Nutrition risk factors as predictors of hospitalisations and mortality among Māori and non-Māori community-living octogenarians

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

Master of Science in Human Nutrition and Dietetics

At Massey University, Albany, New Zealand

Sylvia Michelle North

2015

Acknowledgements

This thesis would not have been possible without the support of many people. Firstly to my supervisors Dr. Carol Wham and Dr. Ruth Teh who've offered ongoing guidance and motivation. Dr. Carol Wham, you have been a source of inspiration to me on many levels.

To all the team involved with the LiLACS for all data collection and background work. Particular acknowledgement to Professor Ngarie Kerse. Sincere gratitude for the opportunity to present such interesting and substantial data. To the many participants whom without their time and consent this research would not have existed.

Special thanks to my family. To mum and dad for being kind and supportive, and to Joanne for inspiring me to excel as you do.

To Andrew, for keeping my feet grounded on the earth, for being an endless source of kindness and joy, and for offering to fix any and every technical issue as well as reading my drafts.

Abstract

Aim: The aim was to examine the consequences of high nutrition risk (hospital admissions and mortality at 24-months) using the Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) nutrition risk domain scores among the participants of the Life and Living in Advanced Age Cohort Study New Zealand.

Methods: Demographic, lifestyles, and health data from 421 Māori (177 males, age: 82-90) and 516 non-Māori (237 males, age: 84-86) was examined at baseline. The Senior's in the Community: Risk Evaluation for Eating and Nutrition (SCREEN II) tool was used to examine three key domains of nutrition risk (1: "weight change"; 2: "dietary intake"; 3: "factors affecting intake"). Multiple regression analyses examined the relationship between SCREEN II domain scores and all-cause hospitalisations and all-cause mortality.

Results: Half of the participants were at high nutrition risk (Māori 49.4%; non-Māori 38.3%), with a higher prevalence among women (Māori 54.2%; non-Māori 48.6%). For Māori, the SCREEN II "dietary intake" domain score was negatively associated with mortality [OR (95%CI) 0.74 (0.71-0.98), p=0.034], once adjusted for age, gender, socioeconomic deprivation, education level, previous hospital admission, comorbidities, and activities of daily living. There was trend toward a negative association for all-cause hospitalisations (p=0.150). There was no significant relationship between SCREEN II domain scores and hospital admissions or mortality for non-Māori.

Conclusions: For older Māori at high nutrition risk, dietary intake is the strongest nutrition risk predictor of all-cause mortality and may predict risk of hospitalisation. Strategies to ensure dietary adequacy and consumption of a variety of foods may assist to improve health outcomes.

Table of Contents

List of Tables

List of Figures

Glossary of Māori Terms

Māori name	Translation
hapū	sub-tribe
iwi	tribe
kai	food
kuia	older women
kaumātua	older men
te Tangata Whenua	The indigenous people of New Zealand.
whakapapa	genealogical ties
whānau	family, usually inclusive of extended family

List of Abbreviations

Abbreviation	Definition
ADLs	Activities of daily living
BMI	Body mass index
DALYs	Disability Adjusted Life Years
GDS-15	Geriatric depression scale, 15 item index
LiLACS NZ	Life and Living in Advanced Age: a cohort study in New Zealand
NEADL	Nottingham Extended Activities of Daily Living
SCREEN II	Seniors in the Community: Risk Evaluation for Eating and Nutrition version II
2008/09 NZANS	2008/09 New Zealand Adult Nutrition Survey

1.0 Introduction

New Zealand is in the midst of a population transition as the population of older people is increasing both in number and proportion. The fastest growing group are those aged 85 years and older: the adults in advanced age. Recent population projections have predicted that by 2050, adults aged 85 years and older will represent 5.3% of the population (Statistics New Zealand, 2014). Advanced age adults have the highest rates of hospitalisations and procedures than any other age group; with the predicted population growth this has significant future economic implications.

Adults of advanced age live an average of five years past their life expectancy from birth and represent the successfully aged in New Zealand (Statistics New Zealand, 2015a). The New Zealand government's 'Positive Ageing Strategy, and 'Aging in Place' goal, was developed to create new understandings to enable older people to remain healthy and independent in their communities and, therefore, to have minimal need for engagement with acute care and support services (Ministry of Social Development, 2001).

Nutrition is a key determinant of successful ageing. As well as having a critical role for physiological wellbeing, it also supports other aspects of health in old age, such as independence and psychological health, through the social meaning of food and cultural relationships (American Dietetic Association, 2005; Stanner, Thompson, & Buttriss, 2009). The determinants of nutritional health are complex and involve an interplay of many individual, social, and socioeconomic factors (Ministry of Health, 2013a). Nutrition risk screening aims to identify characteristics known to be associated with nutritional problems (Phillips, Foley, Barnard, Isenring, & Miller, 2010). For those considered to be at high nutrition risk, screening allows appropriate referral and intervention planning to prevent further worsening of nutrition status (Keller, 2007; Writing Group of the Nutrition Care Process/Standardized Language Committee, 2008).

The Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) nutrition risk screening tool is one of few specifically developed for community-living older adults (Keller, Goy, & Kane, 2005). It assesses nutrition risk according to three key domains: 1) Weight Change, 2) Dietary Intake, 3) Factors Affecting Intake (adaptive and functional) (Keller, 2006). Identifying nutritional problems from these key domains creates an opportunity for appropriate intervention planning to promote good outcomes and enable positive ageing.

SCREEN II has been validated among octogenarians in New Zealand, against a standardised dietitian's nutrition risk rating score (Wham, Redwood, & Kerse, 2014). Also used widely in Canada, it has been shown to have excellent test-retest validity and interrater reliability (Beath & Keller, 2007; Keller, McKenzie, & Goy, 2001). With this tool, it has been estimated the prevalence of nutrition risk is approximately 30-60% among community-living older adults in New Zealand (Watson, Zhongxian, & Wilkinson, 2010; Wham, Carr, & Heller, 2011; Wham, Teh, Robinson, & Kerse, 2011; Wham et al., 2014).

In the interest of public policy and to create better understanding of the determinants of successful ageing for older people in New Zealand, the nutrition risk status of community living octogenarians warrants further investigation. In 2010 an assessment of nutrition risk was undertaken for the baseline assessment of the 'Life and Living in Advanced Age: A Cohort study in New Zealand' (LiLACS NZ). The purpose of LiLACS NZ is to establish the health status and predictors of successful ageing and to understand the trajectories of health and well-being in advanced age (Hayman et al., 2012). Two cohorts of equal size, which included 421 Māori (aged 80-90 years) and 516 non-Māori (aged 85 years), were recruited at the beginning of 2010. At baseline a standardised questionnaire was administered during a face-to-face interview. This included the SCREEN II tool, as well as assessments of personal history, lifestyle and health behaviours such as smoking and alcohol, physical and mental health, body weight, and physical function. Social networks and supportive exchanges, utilisation of health services, and food security was also examined.

The construct of nutrition risk in older adults is extensive and combines both clinical and social determinants (Keller, 2006). In the baseline assessment of LiLACS NZ, various sociodemographic, lifestyle, physical, and mental health factors were associated with nutrition risk among community living octogenarians (Wham et al., 2015). In the feasibility study for LiLACS NZ, high nutrition risk was found to correlate with a decline in physical function and lower levels of haemoglobin and serum zinc (Wham et al., 2011). Among older adults in Alabama, high nutrition risk was shown to be related to mortality and hospitalisation (Buys et al., 2014). These studies demonstrate significant complex relationships between lifestyle, health, and outcome (mortality and hospitalisation) factors and nutrition risk scores. Currently, there is limited knowledge of which specific areas of nutrition risk are most associated with these factors for adults who have aged successfully.

This study is a sub-study of the LiLACS NZ. It aims to understand the relevance of nutrition risk factor items within the key domains of the SCREEN II tool, and consequences of nutrition risk

among community-living octogenarians. The outcomes explored in this study are all-cause hospitalisations and all-cause mortality at twenty-four months from baseline. From the current knowledge in published literature, we hypothesise that high nutrition risk will be related to risk of hospitalisations and mortality for Maori and non-Maori participants at twenty-four months follow up. With regard to the key determining risk factors of SCREEN II, we hypothesise that, for participants at high nutrition risk, not all domains of nutrition risk are equally relevant predictors of outcomes (i.e. hospitalisations and mortality). A better understanding of the construct of nutrition risk items from SCREEN II and related outcomes will provide insight to which risk factors are important for good health and successful ageing.

1.1 Aims and objectives

The aim of this research is to determine the consequences (i.e. mortality and hospitalisations) of high nutrition risk in Māori and non-Māori community-living adults of advanced age in the Bay of Plenty region, New Zealand.

Three key objectives have been identified using the SCREEN II tool:

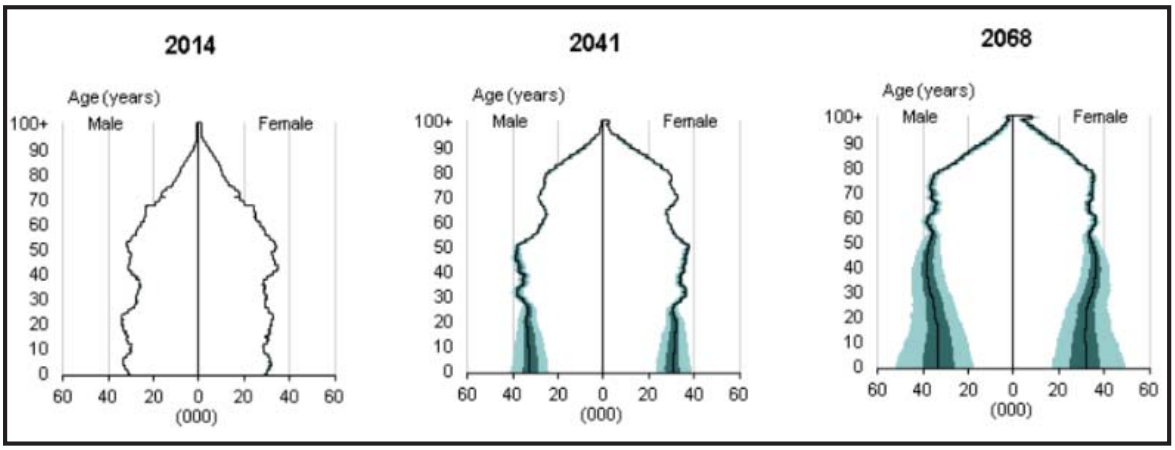
1. To investigate the variances between Māori and non-Māori ethnicities for key determining risk factors associated with high nutrition risk among community-living adults of advanced age.
2. To investigate all-cause hospitalisations for Māori and non-Māori at 24 months follow-up.
3. To investigate all-cause mortality for Māori and non-Māori at 24 months follow-up.

2.0 Literature Review

2.1 Older People in New Zealand

New Zealand is part of a global demographic change. Increasing life expectancy and falling fertility rates has lead towards a population transition and disproportionate growth in the number of older people (World Health Organisation, National Institute on Ageing, National Institutes of Health, & US National Institute of Aging, 2011). Over the next 40 years, the number of adults older than 65 years worldwide is projected to grow from 524 million in 2010 to 1.5 billion in 2050 (World Health Organisation et al., 2011). For New Zealand, projected population changes over this period are consistent with global trends and similar to the likes of Canada and Australia (Dunstan & Thomson, 2006). Population predictions made by Statistics New Zealand in 2014 suggest that by 2068, half the total population will be older than 45 years (Statistics New Zealand, 2014). These changes are best illustrated by populations pyramids shown in Figure 2.1.

Figure 2.1: Population age-sex pyramids 1961, 2014, 2041, and 2068. Sourced from National Population Projections from 2014 –2068 (Statistics New Zealand, 2014).



Among all older adults, the most significant population growth is expected in the 85+ age group. By 2051, 292,000 adults aged 85 years and older will represent 5.3% of the population (Dunstan & Thomson, 2006; Statistics New Zealand, 2014). Although a large proportion of this group are living longer in good health (Statistics New Zealand, 2014), the increasing number and proportion of older people requiring ongoing health care and support presents significant economic implications for New Zealand (Dunstan & Thomson, 2006).

2.1.1 Life expectancy of non- Māori

Life expectancy measures the average number of years for a population to be living independently and in presumable in good health (Ministry of Health, 2002). This measure does not take into account quality of life, but in general, it reflects mortality rates of a specific

population. Life expectancy at age 65 is used when describing the health of older adults (Ministry of Health, 2002). Overall, the life expectancy of older people in New Zealand is increasing (Statistics New Zealand, 2015b). Women tend to live longer than men, but since mid-1980s the gender gap has become smaller (Statistics New Zealand, 2015b). In 2012, life expectancy till death at age 85 was 6.5 years for females and 5.9 years for males (Statistics New Zealand, 2015b).

2.1.2 Life expectancy of Māori

The cultural diversity of New Zealand's ageing population is expected to become even more so with the predicted population growth. According to the 2013 census, 14.9 percent of New Zealander's identify as Māori ethnicity (Statistics New Zealand, 2013). Since the 2006 census when 2,652 Māori 80 years and older represented 0.47% of the total population, the proportion of Māori in the over 80 age group has nearly doubled to 0.75% (4,473) in 2013 (Statistics New Zealand, 2013). There are increasing numbers of Māori living to older age. Population projections by Statistics NZ suggest a 500% increase in Māori over the age of 65 years, with the largest proportion of which being in the 65-74 age group (Dunstan & Thomson, 2006). With this growth comes significant economic implications for supporting the health of older Māori and their local communities (Dunstan & Thomson, 2006).

Life expectancy of Māori is lower than the New Zealand average (Statistics New Zealand, 2015b). At the age of 80, Māori men are expected to live an average of 7.4 years and Māori women expected to live 8.5 years (Statistics New Zealand, 2015b).

2.1.3 Māori Health Strategy

Having higher mortality rates and a shorter life expectancy represent significant health inequalities experienced by Māori in New Zealand. To this day, the social and cultural effects of colonisation by early settlers continue in influence Māori health. Unequal distribution of health determinants which limit one's access to resources that are needed to improve and maintain health outcomes are key (Ministry of Health, 2002a). Previous reports suggest Māori have less access to health care services compared to non-Māori (Hirini et al., 1999; Scott, Marwick, & Crampton, 2003) and may experience delayed or less effective treatment plans (Crengle S, 2005). Disparities in access to health care are attributed to a combination physical and sociocultural barriers (Hirini et al., 1999). For example, westernised health care aligns imperfectly with customary Māori beliefs of health and illness (Table 2.1; Hirini et al., 1999). Recognition of the special relationship between Māori and the Crown is key for addressing inequalities and supporting Māori health.

Māori are te Tangata Whenua, the indigenous people of New Zealand. Protection and concern for the health and wellbeing of was one main intention for the signing of te Tiriti o Waitangi (Ministry of Health, 2002a). The New Zealand Government is committed to fulfilling the special relationship between iwi and the Crown through the principles of *Partnership* (working with Māori communities at all levels to develop strategies for the community's health care), *Participation* (involving Māori at all levels of the planning and delivery of healthcare services), and *Protection* (working to ensure that Māori have at least the same level of health as non-Māori, and safeguarding Māori cultural concepts, values, and practices) (Ministry of Health, 2002a). He Korowai Oranga (The New Zealand Māori Health Strategy) was developed with the aim of improving Māori health and reducing inequalities (Ministry of Health, 2002a). The overall goal is whānau ora, which means for Māori families are to be supported to achieve their maximum health and wellbeing (Ministry of Health, 2002a).

Māori people have a holistic view of health where the whānau health is recognised as the foundation health in Māori society (Ministry of Health, 2002a). "Whare Tapa Wha" is a well-known Māori health model which encompasses whānau (family and community aspects), tinana (physical aspects), wairua (spiritual aspects), and hinengaro (mental and emotional aspects) (Durie, 1994). Health of the whānau, which includes health of older Māori, is supported when each wall of the house works in harmony. The whare tapa whā model, as is was described in detail by Durie (1994), is summarised in Table 2.1. The lens of a holistic Māori health model is to be applied when considering the health of older Māori. Only through the combination of supporting spiritual, mental, physical, and family as well as community health can whānau ora be achieved.

Table 2.1: The whare tapa whā model, adapted from "Whaiora: Māori health development" (Durie, 1994).

	Taha Wairua	**Taha Hinengaro**	**Taha Tinana**	**Taha Whānau**
Focus	**Spiritual**	**Mental**	**Physical**	**Extended family**
Key Aspects	The capacity The capacity for faith and wider communication	The capacity to communicate, to think, and to feel	The capacity for physical growth and development	The capacity to belong, to care, and to share
Themes	Health is related to unseen and unspoken energies	Mind and body are inseparable	Good physical health is necessary for optimal development	Individuals are part of wider social systems

2.1.4 Health of Older People Strategy

The rapidly growing population of seniors in advanced age is predicted to represent a more variable health demographic that will parallel an increasing need for health and support services (Ministry of Health, 2002b). When compared to Australia, New Zealand experiences greater rates of mortality and chronic disease (Kowal, Towers, & Byles, 2014). Untreated disease and disability represent substantial economic loss and productivity for New Zealand (Kowal et al., 2014). Innovative and responsible social policy since has been developed to mitigate the economic implications of population ageing (Ministry of Health, 2002b; Ministry of Social Development, 2001).

The New Zealand government's Positive Ageing Strategy is aimed at promoting the value and participation of older people in their communities through working across sectors to address the needs of both older and younger generations (Ministry of Social Development, 2001). Ageing in Place is one of the key goals of the New Zealand Positive Ageing Strategy (Ministry of Social Development, 2001). The aim of this policy is to enable older people to make choices later in life about where to live and to feel safe and secure in their communities (Ministry of Social Development, 2001). It aligns with a global movement to keep older people living in the community and looking after themselves, thus reducing overall costs of care to society (World Health Organisation et al., 2011).

The Health of Older People strategy was developed with priorities from the New Zealand Positive Ageing Strategy (Ministry of Social Development, 2001) and guided by the aims and principles from the New Zealand Health Strategy (Minister of Health, 2000), New Zealand Disability Strategy (Minister for Disability Issues, 2001), and the Māori Health Strategy, He Korowai Oranga (Ministry of Health, 2002a). It's primary objective is to improve health status and to support the wellbeing and quality of life of older people so they may have control over their lives and contribute to family, whānau, and community life (Ministry of Health, 2002b).

The concept of successful ageing comes centrally to the Health of Older People Strategy. Successful ageing means to progress through life at low risk of disease and disability, to retain high mental and physical function, and have active engagement and enjoyment in life (American Dietetic Association, 2005). According to the most recent New Zealand Health Survey, the majority of older people in New Zealand consider themselves to be healthy and free from disability (Ministry of Health, 2006). However, there is a minority of older adults who become frail and vulnerable in their last few years of life and require a great level of care and support (Ministry of Health, 2006). Declining health in old age occurs through the net accumulation

physiological, socioeconomic, and psychological health determinants (Ministry of Health, 2006). Rather than addressing only comorbidity and disability, the aims of the Health of Older People Strategy incorporate an integral model that considers aspects of quality of life and wellbeing through a life course approach (Ministry of Health, 2002b). This integrated approach not only defines the functional parameters of health, but to also encompass the psychological and social determinants of wellbeing. It also aligns with traditional Māori holistic models of health (Ministry of Health, 2002a).

2.2 Physical health and function of older people

2.2.1 Body composition

Healthy ageing is associated with normal-physiological-changes in body composition that have minimal effects on physical health and function (Jackson, Janssen, Sui, Church, & Blair, 2012; Prado, Wells, Smith, Stephan, & Siervo, 2012). Healthy community-living older people have been shown to have greater fat mass, greater visceral fat mass, and less fat-free mass than their younger counterparts (Kyle et al. 2001). Changes in body composition with ageing are highly heterogeneous as there are influenced by many endogenous non-modifiable (e.g. ethnicity and hormonal factors) and modifiable lifestyle (e.g. nutrition and physical activity) factors (Hao & Guo, 2012). Fat-free mass losses are not inevitable; those who gain weight with age also gain muscle mass and are at lower risk of losing muscle mass as rapidly (Forbes, 1999). When maintained within a healthy range, lean body mass is associated with good physical function that can allow older people to remain functionally healthy and independent their communities (Hao & Guo, 2012; Thomas, 2007).

