hedley, M. R., & Brownlee, S. W. (2000). The development of seniors in the community: risk evaluation for eating and nutrition (SCREEN). *Canadian Journal of Dietetic Practice and Research, 61*(2), 67.

Kruizenga, H., Seidell, J., De Vet, H., & Wierdsma, N. (2005). Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ©). *Clinical Nutrition, 24*(1), 75-82.

Kubrak, C., & Jensen, L. (2007). Malnutrition in acute care patients: A narrative review. *International Journal of Nursing Studies, 44*(6), 1036-1054. http://www.sciencedirect.com/science/article/pii/S002074890600232X doi:http://dx.doi.org/10.1016/j.ijnurstu.2006.07.015

Lang, I., Wallace, R. B., Huppert, F. A., & Melzer, D. (2007). Moderate alcohol consumption in older adults is associated with better cognition and well-being than abstinence. *Age and Ageing, 36*(3), 256-261.

Levy, B. R., & Myers, L. M. (2004). Preventive health behaviors influenced by self-perceptions of aging. *Preventive medicine, 39*(3), 625-629.

Locher, J., Ritchie, C., Roth, D., Baker, P. S., Bodner, E., & Allman, R. (2005a). Social isolation, support, and capital and nutritional risk in an older sample: ethnic and gender differences. *Social Science & Medicine, 60*, 747-761. doi: 10.1016/j.socscimed.2004.06.023

Locher, J., Robinson, C., Roth, D., Ritchie, C., & Burgio, K. (2005b). The effect of the presence of others on caloric intake in homebound older adults. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 60*(11), 1475-1478.

Martínez-Reig, M., Aranda-Reneo, I., Peña-Longobardo, L. M., Oliva-Moreno, J., Barcons-Vilardell, N., Hoogendijk, E. O., & Abizanda, P. (2017). Use of Health Resources and Healthcare Costs associated with Nutritional Risk: The FRADEA Study. *Clinical Nutrition*.

McCaul, K. A., Almeida, O. P., Hankey, G. J., Jamrozik, K., Byles, J. E., & Flicker, L. (2010). Alcohol use and mortality in older men and women. *Addiction, 105*(8), 1391-1400.

McElnay, C., Marshall, B., O'Sullivan, J., Jones, L., Ashworth, T., Hicks, K., & Forrest, R. H. (2012). Nutritional risk amongst community-living Maori and non-Maori older people in Hawke's Bay. *Journal of primary health care (Online)*. http://ezproxy.massey.ac.nz/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsinz&AN=edsinz.749204&site=eds-live&scope=site

Miller, S. L., & Wolfe, R. R. (2008). The danger of weight loss in the elderly. *The Journal of Nutrition Health and Aging, 12*(7), 487-491. doi: 10.1007/bf02982710

Ministry of Health. (2013a). *Food and Nutrition Guidelines for Healthy Older People: a background paper*. Wellington, New Zealand.

Ministry of Health. (2013b). *Health Loss in New Zealand*. Wellington, New Zealand: Ministry of Health.

Morley, J. E., Anker, S. D., & von Haehling, S. (2014). Prevalence, incidence, and clinical impact of sarcopenia: facts, numbers, and epidemiology—update 2014. *Journal of cachexia, sarcopenia and muscle, 5*(4), 253-259.

Pallant, J. (2005). *SPSS Survival Guide-A step by step guide to data analysis using SPSS for windows (Ver. 12)*: Berkshire: Open University Press.

Payette, H. (2005). Nutrition as a determinant of functional autonomy and quality of life in aging: a research program. *Canadian Journal of Physiology & Pharmacology, 83*(11), 1061-1070.

Phillips, M. B., Foley, A. L., Barnard, R., Isenring, E. A., & Miller, M. D. (2010). Nutritional screening in community-dwelling older adults: a systematic literature review. *Asia Pacific journal of clinical nutrition, 19*(3), 440-449.

Ramage-Morin, P. L., & Garriguet, D. (2013). *Nutritional risk among older Canadians* (0840-6529).

Rubenstein, L. Z., Harker, J. O., Salvà, A., Guigoz, Y., & Vellas, B. (2001). Screening for undernutrition in geriatric practice developing the short-form mini-nutritional assessment (MNA-SF). *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 56*(6), M366-M372.

Ruiz-López, M. D., Artacho, R., Oliva, P., Moreno-Torres, R., Bolanos, J., de Teresa, C., & López, M. C. (2003). Nutritional risk in institutionalized older women

determined by the Mini Nutritional Assessment test: what are the main factors? *Nutrition, 19*(9), 767-771.

Saka, B., Kaya, O., Ozturk, G. B., Erten, N., & Karan, M. A. (2010). Malnutrition in the elderly and its relationship with other geriatric syndromes. *Clinical Nutrition, 29*(6), 745-748.

Salomon, J. A., Wang, H., Freeman, M. K., Vos, T., Flaxman, A. D., Lopez, A. D., & Murray, C. J. (2013). Healthy life expectancy for 187 countries, 1990–2010: a systematic analysis for the Global Burden Disease Study 2010. *The Lancet, 380*(9859), 2144-2162.

Serdula, M. K., Brewer, R. D., Gillespie, C., Denny, C. H., & Mokdad, A. (2004). Trends in alcohol use and binge drinking, 1985–1999: results of a multi-state survey. *American journal of preventive medicine, 26*(4), 294-298.

Shahar, S., Dixon, R., & Earland, J. (1999). Development of a screening tool for detecting undernutrition and dietary inadequacy among rural elderly in Malaysia: simple indices to identify individuals at high risk. *International journal of food sciences and nutrition, 50*(6), 435-444.