Body mass index (BMI) is widely used as an indicator of body composition and overall health (World Health Organisation, 2007). It is calculated by a person's body weight divided by their height squared (kg/m^2), the main assumption being that body weight relative to height indicates body fatness (World Health Organisation, 2007). Epidemiological data has shown the link between a BMI below the healthy range and excess mortality in older community-living Australians (Atlantis, Browning, & Kendig, 2010). Older adults who weigh less have increased risk of health loss and nutritional problems (Miller & Wolfe, 2008). The BMI is incorporated in the National Institute for Health and Care Excellence guideline for defining malnutrition in older people: a BMI of less than 18.5 kg/m^2 or less than 20 kg/m^2 combined with unintentional weight loss of greater than 5% within the last 3–6 months suggests malnutrition (National Collaborating Centre for Acute Care (UK), 2006).

The healthy BMI cut off for adult New Zealanders is between 18.5 kg/m^2 and 25 kg/m^2 (University of Otago & Ministry of Health, 2011). However, BMI and actual body composition is enormously heterogeneous between genders, ethnic groups and ages (Gallagher et al., 1996; Jackson et al., 2012). Previously, a higher BMI cut-off of 32.0 kg/m^2 was used among Māori adults to define obesity as Māori tend to be leaner at a higher body weight due to a higher proportion of lean muscle mass (Rush, Freitas, & Plank, 2009; Rush et al., 2007). The clinical relevance of using a different BMI cut-off has been disputed (Taylor et al., 2010). Such ethnic differences were apparent in the 2006/07 New Zealand Health Survey which showed a high prevalence of overweight and obesity among older Māori. For adults aged 65 years and over, 48.9- 55.5% of Māori and 25-28.3% of non-Māori were obese (defined using the BMI cut-off of ≥ 30.0kg/m^2) (Ministry of Health, 2011). Evidence has shown that older adults who are overweight or obese may have a healthy weight for their age (Diehr & Beresford, 2003). With evidence suggesting the relationship between BMI and mortality becomes decreasingly U-shaped with advancing age, high body weight may be protective factor for adults over 75 years (Corrada, Kawas, Mozaffar, & Paganini-Hill, 2006; Winter, Wattanapenpaiboon, Nowson, & MacInnis, 2014).

Accentuated, unintentional, changes in body weight and composition are not a normal part of ageing (Hao & Guo, 2012). When accompanying an underlying disease process, body composition changes are associated with increased morbidity and mortality in older people (Buys et al., 2014; Hao & Guo, 2012; Newman et al., 2001). Even modest changes to body weight (loss of 5% or more over three years), when unintentional, has been shown to increase risk of mortality among community-living older adults (n=4,714 aged ≥65 years) (Newman et al., 2001). A large component of these involuntary changes is the loss of fat-free mass, including skeletal muscle mass, which parallels a decline in physical function (Thomas, 2007). Low fat-free mass has been shown to increase mortality in otherwise healthy community-living older people with a hazards ratio of 0.77 (Genton, Graf, Karsegard, Kyle, & Pichard, 2013). Such disease-related body composition changes are considered to be a cornerstone of the multifactorial process of sarcopenia and cachexia (Hao & Guo, 2012; Thomas, 2007).

As of yet, there is minimal population-based evidence estimating the occurrence of sarcopenia among older Māori and non-Māori New Zealanders. In 2010, a cross-sectional description of 206 vulnerable community-living older people in New Zealand found a 4-12% prevalence of sarcopenia with an additional 16% prevalence of sarcopenic obesity (Waters et al., 2010). Thus 20.4-27.6% had low lean muscle mass which was associated with loss of physical function

(Waters et al., 2010). In addition, they were also found to be at risk of bone mass loss, poor physical functioning, and falls (Waters et al., 2010).

2.2.2 Causes of Morbidity and Mortality

The majority of older people will achieve a relatively healthy positive ageing experience with modest decline in health (Ministry of Health, 2013a). Indeed, some decline in health is an inevitable part of the ageing process, but some more than others experience significant health loss from the effects of chronic disease and disability (Ministry of Health, 2006). Compared to younger adults, older people are more likely to live with four or more chronic diseases, of which most commonly include heart disease, stroke, diabetes, chronic obstructive pulmonary disease (COPD), arthritis, spinal disorders, osteoporosis, and cancer (Ministry of Health, 2006). Cardiovascular diseases and COPD are the leading causes of death among older adults 75 and older (Ministry of Health, 2006). Older Māori, who experience the greatest inequalities in health, are disproportionately affected by cardiovascular disease, some forms of cancer, COPD, and diabetes (Ministry of Health, 2011).

Table 2.2 shows the top five ranked major causes of death for Māori and non-Māori by gender from the 65+ and 85+ age groups. These causes of death have been ranked by age-standardized mortality rates that have been adapted from the "Health of Older Māori Chart Book 2011 (Ministry of Health, 2011)" and the "Older People's Health Chart Book 2006 (Ministry of Health, 2006)".

Table 2.2: Major causes of death, ranked by age-standardised mortality rates, for females and males 85+ years (2000-2002) (Ministry of Health, 2006) and Māori and non-Māori, by gender (2005-2007) (Ministry of Health, 2011).

	All 85+	Māori (65+)	Non-Māori (65+)
Men	Ischaemic heart disease Stroke COPD Other forms of heart disease Prostate cancer	Ischaemic heart disease Lung cancer Diabetes COPD Other form of heart disease	Ischaemic heart disease Stroke Lung cancer COPD Colorectal cancer
Women	Ischaemic heart disease Stroke Other forms of heart disease Organic psychotic causes COPD	Ischaemic heart disease Lung cancer COPD Stroke Diabetes	Ischaemic heart disease Stroke COPD Colorectal cancer Lung cancer

The aforementioned major causes of death and comorbidity for older adults are also ranked highly as the leading causes of health loss in New Zealand. Table 2.3 shows the top ten condition groups ranked according to percentage contribution to total Disability Adjusted Life Years lost (DALYs) (Ministry of Health, 2013b).

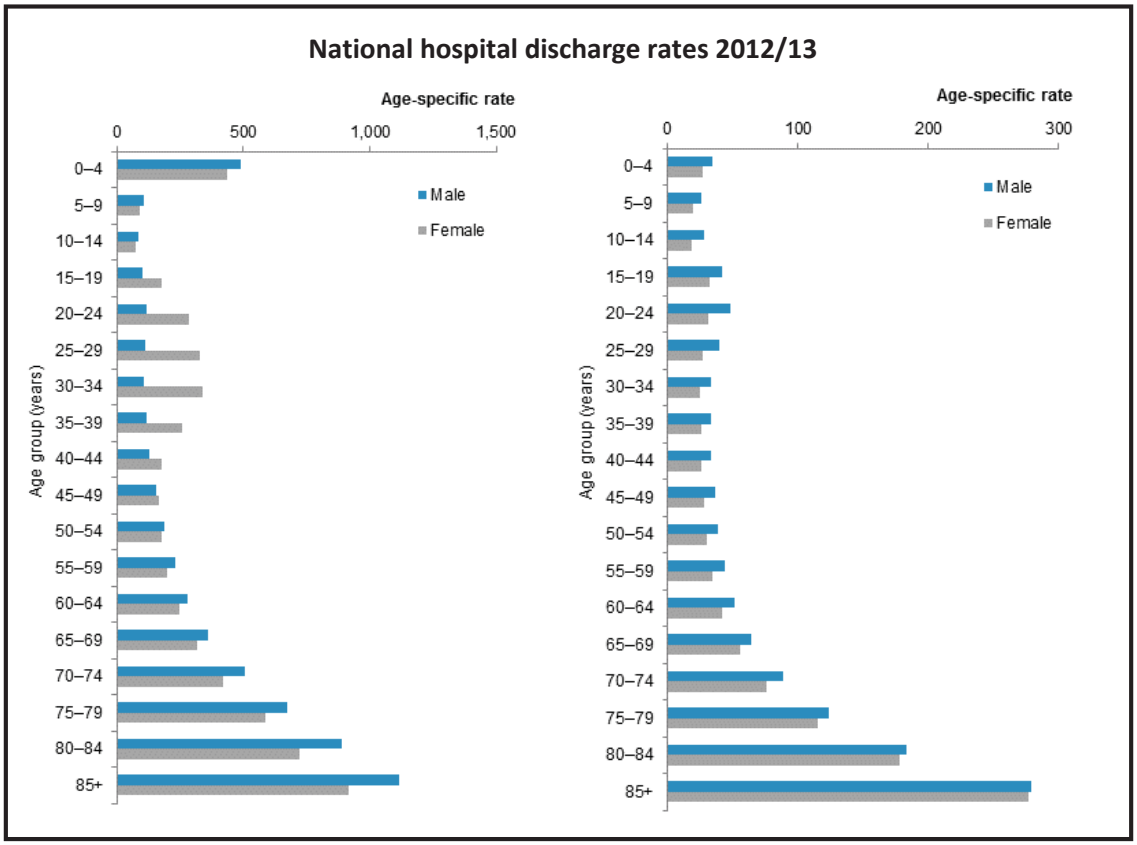
Table 2.3: Top 10 'broad' causes of health loss in New Zealand (2006) described as Disability Adjusted Life Years lost (DALYS) (Ministry of Health, 2013b).

Condition group	Rank	DALY count	Percentage of total DALYs
Cancer and other neoplasms	1	167,149	18
Vascular and blood disorders	2	166,863	17
Mental disorders	3	106,398	11
Musculoskeletal disorders	4	87,225	9
Injury	5	76,269	8
Neurological conditions	6	65,293	7
Respiratory disorders	7	60,276	6
Infant conditions and birth defects	8	50,338	5
Diabetes and other endocrine disorders	9	38,780	4
Reproductive and gestational disorders	10	33,618	4

2.2.3 Causes of Hospitalisations

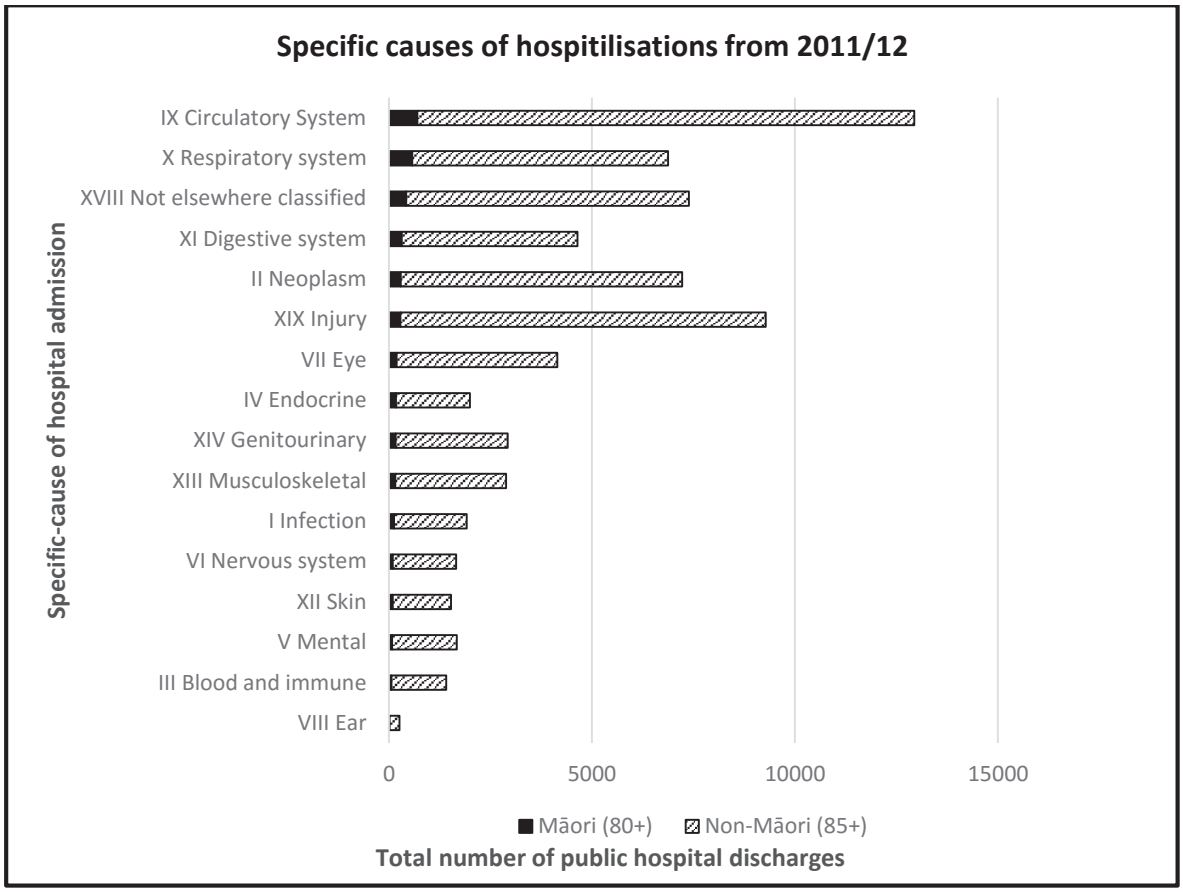
According to the most recent data, in the year 2012/13 there were more than 1.1 million publicly funded discharges from New Zealand hospitals (Ministry of Health, 2015b). Older adults have the highest hospital discharge rates than any other age group; adults aged over 85 years represented 6.5% of all hospitalisations from 2012/13 (Figure 2.2). For hospitalisations from injury, adults aged over 85 years were even more so represented; in 2012/13 falls accounted for more than half (57.7%, 11,972) of injury-related hospitalisation in adults over 85 years – nearly three times that of adults in the 75-79 age group. Figure 2.2 shows publicly funded hospital discharge rates (left) and hospitalisation rates involving injury and poisoning (right), by age and sex for 2012/13 (Ministry of Health, 2015b). Hospitalisation discharge rates are less for Māori. Among the total of 180,877 hospital discharges for Māori, those over the age of 80 years represented 2.2% (4,007).

Figure 2.2: Publicly funded hospital discharge rates (left) and hospitalisation rates involving injury and poisoning (right), by age and sex, 2012/13. Sourced from (Ministry of Health, 2015b)



Causes of hospitalisations are classified by the International Statistical Classification of Diseases and Related Health Problem (ICD-10 codes) (World Health Organisation, 2010). Rates for causes of hospitalisations are summarised in Figure 2.3 which shows diseases of the circulatory system, respiratory system, neoplasms, and injury as the leading diagnoses from publicly funded hospital discharges.

Figure 2.3: Total publicly funded hospital discharges for Māori (80+ years) and non-Māori (85+ years) adults from 1 July 2011 to 30 June 2012 sorted by ICD-10 codes. Sourced from (Ministry of Health, 2015b)



Significant disparities in hospitalisations exist for older Māori. Infectious diseases, which make a large and increasing contribution to hospitalisations, are a significant source of health inequalities for Māori (Baker et al., 2010). A report by Baker et al. (2010) showed the from 1989 to 2008 infectious disease rates have increased by 70.7% for Māori while for NZ European (or other ethnicities) there was a 56.6% increase (Baker et al., 2010). Socioeconomic deprivation, being a strong independent risk factor, makes Māori approximately twice as likely to be hospitalised from infectious disease (Baker et al., 2010).

2.3 Psychological Health of Older People

Changes in cognition with old age can negatively impact a person's autonomy and independence (Ministry of Health, 2013a). Some memory decline is a normal part of ageing (Youngjohn, Larrabee, & Crook, 1991). However, memory disability, which is defined as a long-lasting condition or health problem that causes on-going difficulty remembering things, can majorly influence the health of older people (Ministry of Health, 2013a). According to the 2001 New Zealand Household Disability survey, an estimated 9% of adults over the age 75 years have a remembering disability (Ministry of Health, 2004).

Depression is a significant concern affecting the psychological health of older people. It is associated with cognitive and physical deterioration, comorbidity, disability, and need for social support (Cherubini et al., 2012). Depression is also a risk factor for neurological illnesses such as Parkinson's disease, stroke, and dementia (Cherubini et al., 2012). In New Zealand, the prevalence of anxiety or depressive disorders among older Māori over 65 years was estimated at 7.3% for men and 8.2% for women in 2006/07 (Ministry of Health, 2011). For non-Māori over 65 years, the prevalence was 6.0% among men and 6.6% among women (Ministry of Health, 2011). Hospitalisation from intentional self-harm and suicide mortality among older adults demonstrate a vast social cost of depression in New Zealand (Ministry of Health, 2006). In 2012/13 there were 129 hospital admissions for adults over 75 years for intentional self-harm (Ministry of Health, 2015b). Older men (85+ years) have also been shown to have double the rates of mortality from suicide compared to younger adult counterparts (50-64 years) (Ministry of Health, 2006).

2.4 Nutritional Health of Older People

Good nutrition throughout life is essential for healthy ageing and maintaining quality of life (World Health Organisation & FAO, 2003). It plays a major role for supporting other aspects of health in old age such as mobility, independence, psychological health, and cultural relationships (Stanner et al., 2009; World Health Organisation, 2002). Food has a critical role in both physiological wellbeing and in social, cultural, and psychological quality of life (American Dietetic Association, 2005). Due to the many physiological, metabolic, and cultural changes associated with ageing, the nutritional requirements of older adults require special attention (World Health Organisation, 2002). Overall, older adults require good nutrition to prevent malnutrition, support physical function, reduce the risk of chronic disease, support mental health, and prevent disability (Ministry of Health, 2013a).

Specific nutritional requirements are different for older people in New Zealand (NHMRC & Ministry of Health, 2006). Compared to the wider population, they also tend to have different dietary intakes and food-related behaviours. The 2008/09 New Zealand Adult Nutrition Survey (2008/09 NZANS) provides information on the dietary patterns and nutrient intakes of adults over 75 years (University of Otago & Ministry of Health, 2011). The 2008/09 NZANS describes dietary patterns in relation to the Nutrient Reference Value for Australia and New Zealand (NHMRC & Ministry of Health, 2006) and the Food and Nutrition Guidelines for Healthy Older People (Ministry of Health, 2013a). Nutrient Reference Value for Australia and New Zealand refers to the levels of recommended intakes of essential nutrients (NHMRC & Ministry of Health, 2006). These recommendations are described in terms of life stages; for older people in New Zealand it generally refers to men and women over 70 years old (NHMRC & Ministry of Health, 2006), however, nutritional needs of older adults are non-homogenous and can vary significantly according to one's unique physiological needs, their stage of ageing and presence of chronic disease or disability (Ministry of Health, 2013a).

The determinants of nutritional health for older adults are complex. Involved are an interplay of general socioeconomic, cultural, and environmental conditions; social and community networks; and individual and lifestyle factors. These are summarised in Figure 2.4 (Ministry of Health, 2013a). Nutrition risk factors can arise from individual health conditions and physical independence, from lacking social connections or opportunities to engine in their community, and from wider socioeconomic factors such as food security. In reverse, poor nutritional health can also negatively affect many areas of health and quality of life for older people. Understanding nutrition-related risk factors across all three levels (Figure 2.4) is essential for identifying and providing adequate nutritional care to older adults at high nutrition risk (Dietitians Association of Australia, 2009).

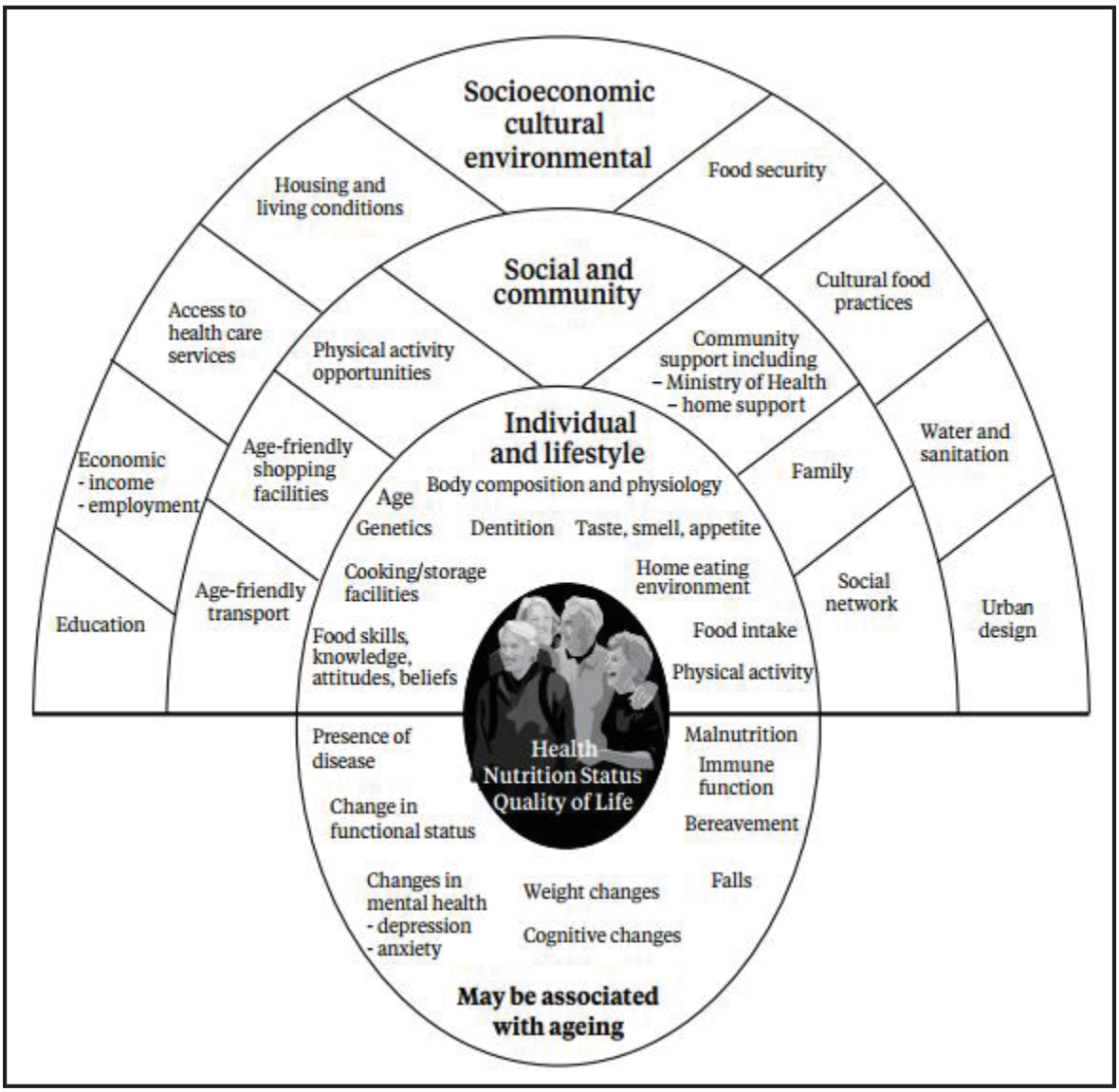


Figure 2.4: Factors contributing to nutrition-related health. Sourced from the Food and Nutrition Guidelines for Healthy Older People (Ministry of Health, 2013a)

2.5 Malnutrition among community-Living older people

Older adults encounter many barriers to access and enjoy healthy food and are at increased risk of malnutrition (Ministry of Health, 2013a). Malnutrition is defined as "a pathological state resulting from a relative or absolute deficiency or excess of one or more essential nutrients, this state being clinically manifested or detected only by biochemical, anthropometric or physiological tests'' (Jelliffe, 1966). This broad definition encompasses any nutritional imbalance including both over and under nutrition (White, 2012). Undernutrition, in particular, is a major concern for community-living adults in advanced age as it is attributed to increased morbidity, mortality, decreased function and quality of life, increased frequency and length of hospital stay, and higher health care costs (White, 2012).

Table 2.5 summarises the Dietitian's Association of Australia evidence-based statements that form the basis of practice guidelines for the nutrition management of malnutrition in older people (Dietitians Association of Australia, 2009). These statements confirm there is a high prevalence of malnutrition among older adults the community setting, and when largely under recognised and under diagnosed, it is associated with adverse clinical outcomes and costs.

Table 2.5. Dietitian's Association of Australia Evidenced-based Statements (Dietitians Association of Australia, 2009). Developed using the NHMRC evidence grading system.

Evidence-based statements	Level of evidence
There is a high prevalence of malnutrition in the community setting (in the order of 10-30%).	Level I Level IV (Aus)
The prevalence of malnutrition is higher in older adults.	Level I Level IV (Aus)
Malnutrition is associated with adverse clinical outcomes and costs in the community setting	Level I Level II (Aus)
Malnutrition is under-recognised and under-diagnosed in the community setting.	Level I
Implementation of malnutrition risk screening programmes improves the identification of individuals at risk of malnutrition in the community setting.	Level IV
Implementation of routine malnutrition risk screening facilitates timely and appropriate referral for nutrition car in the community setting.	Level IV

2.6 Screening for Nutrition Risk

2.6.1 Nutrition screening tools

Nutrition screening is a process of identifying characteristics known to be associated with nutritional problems (Phillips et al., 2010). It is a process by which patients are referred into the Nutrition Care Process for further assessment, diagnosis, and intervention planning (Writing Group of the Nutrition Care Process/Standardized Language Committee, 2008). Various nutrition screening tools have been previously evaluated for their appropriateness of identifying risk of malnutrition among community-living older adults (Table 2.6). Although there is no gold standard for measuring nutrition status, the Mini Nutrition Assessment – Short Form (MNA-SF), Seniors in the Community Risk Evaluation for Eating and Nutrition (SCREEN II), and Nutrition Screening Initiative (NSI, which includes the DETERMINE Checklist) appear to be the most valid and reliable tools having been subjected to suitable testing (Phillips et al., 2010).

Table 2.6: Community-specific nutrition risk screening tools reviewed by Philips et al. (2010).

Community-based Nutrition Screening Tool	Citation	Population	Age group
ANSI	(Cobiac & Syrette , 1995)	Australia, Community-dwelling	>70
MUST	(Elia, 2003)	Clinical or community	Not applicable for adults in advanced age
MNA-SF	(Rubenstein, Harker, Salvà, Guigoz, & Vellas, 2001)	France, Spain, and Mexico. Hospitalised and community-dwelling.	>75
NSI/DETERMINE	(Posner, Jette, Smith, Miller, 1993)	New England. community-dwelling	>70
SNAQ	(Kruizenga, Seidell, de Vet, Wierdsma, & van Bokhorst–de van der Schueren, 2005; Wijnhoven et al., 2012)	Holland. community-dwelling	>65
SCREENI	(Keller, Hedley, & Wong Brownlee, 2000)	Canada. community-dwelling	>65
SCREENII	(Keller et al., 2005)	Canada. community-dwelling	>55
SEGAm	(Oubaya et al., 2014)	Community-dwelling	77
GFST	(Tavassoli et al., 2014; Vellas et al., 2013)	Community-dwelling	>65

2.6.2 Prevalence of Nutrition Risk

Approximately 30-60% of community living seniors are at risk of malnutrition. Table 2.7 summarises the estimated prevalence of nutrition risk among community living seniors in New Zealand and Canadian using the SCREEN II tool. The prevalence of nutrition risk higher among the adults of advanced age and among older Māori.

Table 2.7: Prevalence of high nutrition risk among various groups of community-living older adults, as estimated by the SCREEN II nutrition risk screening tool.

Study	Population	n	Age (years)†	SCREENII Score†	% High risk (SCREENII score cut off)
(Keller et al., 2001)	Canada; Community, rehabilitation, acute	128	74 (9.1)	46.6 (7.4) *	40.6(≤45)* 66.4(≤50)
(Keller & Hedley, 2002)	Canada; Community	247	71.7 (8.3)	49.6 (5.9) *	23.5 (≤45)*
(Keller, 2006) Intervention study	Canada; Community, frail, receiving support	263	78.7 (8.0)	46.9 (5.7) *	41 (≤45)*
(Keller, 2006)	Canada; Community	1,218	74.2 (10.1)	-	37.6 (<50)*
(Keller et al., 2005)	Canada; Community and frail	Study 1: 193 Study 2: 149 Study 3: 52.0	>55	Study 1: 51 (48.3, 30.4)‡ Study 2: 49.0 (47.3, 49.4) Study 3: 52.0 (50.1, 52.4)	-
(Beath & Keller, 2007)	Canada; Community	134	71.9 (8.8)	52.0 (SD 6.3)	- (<50)
(Southgate, Keller, & Reimer, 2010)	Canada; Community	61	50.8% <75 49.2% >75	50.49	62.3 (≤53)
(Wham et al., 2011)	North Island, New Zealand; Community	108 (33 Māori, 79 non-Māori)	Māori: 76.6 (1.8) non-Māori: 85.2 (0.6)	49 (range 29-58)	50.9 (<50)
(Watson et al., 2010)	Christchurch, New Zealand; Community	152	79.5	-	31 (≤49)
(Wham & Bowden, 2011)	Auckland, New Zealand; living alone.	12	79-87	(range 44-56)	50 (<50)
(Wham et al., 2011)	Auckland, New Zealand; Community	51	82.4 (1.7)	52.2 (range 38-61)	31(<50)
(McElnay et al., 2012)	New Zealand; Hawke's Bay electoral roll	473	74	-	32.8 (≤49)
(Broeska, Lengyel, & Tate, 2013)	Canada; Community	522	86.7 (3)	49.9 (range 15-64)	44(≤49)
(Wham et al., 2014) LiLACS NZ sub-study	Tauranga, Western Bay of Pleanty, New Zealand; Community	45	85-86	51.0 (range 36-60)	33(≤49)
(Wham et al., 2015) LiLACS NZ	Tauranga, Western Bay of Pleanty, New Zealand; Community	255 Māori 400 non-Māori	82.3 (2.6) Māori 84.6 (0.5) non-Māori	48 (6)	49.4 Māori, 38.3 non-Māori (≤49)

*Earlier studies using SCREEN version I

†Values are means with SD in parenthesis

‡ Values are median with 95% confidence interval in parenthesis

2.7 Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II)

The Seniors in the Community: Risk Evaluation for Eating and Nutrition, version II (SCREEN II) nutrition risk screening tool was developed by Keller et al. (2005) to fill a needed gap as a "valid, self-administered index that can be used to identify grades of risk in more 'well' seniors where prevention through nutrition education may be more appropriate". SCREEN II is a simple 14 item questionnaire which was first developed to assess nutrition risk among community-living older adults in Canada (Keller et al., 2005). It has since been validated among octogenarians in New Zealand against a standardised dietitian's nutrition risk rating score (Wham et al., 2014). The SCREEN II questionnaire consists of three major domains which are summarised in Figure 2.5. These 14 items provide information on weight change, food intake, and risk factors affecting food intake. For each question in SCREEN II there are five possible responses that provide a score from 0 to 4. Lower scores indicate higher nutrition risk. The validation of SCREEN II suggested individual item scores of ≤2 may indicate nutrition risk, while the overall cut-off of ≤49 is used to identify high nutrition risk.

Figure 2.5: Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN II) nutrition risk screening tool consists of 14 items from three major domains.

1) WEIGHT CHANGE

1. a) Has your weight changed in the last six months?
   - >2.5 kg weight loss
   - >2.5 kg weight gain

   b) Unintentional weight change

   c) Perception of own weight
   - Overweight
   - Underweight

2) DIETARY INTAKE

2. Often/always skip meals
3. Limits or avoids certain foods
4. Fair/poor appetite
5. ≤ 3 fruit and vegetable serves per day
6. ≤ 1 meat or meat alternatives serves per day
7. ≤ 2 milk product serves per day
8. ≤ 3-4 c fluid per day

3) FACTORS AFFECTING INTAKE

9. Has swallowing difficulty
10. Has chewing difficulty
11. Uses meal replacements
12. Eats alone
13. Cooking is a chore
14. Often/always difficulty with groceries

2.8 Nutrition risk factors for SCREEN II

Malnutrition can be described as a complex process (Keller, 2007). It is firstly by the presence of nutrition risk factors which influence dietary intake which progressively lead to inadequate intake relative to a person's nutritional needs (Keller, 2007). Sub-clinical malnutrition may manifest as moderate changes in anthropometry and biochemistry (Keller, 2007). When these nutrition risk factors are left unchanged, overt malnutrition can develop and have global influence on health and physical function (Keller, 2007).

Nutrition support in the community requires a holistic approach (Keller, 2007). Such an approach should identify key nutrition risk factors and barriers to nutritional health, thus providing the basis of intervention for preventing further deterioration of nutrition status and health (Keller, 2007; Mueller et al., 2011).

2.8.1 Weight change

Nutritional assessment in older people involves a component of anthropometric measures (body weight, BMI, body composition) and an investigation into weight history (Mueller et al., 2011; Writing Group of the Nutrition Care Process/Standardized Language Committee, 2008). To identify those at risk of malnutrition in the community setting, many nutrition screening tools include questions about recent weight changes and BMI (Mueller et al., 2011; Skipper, Ferguson, Thompson, Castellanos, & Porcari, 2012). Three questions in the SCREEN II questionnaire (Figure 2.5) are dedicated to the weight change domain. These questions aim to identify significant weight loss or gain (2.5 kg over the last six months), unintentional weight change, and self-perceived weight as over or underweight.

Guidelines from the National Institute for Health and Clinical Excellence describe unintentional weight loss of greater than 10% within the last 3–6 months, or greater than 5% within the last 3–6 months combined with a BMI of less than 20 kg/m^2 suggests malnutrition and the requirement of nutrition support (National Collaborating Centre for Acute Care (UK), 2006). Thus, identifying community living older people at high risk of overt weight changes and malnutrition is essential for providing the appropriate level of care (National Collaborating Centre for Acute Care (UK), 2006).

Unintentional weight loss is associated with morbidity and mortality particularly when excessive (>5% of body weight) or associated with low body weight (BMI <20 kg/m^2) (National Collaborating Centre for Acute Care (UK), 2006). An Australian longitudinal study of ageing established that being underweight (BMI <18 kg/m^2) was associated with excess mortality (HR

2.15) (Atlantis et al., 2010). The same study showed having a high body weight in old age was found to be protective as unintentional weight loss in the overweight or obese(BMI >25kg/m^2) was associated with lower mortality (Atlantis et al., 2010). Newman et al. (2001) showed that among adults over 65 years, those who had lost greater than 5% body weight in 3 years had two times the risk of mortality compared to the stable weight group (Newman et al., 2001). Interestingly, mortality rates were similar regardless of weight loss being intentional or unintentional, and were not affected by baseline starting weight. A meta-analysis of 26 studies demonstrated unintentional weight loss was associated with a 22-39% increase in mortality (Harrington, Gibson, & Cottrell, 2010). The relationship of causation, however, is not always certain as in some cases weight loss may be a marker of an underlying condition being the organic cause health loss and reduced independence (Hao & Guo, 2012).

Weight loss in older people is usually accompanied by a disproportionate loss of lean body mass (Houston et al., 2008; Kyle et al., 2001). Sarcopenic muscle loss can lead to functional decline, disability, and frailty (Edwards et al., 2015). Left unaddressed, these limitations may lead to further worsening nutrition status and health loss (Jung et al., 2014). Jung et al. (2014) showed frail older adults who had experienced greater than 5% unintentional weight loss were 2.9 times more likely to continue to have lean muscle losses over the next year (Jung et al., 2014). A cohort study of 768 adults over 70 years from a range of settings showed that weight loss was related to lost basic activities of daily living which included the ability to self-feed (Martinez-Reig et al., 2014). Also among Danish nursing home residents (n=441, aged ≥65 years), eating dependency, low appetite, and eating difficulties could predict future weight loss (Beck, 2015). These studies demonstrate a relationship between body weight and the presence of nutrition risk factors affecting dietary behaviours.

2.8.2 Inadequate Intake

"Food Intake" is the second domain of SCREEN II that aims to identify general dietary inadequacies that may contribute to risk of malnutrition (Figure 2.5). As shown in the 2008/09 NZANS, the majority of older New Zealanders obtain energy and nutrients from a variety of foods and beverages (University of Otago & Ministry of Health, 2011). Consuming a variety of nutritious foods from the main food groups daily is important for keeping in good health, maintaining nutrition status, and overall quality of life (Ministry of Health, 2013a). Inadequate food intake relative to nutritional needs can progressively contribute to developing compromised nutritional status. Therefore, dietary behaviours of older people in the community are a significant component of nutrition risk to consider (Keller, 2007).

2.8.2.1 Skipping meals, food avoidance, and loss of appetite

Three items in SCREEN II are directed at dietary behaviours and are associated with risk of malnutrition (Wham et al., 2014). These include (item 2) “often or always skipping meals”, (item 3) “limiting or avoiding certain foods”, and (item 4) “fair or poor appetite” (Figure 2.5). These factors are important as low intake or complete exclusion of certain food groups increases the likelihood of dietary inadequacies and risk of nutritional problems.

Appetite is known to decrease with age. Older people are less hungry, feel more quickly satiated after a meal, and eat fewer snacks (Morley, 2012; Hao & Guo, 2012). However, a severe loss of appetite with age, termed “anorexia of ageing,” is a disease-related geriatric syndrome (Morley, 2012). By leading to weight loss, anorexia can predispose a person to becoming frail and subsequently at risk of poor health (Morley, 2012). A Spanish study involving 678 adults over 70 years found anorexia, among weight loss and mobility impairment, predicted of incidence of disability that was associated with nutrition risk (Martinez-Reig et al., 2014). Age-related changes to appetite and changes to dietary behaviours are connected; they can make older people at risk of having low food intake (Hao & Guo, 2012). Donini et al. (2013) analysed the dietary patterns of 526 adults over the age of 65 from both the community and residential care setting, of which 21.2% had symptoms of anorexia. Not only did this study reveal a marked decrease in overall food intake in anorexic participants, but certain food groups were favoured more than others. Foods limited or avoided were “fruits and vegetables” and “meat, eggs, and fish” (Donini et al., 2013). As the latter is an important source of high biological value protein and energy, and both food groups sources of essential vitamins and minerals, it is unlikely for such an anorexic dietary pattern to provide adequate nutrition for good health. Indeed, dietary variety has been associated with better biochemical and anthropometric nutritional status among frail elderly in residential care (Bernstein et al., 2002).

Dietary habits of New Zealanders was examined in the 2008/09 NZANS (University of Otago & Ministry of Health, 2011). When asked “How many days in an average week do you have something to eat for breakfast?” 95.5% of men and 96.9% of women over 71 years reported eating breakfast daily. In contrast to younger age groups, older adults had the highest prevalence of regularly eating breakfast. For Māori aged over 51 years, regular breakfast consumption was less, 60.5% of men and 68.7% of women reported to eat breakfast daily.

2.8.2.2 Low vegetable and fruit intake

Vegetables and fruit are considered one of the most important dietary factors for preventing age-related chronic disease (Anlasik et al., 2007; Hung et al., 2004; World Health Organisation & FAO, 2003). For older people in New Zealand, they are an important source of essential vitamins

(especially folate, vitamin A, and vitamin C), minerals (potassium and magnesium), dietary fibre, and energy in the form of carbohydrates (Ministry of Health, 2013a). Consuming three or fewer servings of vegetables and fruit daily is a risk factor for malnutrition (Figure 2.5). In interviews with single older men in New Zealand at risk of malnutrition, Wham & Bowden (2011) identified limiting fresh fruit and vegetables purchases to cut grocery costs was a common practice. Donini (2013) identified in a cross-sectional study (n=526, aged ≥65 years) that older people with low intakes of fruits and vegetables were more likely to have poor nutritional biochemistry and anorexia. Overall, consumption of fruit and vegetables is associated with better food habits and nutritional status (Aparacio, Andres, Perea, Lopez-Sobaler, & Ortega, 2010).