Singh, A., & Misra, N. (2009). Loneliness, depression and sociability in old age. *Industrial psychiatry journal, 18*(1), 51.

Statistics New Zealand. (2013). *2013 QuickStats about national highlights*. Wellington, New Zealand: Statistics New Zealand.

Statistics New Zealand. (2014). *2013 QuickStats about culture and identity*. Wellington, New Zealand: Statistics New Zealand.

Statistics New Zealand. (2015). *2013 QuickStats about people aged 65 and over*. Wellington, New Zealand: Statistics New Zealand.

Sutton, J. L., Gould, R. L., Daley, S., Coulson, M. C., Ward, E. V., Butler, A. M., . . . Howard, R. J. (2016). Psychometric properties of multicomponent tools designed to assess frailty in older adults: A systematic review. *BMC geriatrics, 16*(1), 55.

Tiggemann, M. (2004). Body image across the adult life span: Stability and change. *Body image, 1*(1), 29-41.

Towers, A., Philipp, M., Dulin, P., & Allen, J. (2016). The "Health Benefits" of Moderate Drinking in Older Adults may be Better Explained by Socioeconomic Status. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, gbw152.

Towers, A., Stevenson, B., Breheny, M., & Allen, J. (2015). Health, Work, and Retirement Longitudinal Study. In A. N. Pachana (Ed.), *Encyclopedia of Geropsychology* (pp. 1-9). Singapore: Springer Singapore.

United Nations Department of Economic and Social Affairs Population Division. (2013). *World Population Ageing 2013*.

United Nations Second World Assembly on Ageing. (2002). *Political Delcaration and Madrid International Plan of Action on Ageing*.

University of Otago, & Ministry of Health. (2011). *A Focus on Nutrition Key Findings of the 2008/09 New Zealand Adult Nutrition Survey*. Wellington, New Zealand: Ministry of Health.

Visser, M., Goodpaster, B. H., Kritchevsky, S. B., Newman, A. B., Nevitt, M., Rubin, S. M., . . . Harris, T. B. (2005). Muscle mass, muscle strength, and muscle fat infiltration as predictors of incident mobility limitations in well-functioning older persons. *The Journals of Gerontology Series A: Biological Sciences and Medical Sciences, 60*(3), 324-333.

Waldon, J. (2004). Oranga Kaumatua: Perceptions of health in older Maori people. *Social Policy Journal of New Zealand, 23*, 167-180.

Watson, S., Zhang, Z. K., & Wilkinson, T. J. (2010). Nutrition risk screening in community- living older people attending medical or falls prevention services. *Nutrition & Dietetics, 67*(2), 84-89.

Wham, C., Baggett, F., Teh, R., Moyes, S., Kēpa, M., Connolly, M., . . . Kerse, N. (2015a). Dietary protein intake may reduce hospitalisation due to infection in Māori of advanced age: LiLACS NZ. *Australian and New Zealand journal of public health, 39*(4), 390-395.

Wham, C., Carr, R., & Heller, F. (2011a). Country of origin predicts nutrition risk among community living older people. *The Journal of Nutrition, Health & Aging, 15*(4), 253-258.

Wham, C., Dyall, L., Teh, R. O., & Kerse, N. M. (2011b). Nutrition risk: cultural aspects of assessment. *Asia Pacific journal of clinical nutrition, 20*(4), 632-638.

Wham, C., McLean, C., Teh, R., Moyes, S., Peri, K., & Kerse, N. (2014a). The BRIGHT Trial: What are the factors associated with nutrition risk? *The Journal of Nutrition, Health & Aging, 18*(7), 692-697.

Wham, C., Redwood, K., & Kerse, N. (2014b). Validation of the nutrition screening tool 'Seniors in the Community: Risk Evaluation for Eating and Nutrition, version II'among octogenarians. *The Journal of Nutrition, Health & Aging, 18*(1), 39-43.

Wham, C., Teh, R., Moyes, S., Dyall, L., Kepa, M., Hayman, K., & Kerse, N. (2015b). Health and social factors associated with nutrition risk: Results from life and living in advanced age: A cohort study in New Zealand (LILACS NZ). *journal of nutrition, health & aging*, (6). http://ezproxy.massey.ac.nz/login?url=http://search.ebscohost.com/login.aspx?direct=true&db=edsagr&AN=edsagr.US201600086836&site=eds-live&scope=site

Wham, C., Teh, R., Moyes, S. A., Rolleston, A., Muru-Lanning, M., Hayman, K., . . . Kerse, N. (2016a). Macronutrient intake in advanced age: Te Puāwaitanga o Ngā Tapuwae Kia ora Tonu, Life and Living in Advanced Age: A Cohort Study in New Zealand (LiLACS NZ). *British Journal of Nutrition, 116*(6), 1103-1115.

Wham, C., Teh, R., Moyes, S. A., Rolleston, A., Muru-Lanning, M., Hayman, K., . . . Adamson, A. (2016b). Micronutrient intake in advanced age: Te Puāwaitanga o Ngā Tapuwae Kia ora Tonu, Life and Living in Advanced Age: A Cohort Study in New Zealand (LiLACS NZ). *British Journal of Nutrition, 116*(10), 1754-1769.

Wham, C., Teh, R. O. Y., Robinson, M., & Kerse, N. M. (2011c). What is associated with nutrition risk in very old age? *The Journal of Nutrition, Health and Aging*(4), 247.

Williams, D. R., & Mohammed, S. A. (2013). Racism and health I: pathways and scientific evidence. *American Behavioral Scientist, 57*(8), 1152-1173.

Winter, J., McNaughton, S., & Nowson, C. (2016). Older adults' attitudes to food and nutriton: A qualitative study *The journal of aging research and clinical practice, 5*(2), 114-119.