According to the 2008/09 NZANS (University of Otago & Ministry of Health, 2011), older New Zealanders were more likely to eat the recommended three or more servings of vegetables and two or more servings of fruit daily compared to younger age groups. However, the survey also showed that approximately one fifth (18.6% of men and 23.1% of women) reported to consume inadequate servings of vegetables, and about a third (37.4% of men and 27.6% of women) were not meeting the recommended servings of fruit. For Māori over 51 years, the prevalence of inadequate vegetable intake is nearly double that of aged-matched non-Māori (Māori: 41.4% of men and 35.6% of women versus non-Māori: 29.5% of men and 15.1% of women, Table 2.8).

Table 2.8: Prevalence of self-reported inadequate vegetable and fruit consumption for Māori and non-Māori adults over the age of 51 years and all adults over 71 years by gender. Adapted from the 2008/09 New Zealand Adult Nutrition Survey data tables (Ministry of Health, 2015a).

	Māori (51+) % (95% CI)	**Non-Māori (51+)*** % (95% CI)	**All adults 71+** % (95% CI)
Less than three Vegetables			
Men	41.4 (29.6-53.2)	29.5 (24.4-34.7)	23.1 (16.8-29.4)
Women	35.6 (25.1-46.2)	15.1 (12.1-18.1)	18.6 (15.6-21.6)
Less than two fruit			
Men	40.8 (28.2-53.5)	61.1 (33.4-44.4)	37.4 (32.3-42.6)
Women	38.4 (26.7-50.1)	25.9 (21.4-30.4)	27.6 (22.7-55.2)

* "New Zealand European and Others."

2.8.2.3 Low meat alternatives intake

Low intake of meat or meat alternatives is the sixth nutrition risk item on SCREEN II (Figure 2.5). Older adults are recommended to consume at least one serving from this food group daily (Ministry of Health, 2013a) Foods from the meat and alternatives food group are nutrient dense, providing important dietary sources of protein, energy, essential fatty acids, vitamins (B_{12}, niacin, thiamine), and minerals (iron, zinc, magnesium, copper, potassium, phosphorus,

selenium, and iodine) (Ministry of Health, 2013a). For adults over 71 years in New Zealand, they are been shown to provide approximately 29.9-38.7% dietary protein, and a quarter of total dietary iron (23.0-25.1%) and zinc (25.7-27.8%) (University of Otago & Ministry of Health, 2011). Particularly in old age protein needs are higher; adults over 70 years require approximately 11 (women) to 17 (men) more grams of dietary protein per day than their younger counterparts (NHMRC & Ministry of Health, 2006). Age-related changes to gastrointestinal function also make older people more vulnerable to micronutrient deficiencies through impaired absorption of micronutrients such as zinc (Mocchegiani et al., 2013) and vitamin B_{12} (Johnson et al., 2010). Special attention should be emphasised on having regular intake of the highly bioavailable sources of these nutrients.

Dietary intake of meat and alternatives positively correlated with protein intake as well as muscle mass, and nutritional status of older community-living adults in the UK and Italy (Asp, Richardson, Collene, Droll, & Belury, 2012; Donini et al., 2013). It is also associated with reduced risk of malnutrition (Donini et al., 2013). However, many older adults may have low dietary intakes of these foods due to disliking the taste, finding the tough texture of some meats difficult, or concerns about freshness and availability (Best & Appleton, 2013). Older adults with limited mobility and independence have fewer opportunities to shop for fresh food (Best & Appleton, 2013). Choice of meat and alternatives is often compromised as they require cooking skills and are susceptible to spoilage and wastage (Best & Appleton, 2013).

2.8.2.4 Low milk product intake

The milk and milk products food group includes milk, cheese, yoghurt, ice cream, and milk alternatives such as calcium-fortified soy milk (Ministry of Health, 2013a). Older people in New Zealand are recommended to choose at least three servings from this food group daily (Ministry of Health, 2013a). Consuming fewer than two servings of these foods is included in SCREEN II (Figure 2.5) and has been previously determined to be as a risk factor for malnutrition (Wham et al., 2014). There is evidence that older community-living New Zealanders at risk of malnutrition may have compromised milk product intake (McElnay et al., 2012; Watson et al., 2010). Milk products are an important nutrient-dense food for vulnerable older people (Keller, 2002), thus excluding them from the diet creates opportunity for nutritional insufficiencies.

For older New Zealanders, milk and milk products are predominant sources of dietary energy, protein, minerals (calcium, phosphorus, iodine, selenium), riboflavin and vitamin B_{12} as well as fat soluble vitamins A and D (Ministry of Health, 2013a). Findings from the 2008/09 NZANS showed milk and milk Products provide nearly half (45-46.2%) of dietary calcium and

approximately a third (33.3-35.8%) of dietary riboflavin for adults over 71 years. Older adults have higher dietary requirements for calcium due to age related bone mineral losses (NHMRC & Ministry of Health, 2006). In addition, calcium absorption is also known to decrease with age (NHMRC & Ministry of Health, 2006). Adequate dietary calcium is important in advancing age to support bone mineral density and subsequent risk of fractures (Rizzoli et al., 2014).

2.8.2.5 Low fluid intake

Water is an essential nutrient that is required for all metabolic processes throughout the body (NHMRC & Ministry of Health, 2006). Consuming fewer than three to four cups of fluid per day is a nutrition risk factor included the SCREEN II tool (Figure 2.5) as dehydration alone is a form of malnutrition (American Dietetic Association, 2005). Despite having similar fluid requirements as younger adults, older people are at greater risk of becoming dehydrated (NHMRC & Ministry of Health, 2006). Older people may drink less due to being less sensitive to thirst, having mobility impairment or pain, a fear of incontinence, delirium or dementia, or side effects from medication (American Dietetic Association, 2005). Older people with eating or swallowing difficulties having to consume texture modified diets may also drink less ("Australian and New Zealand Society for Geriatric Medicine. Position Statement - Dysphagia and aspiration in older people," 2011). Low fluid intake is an important nutrition risk factor as it may indicate that one or several of these problems are affecting intake of other nutritious foods and overall nutritional health.

2.8.3 Factors Affecting Food Intake

2.8.3.1 Swallowing or chewing difficulty

There are two items from SCREEN II which aim to identify the presence of the nutrition risk factors “swallowing difficulty” and “chawing difficulty” (Figure 2.5). A person’s chewing and swallowing abilities directly influence the kinds of food and drink consumed. Dysphagia is a disorder of the swallowing process (Bloem et al., 1990). Thorough potentially limiting food choices and total dietary intake, swallowing problems in older adults can contribute to risk of compromised nutritional status (Bloem et al., 1990; Takeuchi et al., 2014). Dysphagia has been found to be independently associated with malnutrition among frail community-dwelling older adults in Japan, thus, it is thought to be an important predictor in the malnutrition process (Takeuchi et al., 2014). Older people with chewing difficulties, which may be due to poor dentition, are at risk of encountering similar nutritional limitations. Donini et al. (2013) identified that among anorexic older adults with poor intakes, both swallowing and chewing difficulties were common. The prevalence of dysphagia among community-living older people is

estimated to be between 7 and 22% (Bloem et al., 1990), however such prevalence among older Māori and non-Māori in New Zealand has not been established.

2.8.3.2 Use of meal replacements or nutritional supplements

Use of meal replacements is the eleventh nutrition risk factor item in the SCREEN II tool (Figure 2.5). A meal replacement refers shakes, puddings, or energy bars. While some nutrition support products in New Zealand can be provided on prescription (for example through a registered dietitian), there are also various products that can also be purchased by free-living people in the community.

Nutritional support with supplements or meal replacements under the supervision of a registered dietitian or another health care professional is indicated for people who are malnourished or at risk of malnutrition (National Collaborating Centre for Acute Care (UK), 2006; Volkert et al., 2006). The use of such products aims to provide sufficient amounts of energy, protein, and micronutrients to support maintenance or improvement of nutritional status, physical function, and quality of life, as well as aiming to reduce morbidity and mortality (Volkert et al., 2006). While there is substantial evidence to support the use of nutritional supplements for meeting the nutritional needs of older people at high risk in inadequacies, their role in improving overall quality of life and reducing mortality is uncertain (Volkert et al., 2006).

Nutritional supplement usage was examined in the 2008/09 NZANS (University of Otago & Ministry of Health, 2011). Among adults aged over 71 years, 38.4% of men and 49.2% of women reported to have used any supplement in the last year. In addition, older adults were represented has the highest regular users of supplements – 33.4% of men and 44.2% of women. The main types of supplements used by adults over 71 years were oils (men 13.7%, women 18.9%), multi-vitamin and multi-mineral (men 10.6%, women 18.6%), and glucosamine/chondroitin (men 13.0%, women 15.4%). Supplement use is less prevalent among older Māori. Less than a quarter of Māori adults over 51 years (23.5% of men and 24.3% of women) reported using any form of supplements regularly. The main types of supplements used by Māori over 51 years were nutritional oils (men 9.5%, women 10.3%), multi-vitamin and multi-mineral (men 11.9%, women 2.7%), and glucosamine/chondroitin (males 10.0%, females 6.5%).

2.8.3.3 Eating alone and living alone

Social connection is an important component of health and quality of life through all life stages. To “take opportunities to eat meals with other people” is included in the New Zealand Food and Nutrition Guideline Statements for Healthy Older People (Ministry of Health, 2013a).

Particularly for Māori, sharing food has wider cultural and spiritual significance that extends beyond the nutritional quality of a meal. Traditional kai Māori (food) represents the relationship between the environment and health; it reinforces the whakapapa (genealogical ties), cultural identity, and resilience (McKerchar, Bowers, Heta, Signal, & Matoe, 2014).

Eating alone is a risk factor for malnutrition that is included in SCREEN II (Figure 2.5). Older adults who eat alone have been shown to be more likely to have a lower BMI and poor dietary variety that could suggest inadequate nutrient intake (Kimura et al., 2012). Lack of communication and connection over meals may be a key contributor to the poor nutritional health in older people who eat alone. Feelings of loneliness may lead to a depressive mood that can negatively influence appetite and motivation to eat (German et al., 2011). Conversely, older adults have been shown to eat more when in the presence of others (Locher, Robinson, Roth, Ritchie, & Burgio, 2005). In a qualitative study of six older men who were living alone in New Zealand, Wham & Bowden (2011) identified lack of a family structure, having limited finances, lack of personal transport, and lack of nutrition knowledge and cooking skills were common themes which influenced food behaviours. However in contrary, it is not unlikely for older people who live alone to maintain in good health. As shown in a study of New Zealand women (n=5, over 85 years), maintaining active engagement in one's local community and having a high perceived value of healthy living appear to be common themes among those with good nutritional health (Foster & Neville, 2010).

2.8.3.4 Difficulty acquiring or preparing food

The final risk factor items on SCREEN II identify difficulties acquiring or preparing food, specifically these two questions ask if "cooking is a chore" and if one "often/always (has) difficulty with groceries" (Figure 2.5). Older people with limited independence with daily nutrition-related tasks are less likely to consume nutritious foods. Those identified in the community that require additional help services such as meals on wheels are likely to be high nutrition risk (Johansson, Sidenvall, Malmberg, & Christensson, 2009). There is an unknown prevalence of older people in the community for which the need for additional help is not met.

Older people who have difficulty with acquiring and preparing nutritious food are at risk of poor dietary intake (American Dietetic Association, 2005). For example vulnerable older people receiving services such as 'meals on wheels' may have compromised intake. In a prospective study (n=296, twin matched pairs) risk of nutritional problems were shown to be far greater for those with higher ratings of compromised independence and self-perceived isolation (Johansson et al., 2009). Older people with signs of poor intake and compromised nutrition

status are more likely to be dependent on others for basic activities of daily living and cooking food (Donini et al., 2013). Thus, social isolation and lack of support particularly for vulnerable older people in need can likely lead to worsening nutritional problems.

Alternatively, older adults who are functionally independent in the community are more likely to engage in the procurement and preparation of nutritious foods which can positively influence their nutritional intake and health. From the sample of older men living alone in New Zealand described by Wham & Bowden (2011), the few who took enjoyment from shopping for food were seen to foster positive nutrition behaviours such as developing set routines.

2.9 Additional Risk Factors Impacting Nutritional Health

Evidence for the literature suggests there are many other risk factors, not specifically included in the SCREEN II tool, which influence the nutritional health of older people in the community. Some of these factors are explored below.

2.9.1 Taste and smell changes

Chemosensory changes associated with ageing may also play a role in changes to appetite and food intake. Older people may experience changes in food preferences that could affect food or nutrient intake (Rolls, 1999). For example, a preference toward more salty and sweet tasting foods may displace more nutrient dense bitter and sour tasting foods such as vegetables and fruit (Rolls, 1999). Donini et al. (2013) found 15.7% of anorexic participants who demonstrated signs of compromised nutrition status had different perceptions of taste. As for the decline in smell sensitivity with age, it has been related to appetite changes and lower energy intake (Kim, Hur, Cho, & Lee, 2003).

2.9.2 Polypharmacy

Polypharmacy, defined as the concurrent use of more than five medications, is used in research as an indicator of declining health status (Jyrkkä, Enlund, Lavikainen, Sulkava, & Hartikainen, 2011). It is common among older people in New Zealand, as prescribing rates are typically high for this group (Ministry of Health, 2006, 2013a). Approximately half of adults over 75 years report having received more than 15 prescriptions from their GP in the last 12 months (Ministry of Health, 2006). Polypharmacy is associated with food-drug interactions what may affect nutritional status or food intake (Jyrkkä, Mursu, Enlund, & Lonnroos, 2012). A study of 81 retirement home residents showed the average number of medications taken by older people the risk of malnutrition was higher than those without nutritional problems (Griep, Mets, Collys, Ponjaert-Kristoffersen, & Massart, 2000). Certainly, the presence of disease that is intended to be treated by medication could explain this relationship. A study of community-dwelling older

people showed when adjusted for comorbidity status, excessive polypharmacy remained associated with declining nutritional status (Jyrkkä et al., 2011)

2.9.3 Physical activity

Physical activity is important for good health with advancing age through supporting muscle strength and function as well as overall quality of life (Chodzko-Zajko, 2014). As people age, there is a general decline in physical activity (Speakman & Westerterp, 2010) which is associated with lower levels of fat-free mass (Speakman & Westerterp, 2010). In otherwise healthy community-living older people, fat-free mass has been shown to be a single predictor of poor outcomes including mortality (Genton et al., 2013). In older people living with disabilities who have limited physical function, low fat-free mass is hallmark of frailty and associated poor outcomes (Morley et al., 2013). A study of community-living older people (n=506, aged over 50 years) showed regular moderate intensity physical activity could reduce the likelihood of falling by 8.6%, even among frail people with lower levels of health (Pereira, Baptista, & Infante, 2014).

Older adults who are less physically active are at greater risk of malnutrition. An observational study of 181 older adults in ambulatory rehabilitation established that older adults who were malnourished or at risk of malnutrition had poorer physical performance, specifically weaker hand grip and slower gait (Chevalier, Saoud, Gray-donald, & Morais, 2008). Among community-living Maori and non-Maori in New Zealand (aged 75-85 years), those at lower risk of malnutrition were shown to be more physically active and engaged more in leisure activities (Wham et al., 2011). Those with lower nutritional risk also had higher grip strength, indicating greater of muscle mass and physical functioning (Wham et al., 2011).

2.9.4 Sleeping difficulties

Getting adequate and quality sleep plays an important role in maintaining health and quality of life (Faubel et al., 2009; Lee et al., 2009; Magee, Caputi, & Iverson, 2011). Difficulty sleeping has been linked to a number of health conditions including obesity (Xiao, Arem, Moore, Hollenbeck, & Matthews, 2013), Type 2 diabetes (Holliday, Magee, Kritharides, Banks, & Attia, 2013) and cardiovascular disease (Suzuki et al., 2009), as well as chronic pain conditions and depression (Foley, Ancoli-Israel, Britz, & Walsh, 2004). As sleep is known change with ageing, so sleep disturbances and disorders are common in older people (Bombois, Derambure, Pasquier, & Monaca, 2010). An estimated 38% of adults over the age of 65 years have sleeping problems (Foley, Monjan, Brown, & Simonsick, 1995). Further, a national survey of New Zealand adults (aged 20 to 59) that was conducted in 2001 identified Māori are disproportionately affected by sleeping difficulties (Paine, Gander, Harris, & Reid, 2005). Older Māori, though not examined in

the aforementioned survey, could be a particularly vulnerable to the consequences of chronic sleep problems.

Sleeping problems have been investigated alongside nutrition risk in a number of studies. In the Nutrialz Trial, a cross-sectional analysis of 940 community-dwelling older adults, the prevalence of sleep problems which affected 58% of participants was significantly related to risk of malnutrition (Roque, Salva, & Vellas, 2013). However, in a recent Swedish study (n=465, aged between 76 and 90), in which the SCREEN II tool was used to assess nutrition risk, a significant relationship between sleep and risk of malnutrition was not found (Westergren, Hagell, & Sjödahl Hammarlund, 2014). Although there is no clear, direct physiological relationship between sleeping problems nutrition risk, these as additional stresses for older people may act in the domain of social and emotional health that can subsequently affect nutritional health and wellbeing (Cochen et al., 2009).

2.9.5 Psychological health

Changes in cognitive function is believed to be a normal part of ageing, although such decline can be highly heterogeneous. For certain vulnerable older people, cognitive decline may have a significant impact on their health. Cognitive problems in older people may exist as a domain of frailty that alongside physical and nutritional problems can affect the independence and quality of life (Halil, Cemal Kizilarslanoglu, Emin Kuyumcu, Yesil, & Cruz Jentoft, 2015). In a prospective cohort study of four years (n=2737 aged ≥65 years), physical frailty was shown to predict future cognitive decline (Auyeung, Lee, Kwok, & Woo, 2011). A similar relationship was established by Buchman et al. (2007) where increasing frailty status was associated with the rate of cognitive decline over a three year period. Alike to its effect of deteriorating physical health, cognitive decline negatively impacts on nutritional health and risk of malnutrition. A Swedish study (n=1402, aged between 60 and 96 years of age) showed a positive relationship between cognition and nutrition status among adults aged ≥60 years (Fagerström, Palmqvist, Carlsson, & Hellström, 2011). Further, a subset of this group with moderate or severe cognitive impairment and living in special housing were 16 times more likely to be malnourished. A longitudinal study conducted in Sweden found risk of men becoming malnourished was increased significantly with cognitive impairment (Johansson et al., 2009). Among women, memory impairment which negatively affected ADLs increased risk of becoming malnourished (Johansson et al., 2009). In a similar way functional disability is likely to affect independence, cognitive impairment can make a person more dependent with nutrition-related activities which may subsequently influence dietary adequacy (Johansson et al., 2009; Shatenstein, Kergoat, & Reid, 2007).

Mood disorders including anxiety and depression can also significantly influence the nutritional health of older people. Depression has been attributed as a predominant cause of anorexia and unintentional weight loss in older people (Morley, 2012), both hallmarks of malnutrition (Keller, 2007). Depressive symptoms have been associated with nutrition risk in both the inpatient medical setting (German et al., 2008) and among community-living older adults (German et al., 2011). A cross-sectional study of the randomised clinical trial Nutrialz identified that among 940 community-living adults with dementia, anxiety and depression associated with risk of malnutrition (Roque et al., 2013). Mood disturbances which are prevalent during the early stages of disease affect risk of malnutrition through decreasing a person's interest in eating a healthy and varied diet (Roque et al., 2013). Other contributing factors related to depressive symptoms and nutrition risk are living alone (Hsieh, Sung, & Wan, 2010) and socioeconomic deprivation (Engin, Ozturk, Engin, & Kulaksizoglu, 2010).

2.9.6 Food insecurity

The wider socioeconomic and cultural climate has a role in enabling and fostering healthy food choices to promote good nutrition and health (American Dietetic Association, 2005). Food insecurity, defined as the limited availability of nutritionally adequate and safe food, or limited ability to acquire foods in socially accepted ways, is a concern for the nutritional health of community-living older people (American Dietetic Association, 2005). It can potentially limit the nutritional adequacy of a person's diet, arouse anxiety about acquiring nutritious food, and is associated with poorer self-rated health (Carter, Lanumata, Kruse, & Gorton, 2010; Russell, Flood, Yeatman, & Mitchell, 2014). Food insecurity has also been shown in a community-based cross-sectional study (n=650, aged 65-97 years), to be associated with risk of malnutrition (Simsek, Meseri, Sahin, & Ucku, 2013). Further, a study of 718 older adults from a range of settings identified the inability to shop, prepare and cook meals because of low income was related to risk of malnutrition (Donini et al., 2013). When older adults must choose which foods are given priority, vegetables and fruit are eaten less or excluded completely, while foods that cost less and provide lower nutritional quality are chosen more often (Donini et al., 2013).

A survey conducted in New Zealand from 2002-2010 of adults living in private dwellings estimated 6.8% of adults over 65 years were food insecure (Carter et al., 2010). In a larger Australian cohort study of community living adults, it was estimated that 8.4% of adults over 70 years were food insecure (Russell et al., 2014). Numerous socioeconomic and environmental factors influence accessibility and affordability of nutritious food for older people in New Zealand. Data from the aforementioned New Zealand survey suggested, older adults who are

unmarried, Māori or Pacific ethnicity, or from lower socioeconomic groups have a greater risk of being food insecure (Carter et al., 2010).

2.10 Summary

In the midst of a demographic transition, New Zealand's population is expected to see a disproportionate growth of people living to old age over the next fifty years (Statistics New Zealand, 2014). Among this change the most significant population growth is expected in the 85+ age group (Statistics New Zealand, 2014). Although the majority of older people in New Zealand consider themselves to be healthy and free from disability, there is a minority of older adults who become frail and vulnerable in their last few years of life and require a great level of care and support (Ministry of Health, 2006). An increasing proportion of older people requiring ongoing health care and support in New Zealand presents significant economic implications for the future (Dunstan & Thomson, 2006; Kowal et al., 2014; Statistics New Zealand, 2014).The New Zealand Health of Older People Strategy and Positive Ageing Strategy (Ministry of Social Development, 2001) was developed with the primary objective being to improve health status and to support the wellbeing and quality of life of older people so they may have control over their lives and contribute to their communities (Ministry of Health, 2002b) . The strategy encompasses the concept of successful ageing which means to progress through the life stages at low risk of disease and disability, to retain high mental and physical function, and have active engagement and enjoyment in life (American Dietetic Association, 2005).

Ageing is associated with changes in body composition and physical function as well psychological changes. Being highly heterogeneous, some older people may experience minimal physical effects of ageing that allow them to remain functionally healthy and independent their communities. For others, accentuated and unintentional changes in body composition and physical function that accompany an underlying disease process are associated with greater morbidity and mortality. Older people in New Zealand are more likely to live with multiple chronic conditions than any other age group (Ministry of Health, 2006). Particularly adults over 85 years, hospitalisation rates are excessive of any other age group (Ministry of Health, 2015b).

Good nutrition throughout life is essential for healthy ageing (World Health Organisation & FAO, 2003). It plays a major role in supporting many domains of health in old age including independence, psychological health, and social connectedness. Older adults who experience many barriers to access and consumption of healthy food are at increased risk of malnutrition (Ministry of Health, 2013a). Undernutrition is a major concern for community-living adults in advanced age as it is attributed to poor health including increased morbidity and mortality (White, 2012). Currently, prevalence high nutrition risk among community-living older people in

advanced age in New Zealand is estimated at 49.4% among Māori and 38.3% non-Māori (Wham et al., 2015).

Nutritional screening is a process of identifying individuals at risk of malnutrition through certain characteristics that are associated with nutritional problems (Phillips et al., 2010). Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN II) nutrition risk screening tool is one of three tools that has been validated specifically for community-living adults (Phillips et al., 2010). SCREEN II is the only nutrition risk screening tool validating among community-living octogenarians living in New Zealand (Wham et al., 2014). Consisting of 14 items, SCREEN II identifies risk factors for malnutrition from three major domains which include "weight change", "dietary intake", and "risk factors affecting intake." There is significant evidence from the literature suggesting risk factors from these three domains in SCREEN II are associated with risk of malnutrition and subsequent poor health in older people. Additional risk factors for malnutrition not included in SCREEN II were taste and smell changes, polypharmacy, physical inactivity, mental health problems, and food insecurity. There are many factors known from the literature to influence the nutritional health of older people. Therefore, this study will extract key determining risk factors from the SCREEN II domains associated with high nutrition risk among community-living Māori and non-Māori adults in advanced age and investigate the consequences of high nutrition risk for these populations.

3.0 Methods

3.1 Life and Living in Advanced Age: A Cohort Study in New Zealand

Life and Living in Advanced Age Cohort Study in New Zealand (LiLACS NZ) is a longitudinal study of people living in advanced age. The purpose of LiLACS NZ is to establish the health status and predictors of successful ageing and to understand the trajectories of health and well-being in advanced age (Hayman et al., 2012). Beginning in 2010, two cohorts of equal size, Māori aged 80-90 and non-Māori (other ethnicities) aged 85, were recruited from Lakes or Bay of Plenty District Health Board (DHB) areas of the North Island, New Zealand (Hayman et al., 2012). Recruitment was carried out through local Primary Health Organisations (PHO) and Māori Rūnunga (Māori tribal organisations). The New Zealand general and Māori electoral rolls, primary health care databases through PHOs, and general practice (GP) databases were used to ascertain a complete sample of eligible older people. Baseline data was collected during in a comprehensive face-to-face standardised interview, as well as health assessments, and a brief review of diagnosed medical conditions.

3.1.1 Ethical approval

Ethical approval was gained by the Northern X Regional Ethics Committee, Ministry of Health, New Zealand. Further, Rōpū Kaitiaki o Ngā Tikanga Māori (The Protectors of Principles of Proper Conduct in Māori) were consulted regarding processes for approaching Māori adults of advanced age and their communities.

3.2 Participant recruitment

For the current sub-study, data was drawn from the LiLACS NZ Māori and non-Māori cohorts: wave one baseline interview and assessment (2010) and the wave three 24 months follow up assessment data (2012). The inclusion criteria for these cohorts was to be living within Lakes or Bay of Plenty DHB areas, and to be born between 1 January 1920 and 31 December 1930 (aged 80-90 in 2010) for Māori, and between 1 January and 31 December 1925 (aged 85 in 2010) for non-Māori. Recruitment methods for LiLACS NZ have been detailed by Dyall et al. (2013).

3.3 Data collection

At baseline, comprehensive face-to-face interviews were conducted according to a standardised questionnaire. General health data was gathered from health assessments as well as a brief review of the participants' medical history of past diagnoses. Detail of all components assessed at baseline has been described elsewhere (Hayman et al., 2012). Demographic, health,

anthropometric, lifestyle, and nutritional risk data was extracted for the purposes of this sub-study. Outcome data (hospitalisations and mortality) was extracted from the LiLACS wave three 24 months follow up assessments. This section will outline specific data analysed for the purposes of this sub-study.

3.3.1 Demographic data

Demographic data that was gathered from the LiLACS NZ wave one baseline interview database. Socio-demographic characteristics of both Māori and non-Māori cohorts included age, gender, and country of birth.

Socioeconomic status was reported on at baseline according to the New Zealand Deprivation index (NZDep2006) obtained from the Ministry of Health. Geo-coded addresses used in the index reflect eight dimensions of material and social deprivations including lack of income, employment, communication, transport, support, education qualifications, home ownership, and living space (Salmond, Crapmton, & Atkinson, 2007). A score (one to 10) was given according to each participant's residential address (one indicates the least deprived and 10 indicates the most deprived). Deprivations scores were classified by quintiles (quintile 1 indicating least deprivation).

Marital status was reported on based on four categories: Married/partnered, widowed, divorced/separated, or never married. Categories from the original LiLACS questionnaire were used to report the highest level of education achieved (primary, secondary (no qualification), secondary (qualification), trade, tertiary) and smoking status (current, former, never). Frequency of alcohol consumption was reported on by the categories never, monthly or less, two to four times a month, two to three times a week, and four or more times a week.

3.3.2 Health data

Health measures were reported on from those established at baseline during the LiLACS NZ wave one interview and health assessments. Number of existing health conditions were reported on according to nineteen defined comorbidities which are listed below. Detailed reports of these conditions are provided elsewhere (Teh, 2014).

- Hypertension
- Coronary artery disease
    - Congestive heart failure
    - Cerebrovascular disease
    - Peripheral vascular disease
- Atrial Fibrillation
- Eye disease
- Asthma or chronic lung disease

- Type 2 diabetes
- Osteoarthritis
- Rheumatoid arthritis
- Depression
- Anaemia
- Cancer
- Osteoporosis
- Dementia
- Renal impairment
- Parkinson disease
- Thyroid disease

Number of medications taken, use of nutritional supplements, complementary and alternative medicines, and Rongoa Māori was also established.

The total score from the SF-12 physical and mental health questionnaires (Brazier & Roberts, 2004; Fleishman et al., 2010) was included as a measure of self-rated health-related quality of life based on the participant's perception of their well-being across multiple domains of health (physical, emotional, social, and mental). Scores range from one to 100, higher scores indicate better perception of health.

As a measure of depressive symptoms, the 15-item Geriatric Depression Scale (GDS-15) scores were included (Montorio & Izal, 1996). The GDS-15 is a valid and reliable tool used for screening self-rated depression among community-dwelling older people (Yesavage et al., 1983). The maximum score is 15. A score of above 5 is considered to indicate significant depressive symptoms that are associated with moderate or major depression (Yesavage J & Sheikh J, 1986)

Self-reported physical function was assessed according to the participant's total score for the Nottingham Extended Activities of Daily Living (NEADL) scale (Essink-Bot, Paul, Bonsel, & Aaronson, 1997). A twenty-two item questionnaire, the NEADL scale measures independence across four domains of physical function that include mobility, kitchen tasks, domestic tasks, and leisure activities. Higher scores indicate higher levels of function and independence.

3.3.3 Anthropometric data

Anthropometry was assessed using the Body Mass Index (BMI), determined by the participant's weight divided by height squared (kg/m^2). The World Health Organization (World Health Organisation, 2007) BMI cut-off points were used to define the weight status of both Māori and non-Māori participants. These BMI categories include underweight (<18.5 kg/m^2), normal weight (18.5–24.9 kg/m^2), overweight (25.0–29.9 kg/m^2), and obese (≥30.0 kg/m^2).

3.4 Nutritional assessments

3.4.1 Nutritional Risk assessment

Nutrition risk was determined using the valid 14-item questionnaire Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II). First developed to assess nutrition risk among community living older people in Canada, SCREEN II has been validated and shown excellent inter-rater and test-retest reliability (Keller et al., 2001; Keller et al., 2005). It has since been validated among community living non-Māori octogenarians as a cross-sectional sub-study of LiLACS NZ (Wham et al., 2014).

3.4.1.1 Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) nutrition risk screening tool

SCREEN II assesses nutrition risk from three main domains. Each weighted differently to the overall SCREEN II score, nutrition risk items from the three domains are listed below.

- Domain 1: Weight change (greater than 2.5 kg loss or gain, unintentional weight loss, perception of own weight being more or less than it should be), highest score possible is 12.
- Domain 2: Dietary intake (meal frequency, diet restriction, appetite, daily intake of fruit and vegetable, meat or alternatives, milk products, and fluid), highest score possible of 28.
- Domain 3: Factors affecting food intake (chewing and swallowing difficulties, use of meal replacements, eating alone, cooking and shopping difficulties), highest score possible of 24.

The total score possible ranges from 0 to 64, lower scores indicate higher nutrition risk. For each individual item, a score from zero to four is possible. Individual item scores of ≤2 may contribute to nutrition risk while total score cut-off of ≤49 is considered to identify high nutrition risk. The full SCREEN II scoring card is included in Appendix 1.

3.4.1.2 Validation of SCREEN II

In the validation of SCREEN II among community living non-Māori octogenarians, forty-five participants were recruited from Tauranga, Western Bay of Pleanty in New Zealand. Participants were screened prior recruitment ensured an even proportion of high, medium, and low nutrition risk as per their SCREEN II score. The inclusion criteria were 85 years old (born between January 1st and December 31st 1925), living in the community, non-Māori ethnicity, and cognitively able (Modified Mini Mental Status Exam score 72 or higher).

SCREEN II was administered alongside one of three 24 hour multiple pass dietary recalls and a "comprehensive nutritional risk assessment" criteria (Keller et al., 2005). Nutrition risk was assessed following a standardised "Dietitian's Nutrition Risk Checklist." A dietitian's risk rating

score from one to ten was given (1 indicated low risk and 10 high risk) according to four domains of nutrition assessment (body composition and weight change; medical history and comorbidities; dietary related risk factors; functional risk factors; and social risk factors) (Keller et al., 2001). After testing for specificity and sensitivity by creating an ROC curve, the dietitian's risk rating score of >7 was used to determine the optimal SCREEN II cut-off point of <49 to identify participants at high nutrition risk.

3.4.2 Other nutrition related factors

Health and social characteristics related to nutrition risk that had been examined during the LiLACS NZ wave one baseline questionnaire were selected from the knowledge of the literature. Those additional related health and social factors examined in the current study are listed below.

- Sleeping difficulties ("Do you have trouble with your sleeping (on at least 3 nights per week) such that it interferes with your activities the following day (e.g. un-refreshed in the morning, fatigue, poor concentration or irritability)?")
- Use of nutritional supplements ("Do you currently take any nutritional supplements?")
- Use of complementary or alternative medicine ("Do you take any "natural" or "herbal" products or traditional medicines?")
- Use of Ronga Māori ("Do you take any Rongoa Māori medicines?")
- Any form of dentures ("Do you wear dentures?")
- Symptoms of dry mouth ("Do you suffer from dry mouth or reduced salivation?")
- Visited a dentist ("In the last year have you visited, or had a visit from, any of the following health professionals? - dentist")
- Visited a dietitian ("In the last year have you visited, or had a visit from, any of the following health professionals? - dietitian")
- Receiving support services ("Do you receive any regular support service (such as home help)?")
- Receives a meal service
- Difficulty getting to the shops ("How difficult is it for you to get to the shops?")
- Sufficiency of support for daily tasks ("when you need extra help, can you count on anyone to help you with daily tasks like grocery shopping, cooking, house cleaning, telephoning, give you a ride?")
- Community connectedness ("How connected are you to your community?")
- Food security ("I/we can afford to eat properly", "I/we eat less because of money" and "the variety of foods I am able to eat is limited by lack of money")

3.5 Hospitalisations

All-cause hospital admissions at 24 months (from baseline data collection at wave one to wave three) were investigated for both Māori and non-Māori cohorts. Hospitalisation events coded according to the International Statistical Classification of Diseases and Related Health Problem

(ICD-10 codes) (World Health Organisation, 2010) were obtained from the Ministry of Health. The ICD-10 codes by which causes of hospitalisations were reported on are listed below.

- A00-B99 I Certain infectious and parasitic diseases
- C00-D48 II Neoplasms
- D50-D89 III Diseases of the blood and blood-forming organs and certain disorders involving the immune mechanism
- E00-E89 IV Endocrine, nutritional and metabolic diseases
- F00-F99 V Mental and behavioural disorders
- G00-G99 VI Diseases of the nervous system
- H00-H59 VII Diseases of the eye and adnexa
- H60-H95 VIII Diseases of the ear and mastoid process
- I00-I99 IX Diseases of the circulatory system
- J00-J99 X Diseases of the respiratory system
- K00-K93 XI Diseases of the digestive system
- L00-L99 XII Diseases of the skin and subcutaneous tissue
- M00-M99 XIII Diseases of the musculoskeletal system and connective tissue
- N00-N99 XIV Diseases of the genitourinary system
- R00-R99 XVIII Symptoms, signs and abnormal clinical and laboratory findings, not elsewhere classified
- S00-T98 XIX Injury, poisoning and certain other consequences of external causes
- Z00-Z99 XXI Factors influencing health status and contact with health services

3.6 Mortality

All-cause mortality at twenty-four months follow-up (from baseline data collection at wave one to wave three) were determined for both Māori and non-Māori cohorts.

3.7 Statistical analysis

Statistical analyses were performed on data received from the LiLACS NZ database using the statistical programme SPSS 20. Participants were analysed as Māori and non-Māori cohorts independently. These cohort groups were analysed separately due to sampling differences in age and to enable ethnicity specific interpretations of the findings. Each cohort was categorised into gender groups.

Descriptive analyses were carried out for study variables listed below.

- Demographics – age, gender, ethnicity (for non-Māori), country of birth
- Lifestyle characteristics – marital status, highest level of education, socioeconomic status, smoking status, alcohol consumption
- Health – number of comorbidities, number of medications, SF-12 physical and mental health, GDS-15, NEADL scores.
- Anthropometric – BMI categories (underweight, normal weight, overweight, obese)
- Related health and social factors – living alone, sleeping difficulties, nutritional supplement, complementary alternative medicines, Ronga Māori, utilisation of health

professional services (dietitian and dentist), receiving regular support services, receiving meal service, sufficiency of support for daily tasks, community connectedness, difficulty getting to shops, food security (affords to eat properly, eats less because of money, variety limited because of money)

- SCREEN II nutrition risk factors – Total SCREEN II score, prevalence of high nutrition risk, individual SCREEN II item scores ≤2 that may contribute to nutrition risk, total SCREENII scores for each of the three nutrition risk domains (weight change, intake, factors affecting intake)
- All-cause and specific-cause hospitalisations (twenty-four months follow up)
- All-cause mortality (twenty-four months follow up)

Categorical data was presented as number of participants for each group. Percentages were calculated by columns to allow for comparison for gender. For continuous variables, Kolmogorov-Smirnov and Shapiro-Wilk tests for normality, as wells as histograms, normal Q-Q plots, were assessed to determine the most appropriate measures of central tendency and dispersion. Non-normally distributed data was reported as the median and interquartile range (IQR). Independent t-test or Mann-Whitney tests were performed to ascertain differences between groups (men and women) both Māori and non-Māori datasets. Chi-square tests and Fishers exact tests were used on categorical data. Correlations between SCREEN II domains scores and other potentially related variables (table 4.1-3-6 and 4.2-3-6) were investigated with Spearman's correlations test.

Logistic regression models were constructed to examine the associate between all-cause hospitalisation and mortality with the three main domains from SCREEN II, 1) weight change, 2) dietary intake, 3) factors affecting intake, adjusted for relevant co-variates guided by knowledge from the literature. Variables associated with hospitalisation or mortality from the uni-variate analysis at $p<0.05$ were entered into the final model. Separate analysis were performed each for hospitalisations and mortality. The models were adjusted for gender, condition, NZ deprivation index, highest level of education, and hospitalisations at baseline (for hospitalisation model) or hospitalisation over 24 months (for mortality model).

4.0 Results

In this study of two cohort populations there were 421 Māori and 516 non-Māori participants. The results are presented independently.

4.1 Māori Cohort

4.1.1Participants

In this study cohort of older Māori there were 421 participants, 177 men and 244 women, who were examined at baseline and 24 months follow up. Table 4.1-1 shows 42% were men and 58% were women with the median age for both men and women of 82 years (IQR 4 and 5 each respectively). The age range was 83 to 90 years.

Table 4.1-1: Age and gender of Māori participants

	Total n (%)
	n= 421
Participants	
Men	177 (42.0)
Women	244 (58.0)
Age median (IQR)	
Men	82.0 (4)
Women	82.0 (5)

4.1.2 Demographic characteristics

Demographic characteristics of participants by gender are shown in Table 4.1-2. The majority of Māori participants (99.0%) were born in New Zealand. There were two participants born in Australia, one man born in England, and one women born in the Cook Islands.

Measures of socioeconomic status showed nearly half of Māori men (n=80, 45.5%) and women (n=114, 46.7%) lived within the highest quintile of socioeconomic deprivation. A further quarter of Māori men (n=45, 25.6%) and twenty-two percent of women (n=54) lived in the second highest quintile of socioeconomic deprivation. Few participants (n=10, 2.4%) lived in areas with low socioeconomic deprivation. Nearly a third of Māori men (n=56, 32.9%) and a quarter of Māori women (n=59, 25.0%) obtained primary as their highest level of education. About one-fifth of Māori men (n=30, 17.6%) and women (n=45, 19.1%) had a secondary qualification. Five Māori men (2.9%) and twelve Māori women (5.1%) had a trade qualification. There were nearly twice as many Māori women (n=27, 11.4%) compared to Māori men (n=10, 5.9%) to have gained tertiary education.

Table 4.1-2: Demographic characteristics of Māori men and women

	Men n (%)	**Women n (%)**	**Total n (%)**
	n=176	**n=244**	**n= 420**
Country of birth			
- New Zealand	173 (98.9)	239 (99.2)	412 (99.0)
- Australia	1 (0.6)	1 (0.4)	2 (0.5)
- England	1 (0.6)	0 (0.0)	1 (0.2)
- Cook Islands	0 (0.0)	1 (0.4)	1 (0.2)
Deprivation Index			
- Deprivation Quintile 1 (low)	3 (1.7)	7 (2.9)	10 (2.4)
- Deprivation Quintile 2	16 (9.1)	34 (13.9)	50 (11.9)
- Deprivation Quintile 3	32 (18.2)	35 (14.3)	67 (16.0)
- Deprivation Quintile 4	45 (25.6)	54 (22.1)	99 (23.6)
- Deprivation Quintile 5 (high)	80 (45.5)	114 (46.7)	194 (46.2)
Education			
- Primary	56 (32.9)	59 (25.0)	115 (28.3)
- Secondary (No qualification)	69 (40.6)	93 (39.4)	162 (39.9)
- Secondary (Qualification)	30 (17.6)	45 (19.1)	75 (18.5)
- Trade	5 (2.9)	12 (5.1)	17 (4.2)
- Tertiary	10 (5.9)	27 (11.4)	37 (9.1)

4.1.3 Lifestyle characteristics

Selected lifestyle characteristics of the participants are shown in Table 4.1-3. Marital status differed significantly between Māori men and women (p<0.001). Nearly half of Māori men (n=81, 47.4%) were married or partnered and forty-two percent (n=72) widowed. The reverse was found for Māori women; nearly three quarters were widowed (n=176, 73.6%) and 20.9% (n=50) were married or partnered. The prevalence of Māori men who were separated or divorced (n=11, 6.4%) was twice that of Māori women (n=8, 3.3%). Less than five percent of Māori men (n=7, 4.1%) and women (n=5, 2.1%) had never married.

There were significant differences between men and women for smoking status (p<0.001) and alcohol consumption (p=0.002). Over half (n=101, 58.7%) of Māori men reported to have been former smokers and a third (n=57, 33.1%) to have never smoked. Fewer Māori women were former smokers (n=87, 36.9%) and half (n=120, 50.8%) had never smoked. Less than ten percent of Māori men (n=14, 8.1%) and 12.3% (n=29) of Māori women were current smokers. Alcohol consumption was lesser among Māori women than men; over half (n=84, 54.2%) reported to never consume alcohol which was in contrast to 36.4% of Māori men (n=36).

Table 4.1-3: Lifestyle characteristics of Māori men and women

	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n= 172	**n= 239**	**n=411**	
Marital status				<0.001
- Married/Partnered	81 (47.4)	50 (20.9)	131 (32.0)	
- Widowed	72 (42.1)	176 (73.6)	248 (60.5)	
- Separated/Divorced	11 (6.4)	8 (3.3)	19 (4.6)	
- Never married	7 (4.1)	5 (2.1)	12 (2.9)	
Living situation				<0.001
- Alone	29 (27.1)	81 (50.6)	110 (41.2)	
- With partner/spouse only	40 (37.4)	30 (18.8)	70 (26.2)	
- With others (extended family or non-relatives)	38 (35.5)	49 (30.6)	87 (32.6)	
Smoking				<0.001
- Current	14 (8.1)	29 (12.3)	43 (10.5)	
- Former	101 (58.7)	87 (36.9)	188 (46.1)	
- Never	57 (33.1)	120 (50.8)	177 (43.4)	
Alcohol (frequency)				0.002
- Never	36 (36.4)	84 (54.2)	120 (47.2)	
- Monthly or less	22 (22.2)	39 (25.2)	61 (24.0)	
- Two to four times a month	6 (6.1)	10 (6.5)	16 (6.3)	
- Two to three times a week	13 (13.1)	9 (5.8)	22 (8.7)	
- Four or more times a week	22 (22.2)	13 (8.4)	35 (13.8)	

Qualitative characteristics were analysed with Chi-square tests and Fishers exact tests; post hoc Z score comparisons were performed where an overall gender difference was found. p value <0.05 indicated significance. Qualitative characteristics expressed as count (%).

4.1.4 Health characteristics

Health characteristics of the participants are provided in Table 4.1-4. There were no significant differences between men and women for the SF-12 scores of physical and mental health, GDS-15, and NEADL. Out of maximum score of 100, the median SF-12 physical health score for all Māori participants was 45.5 (IQR 18) while the median SF-12 mental health score was 54.2 (IQR 12). Eighty-five percent of participants (n=217) scored less than five on the GDS-15 indicating mild or no signs of depression. One man (1.0%) and two women (1.3%) had GDS-15 scores greater than 10 indicating severe depression. The median NEADL score for Māori men was 18 (IQR 5, maximum score 22) while women tended to score higher (19, IQR 4) and were close to reaching statistical significance (p=0.079).

There were no significant differences between Māori men and women for number of chronic medical conditions and number of prescription medications. The median number of conditions for all Māori participants was five (IQR 3); 50.6% (n=213) were living with five or more diagnosed medical conditions. Less than five percent (n=12, 2.9%) of participants were without comorbidities from the nineteen conditions examined. The median number of medications taken by Māori men and women was five (IQR 5). More than half of the participants were using five or more medications (n=139, 53.9%).

Table 4.1-4: Health characteristics of Māori men and women

	Men n (%)	Women n (%)	Total n (%)	P value
	n=172	**n=237**	**n=409**	
SF-12 Physical Health				
Median (IQR)	46.97 (19)	43.90 (18)	45.52(18)	0.078
SF-12 Mental Health				
Median (IQR)	53.62 (10)	54.66 (13)	54.20 (12)	0.447
GDS-15				0.974
-0-4 mild	86 (85.1)	131 (85.1)	217 (85.1)	
-5-9 moderate	14 (13.9)	86 (13.6)	35 (13.7)	
-10-15 severe	1 (1.0)	2 (1.3)	3 (1.2)	
NEADL				0.079
Median (IQR)	18.0 (5)	19.0 (4)	19.0 (4)	
Number of conditions				
Median (IQR)	5 (3)	5 (4)	5 (3)	0.347
- None	7 (4.0)	5 (2.0)	12 (2.9)	0.413
- 1-2	33 (18.6)	37 (15.2)	70 (16.6)	
- 3-4	48 (27.1)	78 (32.0)	126 (29.9)	
- 5 or more	89 (50.3)	124 (50.8)	213 (50.6)	
Number of medications				
Median (IQR)	5 (5)	5 (5)	5 (5)	0.753
- None	9 (8.7)	13 (8.4)	22 (8.5)	0.964
- 1-2	19 (18.3)	26 (16.9)	45 (17.4)	
- 3-4	22 (21.2)	30 (19.5)	52 (20.2)	
- 5 or more (polypharmacy)	54 (51.9)	85 (55.2)	139 (53.9)	

Quantitative characteristics were analysed using Mann-Whitney tests to ascertain differences between gender groups. Qualitative characteristics were analysed with Chi-square tests and Fishers exact tests; post hoc Z score comparisons were performed where an overall gender difference was found. p value <0.05 used to indicate significance. Quantitative characteristics are expressed as median (IQR). Qualitative characteristics expressed as count (%).

4.1.5 Body mass index

Table 4.1-5 summarises the body mass index (BMI) characteristics of Māori men and women. The median BMI for Māori participants was 28.7 kg/m^2 (IQR 7) and was similar between men and women. Gender differences were found for the proportion of participants in each BMI category (p=0.015). There were 14.8% more Māori women in the normal weight range for BMI than men. Over a third of Māori participants (n=41, 39.4% for men, n=52, 36.4% for women) had a BMI in the obese range. No participants had a BMI in the underweight category.

Table 4.1-5: Body mass index classification of Māori men and women

	Men n (%)	Women n (%)	Total n (%)	P value
	n=172	**n=237**	**n=409**	
BMI (kg/m^2)				
Median (IQR)	28.93 (8)	28.46(7)	28.70 (7)	0.107
- Underweight , <18.5	0 (0.0)	0 (0.0)	0 (0.0)	0.015
- Normal weight 18.5-24.9	13 (12.5)	39 (27.3)	52 (21.1)	
- Overweight 25.0-29.9	50 (48.1)	52 (36.4)	102 (41.3)	
- Obese ≥30.0	41 (39.4)	52 (36.4)	93 (37.7)	

Differences between gender groups were ascertained using Mann-Whitney tests with a p value <0.05 to indicate significance. Quantitative characteristics are expressed as median (IQR).

4.1.6 Related health and social characteristics

Health and social characteristics of Māori participants that are related to risk of nutritional problems are shown in table 4.1-6. Sleeping difficulties affected over a quarter (n=66, 26.6%) of the participants, the prevalence being similar between men and women. With regard to non-prescription medications, 22.4% (n=57) of the participants used nutritional supplements. Fewer Māori men (n=11, 10.7%) reported to use alternative/herbal medicines than did Māori women (n=36, 23.7%, p=0.009). Seven men (6.9%) and nineteen women (12.8%) used Rongoa Māori.

Nearly three quarters (n=191, 74.9%) of Māori participants, with no significant differences between men and women, had either partial or full dentures. Less than a quarter of participants (n=60, 23.5%) expressed they had symptoms of dry mouth, with no significant differences between men and women.

Engagement with particular health professionals in the last 12 months was low. Less than twenty percent of participants (n=44, 17.2%) had seen a dentist and less than five percent (n=8, 3.1%) had seen a dietitian.

There were no significant differences between Māori men and women regarding support needs. Nearly half (n=110, 43.3%) of Māori participants received regular support services. Of those receiving regular services, two men (4.2%) and seven women (9.7%) received a meal service. Seventeen participants (6.6%) said they could not count on anyone when they needed help with daily tasks such as grocery shopping, cooking, house cleaning, telephoning, and transport.

There were no significant differences between Māori men and women for perceived community connectedness and difficulty shopping. Sixty-one percent (n=158) of Māori participants felt very or extremely connected to their community. Few Māori participants (n=26, 10.3%) stated they find getting to shops very or extremely difficult.

Food security was a potential concern for less than ten percent of Māori participants. The majority (n=252, 98.4%) of participants suggested they could always or sometimes afford to eat properly. Three Māori men (4.6%) and eight Māori women (8.3%) would often or sometimes eat less because of money. Food variety was often limited because of money for four Māori men (6.2%) and ten Māori women (10.4%). There were no significant differences between men and women for each of the three aspects of food security.

Table 4.1-6: Related health and social characteristics of Māori men and women

	Men n (%)	Women n (%)	Total n (%)	P value
	n=103	**n=156**	**n=259**	
Sleeping difficulties				
- Yes	23 (23.5)	43 (28.1)	66 (26.6)	0.416
Non-prescription medicines				
-Nutritional supplement	21 (20.4)	36 (23.7)	57 (22.4)	0.535
-Complementary/alternative/herbal	11 (10.7)	36 (23.7)	47 (18.4)	0.009
-Rongoa Māori	7 (6.9)	19 (12.8)	26 (10.4)	0.139
Dentures				
-Partial/full mouth	69 (69.0)	122 (78.7)	191 (74.9)	0.081
Dry mouth				
-Yes	19 (19.0)	41 (26.5)	60 (23.5)	0.171
Health professional: Dentist				0.197
-Not at all	82 (82.0)	127 (81.9)	209 (82.0)	
-Visited in the last 12 months	16 (15.8)	28 (18.1)	44 (17.2)	
Health professional: Dietitian				0.391
-Not at all	99 (98.0)	148 (96.1)	247 (96.9)	
-Visited in the last 12 months	2 (2.0)	6 (3.9)	8 (3.1)	
Support for daily tasks				
- Receives regular support services	42 (42.4)	68 (43.9)	110 (43.3)	0.820
- Meal service	2 (4.2)	7 (9.7)	9 (7.5)	0.258
- Sufficiency of support for daily tasks				0.242
- Cannot count on anyone	7 (6.9)	10 (6.5)	17 (6.6)	
- Help is sufficient	78 (77.2)	131 (84.5)	209 (81.6)	
- Doesn't need help	16 (15.8)	14 (9.0)	30 (11.7)	
Community connectedness				0.887
-Not at all	8 (7.8)	13 (8.3)	21 (8.1)	
-Somewhat/Moderately	33 (32.4)	46 (29.5)	79 (30.6)	
-Very/Extremely	61 (59.8)	97 (62.2)	158 (61.2)	
Difficulty getting to shops				0.477
-Not at all	88 (88.0)	126 (82.4)	214 (84.6)	
-Somewhat/Moderately	4 (4.0)	9 (5.9)	13 (5.1)	
-Very/Extremely	8 (8.0)	18 (11.8)	26 (10.3)	
Food security				
- Can afford to eat properly				0.141
-always/sometimes	98 (97.0)	155 (99.4)	253 (98.4)	
-never/-don't know	3 (3.0)	1 (0.6)	4 (1.6)	
- Eat less because of lack of money				0.359
-often/sometimes	3 (4.6)	8 (8.3)	11 (6.8)	
-never/don't know	62 (95.4)	88 (91.7)	150 (93.2)	
- Variety limited because of money				0.346
-often/sometimes	4 (6.2)	10 (10.4)	14 (8.7)	
-never/don't know	61 (93.8)	86 (89.6)	147 (91.3)	

Gender differences for qualitative characteristics were analysed with Chi-square tests and Fishers exact tests; post hoc Z score comparisons were performed where an overall gender difference was found. p value <0.05 used to indicate significance. Qualitative characteristics expressed as count (%).

4.1.7 Prevalence of nutrition risk characteristics

The prevalence of nutrition risk among Māori men and women in this study as assessed by Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) is shown in Table 4.1-7. The overall prevalence of nutrition risk among Māori men and women was 49.4%. Māori women (median (IQR), 47.0 (8), p=0.037) had significantly lower SCREEN II scores and were shown to have a higher prevalence nutrition risk than Māori men (median (IQR), 50.0 (10); n (%), 42(42.0%)), although the latter of which exceeded the cut-off for statistical significance (p=0.057). Forty-two Māori men (42.0%) and eighty-four Māori women (54.2%) had SCREENII scores ≤49 which indicated high nutrition risk.

Table 4.1-7: Nutrition risk of Māori men and women as determined by the SCREEN II nutrition screening tool

	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n=177	**n=244**	**n=421**	
SCREEN II score				
Median (IQR)	50.0 (10)	47.0 (8)	49.0 (8)	0.037
Prevalence of nutrition risk				
- SCREENII score ≤49	42 (42.0)	84 (54.2)	126 (49.4)	0.057

Nutrition risk scores, expressed as median (IQR), were analysed using Mann-Whitney tests to ascertain differences between gender groups. Categories of nutrition risk, expressed as count (%), were analysed with Chi-square tests. The p value <0.05 used to indicate significance.

4.1.8 Domains of Nutrition Risk: Nutrition Risk Factors

Nutrition risk factors from the SCREEN II tool are categorised by three key domains. Listed below are the three domains which together make the fourteen items of SCREEN II.

1. Weight change domain
2. Dietary intake domain
3. Factors affecting intake domain

Specific nutrition risk characteristics of the participants and median SCREEN II scores were examined according to each of these domains. Table 4.1-8 shows the median domain scores and the percentage of Māori men and women who responded with an answer scored ≤2 which indicates an area of nutrition risk.

4.1.8.1 Weight change domain

Over a third of Māori participants (n=93, 36.1%) had an 'at risk' response regarding any weight change in the last six months. Of those given a 'yes' response, twice as many Māori participants reported greater than 2.5kg weight loss (n=60, 23.5%) than did those having reported weight gain (n=34, 13.3%). There were no significant differences between Māori men and women regarding weight change in the last six months.

The prevalence of unintentional weight change was five times greater among Māori women (n=17, 11.0%) compared to men (n=2, 2.0%) (p=0.008). Perception of one's weight being more or less than it should be was a nutrition risk factor for half of Māori women (n=76, 49.7%) and over a third of Māori men (n=37, 37.4%, p=0.055).

Table 4.1-8: Proportion of Māori men and women with an "at risk" response to individual SCREEN II items as categorised by the three domains

	Men n (%)	Women n (%)	Total n (%)	P value
	n=101	n=155	n=256	
Nutrition risk item*				
1. Weight change domain				
Domain score				
Median (IQR)	6.0 (5)	6.0 (5)	6.0 (5)	0.414
1.a) Weight change in the last 6 months				0.822
- Don't know	4 (0.4)	7 (0.5)	11(4.3)	
- Yes	34 (34.0)	58 (37.4)	92 (36.1)	
- >2.5kg weight gain	10 (10.0)	24 (15.5)	34 (13.3)	0.238
- >2.5 kg weight loss	25 (25.0)	35 (22.6)	60 (23.5)	
b) Unintentional weight change	2 (2.0)	17 (11.0)	19 (7.5)	0.008
c) Perception of own weight more or less than it should be	37 (37.4)	76 (49.7)	113 (44.8)	0.055
2. Dietary intake domain				
Domain score				
Median (IQR)	19.0 (3)	19.0 (4)	18.0 (4.0)	0.344
2. Often/always skips meals	42 (42.0)	40 (25.8)	82 (32.2)	0.007
3. Limit or avoids certain foods	37 (37.0)	61 (39.4)	98 (38.4)	0.706
4. Fair/poor appetite	8 (7.9)	17 (11.0)	25 (9.8)	0.422
5. Low fruit and vegetable intake (≤ 3 serves per day)	68 (67.3)	87 (56.1)	155 (60.5)	0.073
6. Low meat or meat alternative intake (≤ 1 serves per day)	73 (73.3)	124 (80.0)	197 (77.0)	0.152
7. Low milk product intake (≤ 2 serves per day)	37 (36.6)	68 (43.9)	105 (41.0)	0.250
8. Low fluid intake (≤ 3-4 c per day)	29 (28.7)	36 (23.2)	65 (25.4)	0.324
3. Factors affecting intake domain				
Domain score				
Median (IQR)	22.0 (4)	20.0 (4)	20.0 (4)	0.001
9. Swallowing difficulty	7 (6.9)	19 (12.3)	26 (10.2)	0.168
10. Chewing difficulty	21 (20.8)	29 (18.7)	50 (19.5)	0.681
11. Uses meal replacements	11 (10.9)	22 (14.3)	33 (12.9)	0.430
12. Eats alone	33 (32.7)	83 (53.9)	116 (45.5)	0.001
15. Cooking is a chore	14 (13.9)	28 (18.1)	42 (16.4)	0.375
14. Often/always has difficulty with groceries	8 (8.0)	24 (15.6)	32 (12.6)	0.075

*SCREEN II items with scores less than or equal to two, out of a maximum score of four, potentially lead to 'nutrition risk'.

The proportion of Māori participants "at risk" responses to individual SCREEN II items were analysed with Chi square tests to examine differences between gender groups.

Quantitative characteristics are expressed as median (IQR). Qualitative characteristics expressed as count (%).

4.1.8.2 Dietary intake domain

There was a 16.2% greater prevalence of those reported to of skipping meals among Māori men (n=42, 42.0%) than that of Māori women (n=40, 25.8%, p=0.007). Over a third (n=98, 38.4%) of Māori participants said they limited or avoided certain foods. Less than ten percent of men

(n=8, 7.9%) and eleven percent of women (n=17) had a fair or poor appetite. Responses for the latter two nutrition risk items were similar between men and women.

Two thirds of Māori men (n=68, 67.3%) reported to consume less than four serves of fruits or vegetables daily. Low fruit and vegetable intake was 11.6% less prevalent among Māori women (n=87, 56.1%, p=0.073). Eighty percent of Māori women (n=124) and seventy-three percent of Māori men (n=73) consumed less than two servings of meat or meat alternatives daily. These differences between men and women were not statistically significant. Low milk product intake was a nutrition risk factor for over a third of Māori men (n=37, 36.6%) and for nearly half of Māori women (n=68, 43.9%), while these difference between men and women were not significant. For a quarter of Māori participants (n=65, 25.4%) low fluid intake was a potential nutrition risk factor.

4.1.8.3 Factors affecting intake domain

The prevalence of swallowing and chewing difficulties did not differ significantly between Māori men and women. There were twice as many Māori women with swallowing difficulties (n=19, 12.3%) than there were Māori men (n=7, 6.9%). Less than twenty percent (n=50, 19.5%) of Māori participants reported to have chewing difficulties.

Meal replacements or nutritional supplements usage was similar between men and women. Eleven Māori men (10.9%) and twenty-two Māori women (14.3%) used these in some form. Māori women were significantly more likely to eat alone (n=83, 53.9%) than Māori men (n=33, 32.7%). Fourteen Māori men (13.9%) and twenty-eight Māori women (18.1%) identified with cooking as a chore. Māori women showed to have two times the prevalence of difficulty with groceries (n=24, 15.0%) than Māori men (n=8, 8.0%).

4.1.8.4 Proportional SCREEN II domain score weighting

Derived from the median SCREEN II domain scores of Māori participants, Figure 4.1-1 illustrates the relative proportion of SCREEN II points from each of the three domains scores as compared to the highest scores possible. Māori participants scored relatively fewer points from the "Intake" and "Weight Change" domains of SCREEN II. The most points in SCREEN II are accumulated from the "factors affecting intake" domain. The lower the score the higher the nutrition risk.

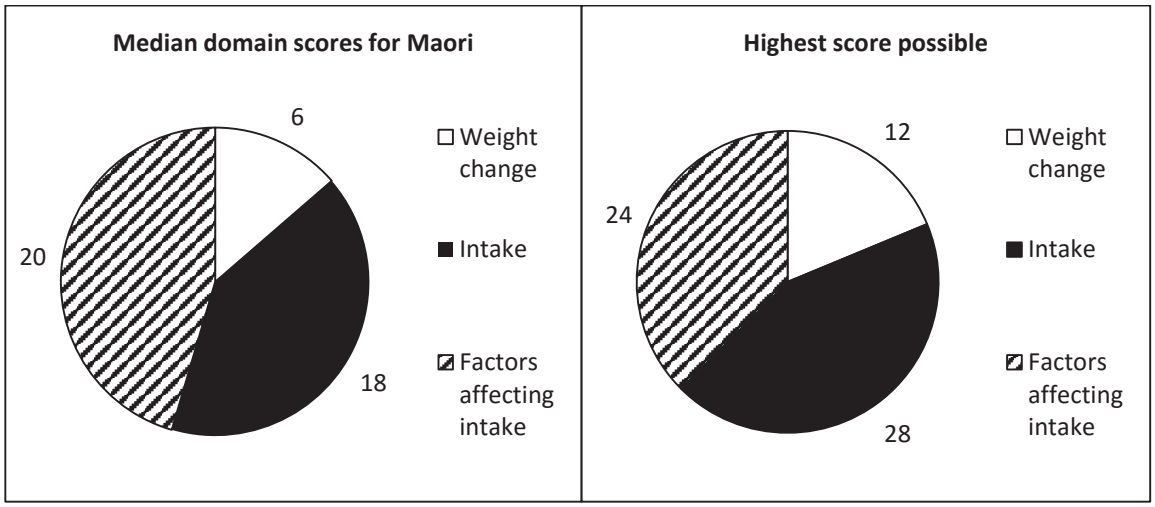


Figure 4.1-1: Proportion of median SCREEN II points from each of the three domains compared to highest SCREEN II score possible

4.1.9 Hospital admission data

Hospital admission data for Māori men and women 12 months prior enrolling in the and over the 24 month study period is shown in Table 4.1-9. All-cause admissions are reported as median number of hospitalisations and as the percentage of participants who were hospitalised.

Table 4.1-9: All-cause hospitalisations for Māori men and women 12 months prior baseline interview and at 24 months follow-up

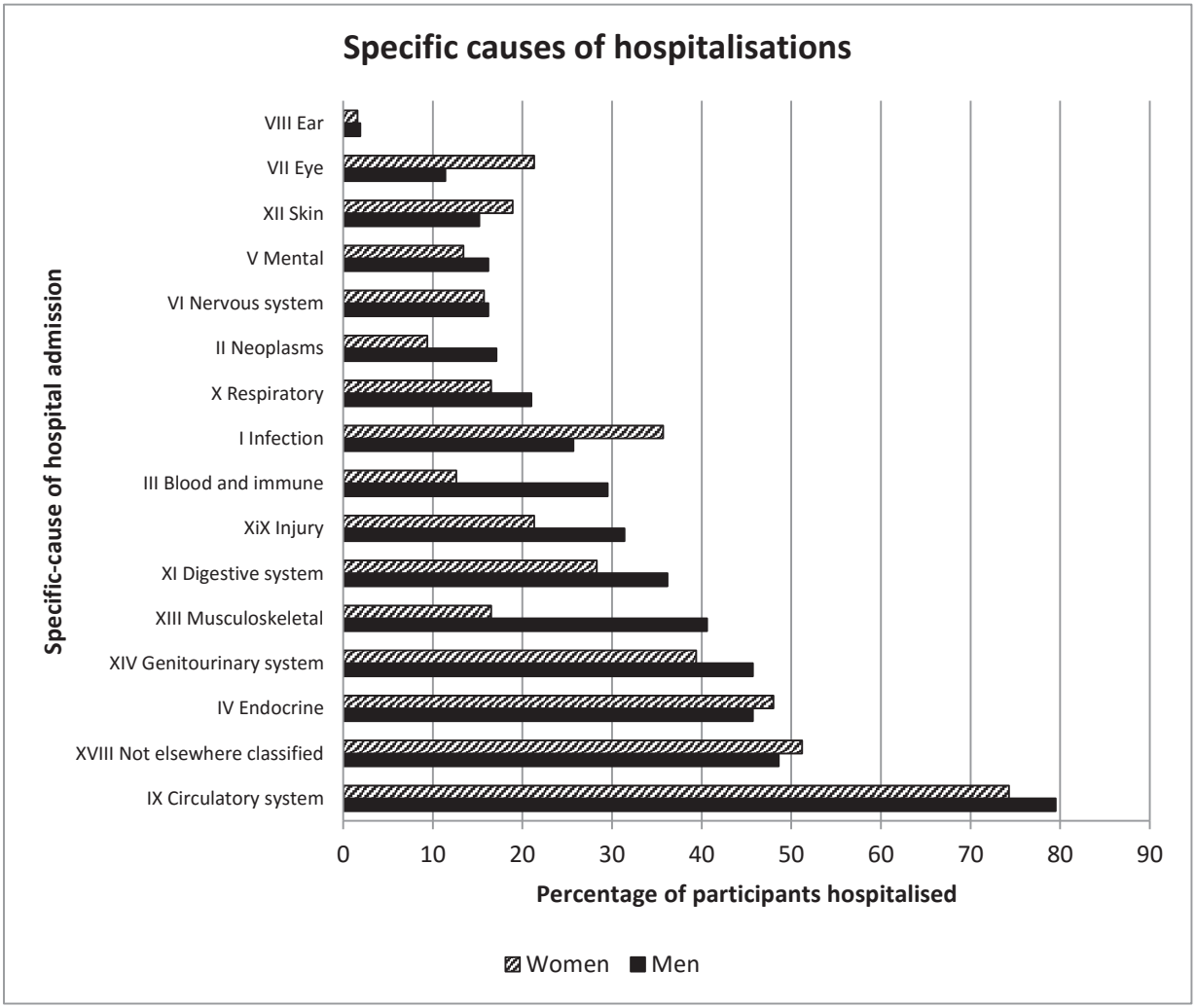
	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n=177	**n=244**	**n= 421**	
All-cause hospital admission 12 months prior study				
-None	100 (56.5)	172 (70.5)	272 (64.6)	0.003
-Yes	77 (43.5)	72 (29.5)	149 (35.4)	
All-cause hospital admission				
Median (IQR)	1 (2)	1 (2)	1 (2)	0.074
-None	72 (40.7)	117 (48.0)	189 (44.9)	0.139
-Yes	105 (59.3)	127 (52.0)	232 (55.1)	

Gender differences for the number of hospital admissions over 24 months, expressed at median (IQR), were analysed using Mann-Whitney tests. Categories for being hospitalised, expressed as count (%), were analysed with Chi-square tests. The p value of <0.05 was used to indicate significance.

In this study over a 24 month period there were 105 Māori men and 127 Māori women admitted to hospital. The median number of hospitalisations for the participants was one (IQR 2). There were no significant differences between Māori men and women for the prevalence or number of hospitalisations.

Specific-cause admissions are shown as number of admissions in Figure 4.1-2 according to the top 10 ICD codes (World Health Organisation, 2010) for board causes of hospitalisations. Diseases of the “circulatory system” were the leading cause of hospitalisations accounting for 76.6% (n=154), with no significant differences between men and women. Nearly half of admissions (n=109, 47.0%) involved diseases classified as “Endocrine, nutrition, and metabolic,” the prevalence of which was similar between men and women. Half of all admissions (50.0%) involved signs or symptoms that could not elsewhere be classified.

Figure 4.1-2: Specific-cause hospitalisations according to the top 10 ICD coded broad causes



for Māori men and women at 24 months.

Categories for specific-causes were analysed with Chi-square test using the level of significance *p<0.05. Frequency of specific-cause hospitalisations expressed as count (%).

*

*

4.1.10 All-cause hospitalisation logistic regression model

Univariate analysis showed a lower SF-12 physical health score ($p<0.001$), greater number of conditions ($p<0.001$), greater number of medications ($p<0.001$), previous hospital admission ($p<0.001$), and receiving regular support ($p=0.043$) were associated with 24-month all-cause hospital admission. Multiple logistic regression models were constructed to examine independent associations between nutrition risk scores from the three key domains and 24-month hospitalisation for age, gender, NZ deprivation and highest education level and the aforementioned univariate predictors.

In the unadjusted model there was a trend toward a lower SCREEN II intake domain score and hospitalisation without statistical significance ($p=0.150$). In the final model (adjusted for age, gender, NZ deprivation and highest education level, previous hospital admission, and comorbidities) there was no association between SCREEN II domain score and hospitalisation (Table 4.1-10).

Table 4.1-10: Logistic regression model showing the relationship between SCREEN II domain scores and 24-month all-cause hospital admissions of Māori participants, unadjusted and adjusted models

Independent variables	Unadjusted model		Adjusted model					
			Model 1		Model 2		Model 3	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
SCREEN II domain score: Weight change	0.99 (0.85-1.14)	0.857	1.00 (0.84-1.17)	0.945	0.99 (0.82-1.18)	0.875	0.99 (0.83-1.18)	0.929
SCREEN II domain score: Dietary intake	0.91 (0.79-1.04)	0.150	0.90 (0.78-1.04)	0.150	0.94 (0.80-1.10)	0.434	0.92 (0.79-1.07)	0.289
SCREEN II domain score: Factors affecting intake	1.07 (0.93-1.23)	0.330	1.07 (0.91-1.26)	0.422	1.03 (0.85-1.24)	0.760	1.09 (0.92-1.30)	0.333
Age			0.99 (0.84-1.18)	0.943	1.01 (0.84-1.24)	0.916	0.98 (0.82-1.17)	0.817
Gender			1.21 (0.43-3.36)	0.722	1.19 (0.40-3.52)	0.760	1.09 (0.37-3.19)	0.874
NZ deprivation index quintile			1.10 (0.72-1.71)	0.656	1.04 (0.65-1.68)	0.870	1.14 (0.73-1.81)	0.562
Education			1.43 (0.91-2.26)	0.124	1.34 (0.83-2.17)	0.230	1.38 (0.86-2.21)	0.180
Previous hospital admission (12 months)					2.08 (0.60-7.18)	0.246	1.99 (0.61-6.51)	0.257
Comorbidities					1.19 (0.92-1.54)	0.198	1.20 (0.94-1.54)	0.152
Formal support services					0.69 (0.26-1.87)	0.467		
Alternative/herbal medicines					0.36 (0.10-1.33)	0.125		

Regression analyses adjusted for age, gender, socioeconomic deprivation (NZ Dep index quintile), highest level of education, comorbidities and hospital admission 12 months prior study. Also adjusted for univariate predictors with a significance level $p<0.05$ and informed by knowledge from the literature (SF-12 physical health score, receiving regular support, alternative/herbal medicines).

4.1.11 Mortality data

Table 4.1-11 shows all-cause mortality data for Māori men and women. Mortality rates were significantly higher among Māori men (p=0.004). Over the 24 month study period, forty-seven Māori men (26.6%) and thirty-seven Māori women (15.2%) became deceased.

Table 4.1-11: All-cause mortality for Māori men and women at 24 months

	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n=177	**n=244**	**n= 421**	
All-cause mortality				
-Participants deceased	47 (26.6)	37 (15.2)	84 (20.0)	0.004

Categories describing mortality status , expressed as count (%), were analysed with Chi-square tests using the level of significance p<0.05 Quantitative characteristics are expressed as median (IQR).

4.1.12 Mortality logistic regression model

Univariate analysis showed living alone (p=0.003), smoking (p=0.032), a lower SF-12 physical health score (p=0.001), lower NEADL score (p=0.001), a greater number of conditions (p<0.001), previous hospital admission (p=0.001), difficulty getting to shops (p=0.014), and receiving regular support (p=0.048) were associated with all-cause mortality. Multiple logistic regression models were constructed to examine independent associations between nutrition risk scores from the three key domains and mortality, adjusting for age, gender, NZ deprivation index, education level and the aforementioned univariate predictors.

In the unadjusted model, the SCREEN II intake domain score was significantly associated with mortality (OR (95% CI) 0.83 (0.71-0.98), p=0.030). In the final model adjusted for all confounding variables (age, gender, NZ deprivation index, education level, hospitalisation, comorbidities, and MEADLs) the negative relationship between SCREEN II intake domain score and mortality remained (OR (95% CI) 0.74 (0.56-0.98), p=0.034).

Table 4.1-12: Logistic regression model showing the relationship between SCREEN II domain scores and 24-month all-cause mortality of Māori participants, unadjusted and adjusted models

Independent variables	Unadjusted model		Adjusted model					
			Model 1		Model 2		Model 3	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
SCREEN II domain score: Weight change	1.07 (0.90-1.27)	0.460	0.93 (0.77-1.14)	0.497	0.90 (0.68-1.20)	0.466	0.86 (0.67-1.12)	0.265
SCREEN II domain score: Dietary intake	0.83 (0.71-0.98)	0.030	0.76 (0.62-0.92)	0.006	0.72 (0.54-0.97)	0.031	0.74 (0.56-0.98)	0.034
SCREEN II domain score: Factors affecting intake	1.06 (0.90-1.24)	0.517	1.12 (0.91-1.38)	0.301	1.02 (0.77-1.35)	0.905	1.06 (0.81-1.38)	0.676
Age			1.30 (1.04-1.62)	0.022	1.25 (0.90-1.74)	0.178	1.31 (0.98-1.76)	0.065
Gender			0.77 (0.20-2.90)	0.695	0.15 (0.02-1.27)	0.082	0.18 (0.2-1.49)	0.111
NZ deprivation index quintile			1.65 (0.89-3.08)	0.113	2.49 (0.96-6.46)	0.062	2.07 (0.93-4.61)	0.076
Education			1.57 (0.98-2.51)	0.062	2.36 (1.10-5.08)	0.028	2.53 (1.26-5.10)	0.009
Hospital admission over 24 months					1.14 (0.18-7.31)	0.890	1.05 (0.19-5.92)	0.956
Comorbidities					1.46 (0.98-2.18)	0.064	1.45 (1.02-2.08)	0.041
NEADL score					0.84 (0.71-1.00)	0.044	0.80 (0.69-0.92)	0.002
Living situation					1.17 (0.41-3.30)	0.774		
Formal support services					1.82 (0.33-10.0)	0.491		
Difficulty getting to shops					0.90 (0.30-2.67)	0.852		

Regression analyses adjusted for age, gender, socioeconomic deprivation (NZ Dep index quintile), highest level of education, comorbidities and hospital admission over the two-year study period. Also adjusted for univariate predictors with a significance level $p<0.05$ and informed by knowledge from the literature (NEADL score, living situation, using formal support services, difficulty getting to shops).

4.2 Results: Non-Māori Cohort

4.2.1 Participants

In this cohort of older non-Māori there were 516 participants, 237 men and 279 women, who were examined at baseline and at 24 months follow up. Tables 4.2-1 shows 46.1% were men and 53.9% were women. The median age for both men and women was 85 years (IQR 1) and range 84 to 86 years.

Table 4.2-1: Age and gender of non-Māori Participants

	Total n (%)
	n= 512
Participants	
Men	236 (46.1)
Women	276 (53.9)
Age median (IQR)	
Men	85.0 (1)
Women	85.0 (1)

4.2.2 Demographic characteristics

Demographic characteristics of participants by gender are shown in Table 4.2-2. Ninety percent of all non-Māori participants identified with New Zealand European ethnicity. One woman (0.4%) identified as Samoan. Twelve percent (n=61) identified as "Other European" and three percent (n=16) as an ethnicity otherwise not classified. The majority (n=414, 80.4%) of the participants were born in New Zealand.

Measures of socioeconomic status showed nearly a third (n=167, 32.4) of non-Māori participants lived in the second highest quintile of deprivation while eighteen percent (n=94) live in areas of high deprivation. Less than ten percent (n=31, 6.0%) were living in areas classified as having low socioeconomic deprivation. For 37.5% (n=195) of participants, secondary education, without a qualification, was their highest level of education. Less than a quarter (n=68, 13.4%) of the participants had obtained tertiary education.

Table 4.2-2: Demographic characteristics of non-Māori men and women

	Men n (%)	**Women n (%)**	**Total n (%)**
	n=237	**n=278**	**n=515**
Ethnicity			
- NZ European	213 (89.9)	251 (90.3)	464 (90.1)
- Samoan	0 (0.0)	1 (0.4)	1 (0.2)
- Other European	32 (13.7)	29 (10.5)	61 (12.0)
- Other	7 (3.1)	9 (3.4)	16 (3.1)
Country of birth			
- New Zealand	185 (78.1)	229 (82.4)	414 (80.4)
- Australia	3 (1.3)	1 (0.4)	4 (0.8)
- England	31 (13.1)	26 (9.4)	57 (11.1)
- Scotland	5 (2.1)	6 (2.2)	11 (2.1)
- South Africa	1 (0.4)	1 (0.4)	2 (0.4)
- Samoa	0 (0.0)	1 (0.4)	1 (0.2)
- Other	12 (5.1)	14 (5.0)	26 (5.0)
Deprivation Index (%)			
- Deprivation Quintile 1 (low)	14 (5.9)	17 (6.1)	31 (6.0)
- Deprivation Quintile 2	47 (19.8)	53 (19.0)	100 (19.4)
- Deprivation Quintile 3	61 (25.7)	63 (22.6)	124 (24.0)
- Deprivation Quintile 4	71 (30.0)	96 (34.4)	167 (32.4)
- Deprivation Quintile 5 (high)	44 (18.6)	50 (17.9)	94 (18.2)
Education			
- Primary	44 (18.9)	39 (14.3)	83 (16.4)
- Secondary (No qualification)	78 (33.5)	112 (41.0)	190 (37.5)
- Secondary (Qualification)	47 (20.2)	58 (21.2)	105 (20.8)
- Trade	26 (11.2)	34 (12.5)	60 (11.9)
- Tertiary	38 (16.3)	30 (11.0)	68 (13.4)

4.2.3 Lifestyle characteristics

Lifestyle characteristics of the participants are summarised in Table 4.2-3. Marital status differed significantly between non-Māori men and women (p<0.001). Nearly two thirds (n=139, 59.4%) of men were married or partnered and nearly one third (n=73, 31.2%) were widowed. Conversely, a quarter (n=67, 24.3) of non-Māori women were married or partnered and two thirds (n=184, 66.7%) widowed.

Also shown with statistical significance (p<0.001), non-Māori men were less likely to be living alone and more likely to be living with a spouse compared to non-Māori women. Sixty-three percent of women (n=134) and thirty-two percent of men (n=61) reported to be living alone. Few (men n=23, 12.1%, women n=32, 15.0%) reported living with other such as extended family of non-relatives.

Smoking status and alcohol consumption characteristics were significantly different between non-Māori men and non-Māori women (p=<0.001 and <0.001, respectively). While less than five percent of women (n=10, 3.6%) and 6.0% of men (n=14) were current smokers, men were shown to have two times (n=144, 61.3%) the prevalence of formers smokers than women (n=81, 29.2%). Further, the prevalence of women to have never smoked was two times that of men (women: n=186, 67.1%; men: n=77, 32.8%). Alcohol consumption was also more common among men. Almost half (n=91, 48.4%) of men but less than a quarter (n=49, 23.1%) of women reported to drink alcohol four or more times a week.

Table 4.2-3: Lifestyle characteristics of non-Māori men and women

	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n= 235	**n= 277**	**n= 512**	
Marital status				<0.001
- Married/Partnered	139 (59.4)	67 (24.3)	206 (40.6)	
- Widowed	73 (31.2)	184 (66.7)	257 (50.4)	
- Separated/Divorced	14 (6.0)	17 (6.2)	31(6.1)	
- Never married	8 (3.4)	8 (2.9)	16 (3.1)	
Living situation				<0.001
- Alone	61 (32.1)	134 (62.6)	195 (48.3)	
- With partner/spouse only	106 (55.8)	48 (22.4)	154 (38.1)	
- With others (extended family or non-relatives)	23 (12.1)	32 (15.0)	55 (13.6)	
Smoking				
- Current	14 (6.0)	10 (3.6)	24 (4.7)	<0.001
- Former	144 (61.3)	81 (29.2)	225 (43.9)	
- Never	77 (32.8)	186 (67.1)	263 (51.4)	
Alcohol (frequency)				<0.001
- Never	33 (17.6)	72 (34.0)	105 (26.3)	
- Monthly or less	13 (6.9)	46 (21.7)	59 (14.8)	
- Two to four times a month	22 (11.7)	27 (12.7)	49 (12.3)	
- Two to three times a week	29 (15.4)	18 (8.5)	47 (11.8)	
- Four or more times a week	91 (48.4)	49 (23.1)	140 (35.0)	

Qualitative characteristics were analysed with Chi-square tests and Fishers exact tests; post hoc Z score comparisons were performed where an overall gender difference was found. p value <0.05 indicated significance. Qualitative characteristics expressed as count (%).

4.2.4 Health characteristics

Health characteristics of the participants are provided in Table 4.2-4. Overall non-Māori men (median (IQR), 45.6 (19)) had better self-ratings of physical health compared to non-Māori women (median (IQR), 39.1 (18), p=0.005, maximum score of 100). There were no significant differences between men and women for all other measures of physical and mental health. The median SF-12 self-rated mental health score was 57 (IQR 9)(maximum score of 100). Nearly ninety percent (n=350, 89.3%) of participants had a GDS-15 score of less than five. One man and one women scored highly on the GDS-15 indicating severe depression. The median NEADL score was 19.0 (IQR 4) out of a maximum score of 22.

Number of comorbidities and number of medications did not differ significantly between non-Māori men and women. The median number of conditions was five (IQR 3); over half (n=278, 53.9%) of the participants had five or more medical conditions. Less than two percent of participants (n=7, 1.4%) were without comorbidities from the nineteen conditions examined. Polypharmacy was common among participants; over fifty percent (n=226, 56.4%) were taking five or more prescription medications.

Table 4.2-4: Health characteristics of non-Māori men and women

	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n=234	**n=275**	**n= 509**	
SF-12 Physical Health				
Median (IQR)	45.6 (19)	39.1 (18)	43.0 (19)	0.005
SF-12 Mental Health				
Median (IQR)	57.1 (7)	57.0 (11)	57.0 (9)	0.888
GDS-15				0.793
-0-4 mild	164 (88.2)	186 (90.3)	350 (89.3)	
-5-9 moderate	21 (11.3)	19 (9.2)	40 (10.2)	
-10-15 severe	1 (0.5)	1 (0.5)	2 (0.5)	
NEADL				
Median (IQR)	18.5 (3)	19.0 (4)	19.0 (4)	0.328
Number of conditions				
Median (IQR)	5 (3)	5 (3)	5 (3)	0.688
- None	1 (0.4)	6 (2.2)	7 (1.4)	0.284
- 1-2	28 (11.8)	35 (12.5)	63 (12.2)	
- 3-4	83 (35.0)	85 (30.5)	168 (32.6)	
- 5 or more	125 (52.7)	153 (54.8)	278 (53.9)	
Number of Medications				
Median (IQR)	5 (6)	5 (5)	5 (5)	0.100
- None	10 (5.3)	12 (5.6)	22 (5.5)	0.233
- 1-2	41 (21.8)	32 (15.0)	73 (18.2)	
- 3-4	40 (21.3)	40 (18.8)	80 (20.0)	
- 5 or more	97 (51.6)	129 (60.6)	226 (56.4)	

Quantitative characteristics were analysed using Mann-Whitney tests to ascertain differences between gender groups. Qualitative characteristics were analysed with Chi-square tests and Fishers exact tests; post hoc Z score comparisons were performed where an overall gender difference was found. p value <0.05 used to indicate significance. Quantitative characteristics are expressed as median (IQR). Qualitative characteristics expressed as count (%).

4.2.5 Body mass index

Table 4.2-5 summarises the body mass index characteristics (BMI) of non-Māori men and women. The median BMI of non-Māori participants was 26.3 kg/m^2 (IQR 5) and was similar between men and women. Three men (1.6%) and four women (2.1%) had a BMI which fell in the "underweight" category. Over two thirds of the participants (253, 67.5%) had a BMI classified as "overweight" or "obese".

Table 4.2-5: Body mass index characteristics of non-Māori men and women

	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n=234	**n=275**	**n= 509**	
BMI (kg/m^2)				
Median (IQR)	26.4(4)	26.1 (6)	26.3 (5)	0.781
- Underweight , <18.5	3 (1.6)	4 (2.1)	7 (1.9)	0.415
- Normal weight 18.5-24.9	51 (28.0)	64 (33.2)	115(30.7)	
- Overweight 25.0-29.9	96 (52.7)	85 (44.0)	181 (48.3)	
- Obese ≥30.0	32 (17.6)	40 (20.7)	72 (19.2)	

Differences between gender groups were ascertained using Mann-Whitney tests with a p value <0.05 to indicate significance. Quantitative characteristics are expressed as median (IQR).

4.2.6 Related health and social characteristics

Health and social characteristics of non-Māori participants that are related to nutrition risk are shown in tables 4.2-6. Significantly fewer men (n=49, 26.2%) reported to have difficulty sleeping than did women (n=77, 36.5%, p=0.028). Upon investigating non-prescription medication, there were significant gender differences with regard to nutritional supplement usage (p=0.001). Over forty percent (n=93, 43.9%) of women and less than thirty percent (n=53, 28.5%) of men reported using nutritional supplements. Women were also seen to be higher users of alternative medicines (n=53, 24.9%) and Rongoa Māori (n=2, 0.9%), however these gender differences were not statistically significant.

Over three quarters (n=309, 77.4%) of the non-Māori participants had either partial of full dentures for which the prevalence was similar between men and women. A third (n=139, 34.8%) of participants had symptoms of dry mouth, also with no significant differences between men and women.

Upon investigating engagement with particular health professionals in the last 12 months, the prevalence of those who had visited a dentist or dietitian did not differ significantly between men and women. Over a third (n=140, 35.0%) had seen a dentist. Less than five percent of men (n=5, 2.7%) and women (n=7, 3.3%) had seen a dietitian.

There were no significant differences between men and women in regard to utilisation of and need for regular support services. Over half (n=209, 52.9%) of participants reported receiving regular support services. Of those, five men (5.4%) and ten women (7.7%) received a regular meal service. The majority of participants said they either have sufficient support (n=320, 80.2%) or do not need help (n=62, 15.5%) with daily tasks such as grocery shopping, cooking, house cleaning, telephoning, and transport.

Perceived community connectedness was similar between men and women. Twenty percent of men (n=38, 20.1%) and fifteen percent of women (n=32, 15.2%) felt they were not connected to their community. Few participants had difficulty getting to shops. Twice as many women (n=12, 5.8%) compared to men (n=6, 3.6%) encountered these difficulties, although these differences were not statistically significant.

With regard to food security, the majority (n=397, 99.5%) of participants could always or sometimes afford to eat properly. Three men (2.0%) and three women (1.9%) would often or sometimes eat less because of a lack of money. Four men (2.7%) and eleven women (7.0%) said food variety was sometimes or often limited because of money. There were no significant differences between men and women for each of the three aspects of food security.

Table 4.2-6: Related health and social characteristics of non-Māori men and women

	Men n (%)	Women n (%)	Total n (%)	P value
	n=188	**n=213**	**n=401**	
Sleeping difficulties				
- Yes	49 (26.2)	77 (36.5)	126 (31.7)	0.028
Non-prescription medicines				
-Nutritional supplement	53 (28.5)	93 (43.9)	146 (36.7)	0.001
-Complementary/alternative/herbal	32 (17.2)	53 (24.9)	85 (21.3)	0.062
-Rongoa Māori	0 (0.0)	2 (0.9)	2 (0.5)	0.185
Dentures				
-Partial/full mouth	139 (73.9)	170 (80.6)	309 (77.4)	0.114
Dry mouth				
-Yes	60 (32.1)	79 (37.3)	139 (34.8)	0.279
Health professional: Dentist				
-Not at all	119 (63.6)	140 (66.4)	259 (64.9)	0.524
-Visited in the last 12 months	69 (36.7)	71 (33.6)	140 (35.0)	
Health professional: Dietitian				
-Not at all	182 (96.8)	203 (96.7)	385 (96.7)	0.531
-Visited in the last 12 months	5 (2.7)	7 (3.3)	12 (3.0)	
Support for daily tasks				
- Receives regular support services	91 (48.9)	118 (56.5)	209 (52.9)	0.134
- Meal service	5 (5.4)	10 (7.7)	15 (6.8)	0.509
- Sufficiency of support for daily tasks				0.071
- Cannot count on anyone	6 (3.2)	11 (5.2)	17 (4.3)	
- Help is sufficient	145 (77.1)	175 (82.9)	320 (80.2)	
- Doesn't need help	37 (19.7)	25 (11.8)	62 (15.5)	
Community connectedness				0.329
-Not at all	38 (20.1)	32 (15.2)	70 (17.5)	
-Somewhat/Moderately	75 (39.7)	96 (45.7)	171 (42.9)	
-Very/Extremely	76 (40.2)	82 (39.0)	158 (39.6)	
Difficulty getting to shops				0.433
-Not at all	175 (93.1)	186 (89.9)	361 (91.4)	
-Somewhat/Moderately	7 (3.7)	9 (4.3)	16 (4.1)	
-Very/Extremely	6 (3.2)	12 (5.8)	18 (4.6)	
Food security				
- Can afford to eat properly				0.935
-always/sometimes	187 (99.5)	210 (99.5)	397 (99.5)	
-never/-don't know	1 (0.5)	1 (0.5)	2 (0.5)	
- Eat less because of lack of money				0.949
-often/sometimes	3 (2.0)	3 (1.9)	6 (1.9)	
-never/don't know	147 (98.0)	155 (98.1)	302 (98.1)	
- Varity limited because of money				0.080
-often/sometimes	4 (2.7)	11 (7.0)	15 (4.9)	
-never/don't know	146 (97.3)	147 (93.0)	293 (95.1)	

Gender differences for qualitative characteristics were analysed with Chi-square tests and Fishers exact tests; post hoc Z score comparisons were performed where an overall gender difference was found. p value <0.05 used to indicate significance. Qualitative characteristics expressed as count (%).

4.2.7 Prevalence of nutrition risk characteristics

The prevalence of nutrition risk among non-Māori men and women as assessed by Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) is shown in Table 4.2-7. In this study there were 153 participants (38.3%) with SCREEN II scores ≤49 indicating high nutrition risk. Women showed to have a significantly higher prevalence of nutrition risk than their male counterparts (men: n=50, 26.6%; women: n=103, 48.6%, p<0.001). Overall, women had lower SCREEN II scores compared to men (median (IRQ); men: 52 (8) women: 49 (8), p<0.001).

Table 4.2-7: Nutrition risk of non-Māori men and women as determined by the SCREEN II nutrition screening tool

	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n=237	**n=279**	**n= 516**	
SCREEN II score				
Median (IQR)	52.0 (8)	49.0 (8)	50.0 (8)	<0.001
Prevalence of nutrition risk				
- SCREENII score ≤49	50 (26.6)	103 (48.6)	153 (38.3)	<0.001

Nutrition risk scores, expressed as median (IQR), were analysed using Mann-Whitney tests to ascertain differences between gender groups. Categories of nutrition risk, expressed as count (%), were analysed with Chi-square tests. The p value <0.05 used to indicate significance.

4.2.8 Domains of Nutrition Risk: Nutrition Risk Factors

Nutrition risk factors from the SCREEN II tool are categorised by three key domains. Listed below are the three domains which together make the fourteen items of SCREEN II.

1. Weight change domain
2. Dietary intake domain
3. Factors affecting intake domain

Specific nutrition risk characteristics of the participants and median SCREEN II scores were examined according to each of these domains. Table 4.2-8 shows the median domain scores and the percentage of non-Māori men and women who responded with an answer scored ≤2 which indicates an area of nutrition risk.

4.2.8.1 Weight change domain

Over a quarter (n=112, 28.1%) of participants reported their weight had changed in the past six months. There were significant differences between non-Māori men and women regarding whether weight changes was loss or gain (p=0.002); compared to men (n=8, 4.3%), women (n=30, 14.2%) were more likely to report having gained weight. Overall, seventy-four (18.5%) participants reported to have lost greater than 2.5 kilograms in the last six months. Unintentional weight change was a nutrition risk factor for 48 participants (12.0%), with no significant differences between men and women. Fewer men (n=64, 34.0%) than women (n=91, 42.9%) perceived their own weight as more or less than it should be, although these differences were not statistically significant (p=0.075).

4.2.8.2 Dietary intake domain

From the dietary intake domain of SCREEN II, skipping meals was a nutrition risk factor for less than ten percent of participants (n=34, 8.5%). Nearly half of non-Māori women (n=103, 48.6%) said they limited or avoided certain foods. The same was said for thirty-five percent of men (n=66, 35.1%, p=0.006). Poor appetite was a nutrition risk factor for twice as many women (n=47, 22.2%) compared to men (n=25, 13.3%, p=0.021). Nineteen percent (n=77) of participants had low fruit and vegetable intake. Low meat or alternative intake was a nutrition risk factor for 67.2% of men (n=125) and over three quarters of women (n=160, 76.9%, p=0.031). Over a third (n=149, 37.4) consumed less than two serving of milk products daily. Twenty percent of men (n=37) and twelve percent of women (n=24) consumed less than 3-4 cups of fluid per day (p=0.022).

Table 4.2-8: Proportion of non-Māori men and women with an "at risk" response to individual SCREEN II items as categorised by the three domains

	Men n (%)	Women n (%)	Total n (%)	P value
	n=188	n=212	n=399	
Nutrition risk item*				
Weight change domain				
Domain score				
Median (IQR)	6.0 (2)	6.0 (2)	6.0 (2)	0.599
1.a) Weight change in the last 6 months				0.415
- Don't know	5 (2.7)	7 (3.3)	12 (3.0)	
- Yes	47 (25.0)	65(30.6)	112 (28.1)	
- >2.5kg weight gain	8 (4.3)	30 (14.2)	38 (9.5)	0.002
- >2.5 kg weight loss	38 (20.2)	36 (17.0)	74 (18.5)	
b) Unintentional weight change	19 (10.1)	29 (13.7)	48 (12.0)	0.272
c) Perception of own weight more or less than it should be	64 (34.2)	91 (42.9)	155 (38.8)	0.075
Dietary intake domain				
Domain score				
Median (IQR)	21.0 (4)	21.0 (4)	21.0 (4)	0.264
-Often/always skips meals	20 (10.6)	14 (6.6)	34 (8.5)	0.149
-Limit or avoids certain foods	66 (35.1)	103 (48.6)	169 (42.3)	0.006
-Fair/poor appetite	25 (13.3)	47 (22.2)	72 (18.0)	0.021
-Low fruit and vegetable intake (≤ 3 serves per day)	44 (23.5)	33 (15.8)	77 (19.4)	0.052
-Low meat or meat alternative intake (≤ 1 serves per day)	125 (67.2)	160 (76.9)	285 (72.3)	0.031
-Low milk product intake (≤ 2 serves per day)	68 (36.2)	81 (38.6)	149 (37.4)	0.621
-Low fluid intake (≤ 3-4 c per day)	37 (19.8)	24 (11.5)	61 (15.4)	0.022
Factors affecting intake domain				
Domain score				
Median (IQR)	22.0 (4)	20.0 (4)	20.0 (4)	<0.001
-Swallowing difficulty	19 (10.1)	40 (18.9)	59 (14.8)	0.014
-Chewing difficulty	30 (16.0)	46 (21.7)	76 (19.0)	0.151
-Uses meal replacements	20 (10.7)	18 (8.6)	38 (9.6)	0.473
-Eats alone	57 (30.3)	121 (57.3)	178 (44.6)	<0.001
-Cooking is a chore	23 (12.2)	77 (36.8)	100 (25.2)	<0.001
-Often/always has difficulty with groceries	10 (5.4)	18 (8.7)	28 (7.2)	0.207

*SCREEN II items with scores less than or equal to two, out of a maximum score of four, potentially lead to 'nutrition risk'.he proportion of non-Māori participants "at risk" responses to individual SCREEN II items were analysed with Chi square tests to examine differences between gender groups.
Quantitative characteristics are expressed as median (IQR). Qualitative characteristics expressed as count (%).

4.2.8.3 Factors affecting intake domain

In the third SCREEN II domain "Factors affecting intake" women (20.0 (IQR 4.3)) had a significantly lower median score than men (22.0 (IQR 4), p<0.001) thus contributing fewer points to the overall SCREEN II score.

Swallowing or chewing difficulty was a nutrition risk factor for 59 (14.8%) and 76 (19.0%) participants respectively. Ten percent of participants (n=38, 9.6%) used nutritional supplements or meal replacements. Eating alone was a nutrition risk factor for twice as many women (n=121,

57.3%) compared to men (n=57, 30.3%, p<0.001). Women (n=77, 36.8%) were also more likely to find cooking a chore than their male counterparts (n=23, 12.2%, p<0.001). Less than ten percent of participants had difficulty with getting groceries (n=28, 7.2%).

4.2.8.4 Proportional SCREEN II domain score weighting

Derived from the median SCREEN II domain scores of non-Māori participants, Figure 4.2-1 illustrates the relative proportion of SCREEN II points from each of the three domains scores as compared to the highest scores possible. SCREEN II points from the "Intake" and Factors Affecting Intake" domains are weighted equally for non-Māori. The median "Weight Change" domain score has a relatively smaller contribution to the total SCREEN II score compared to the highest score possible.

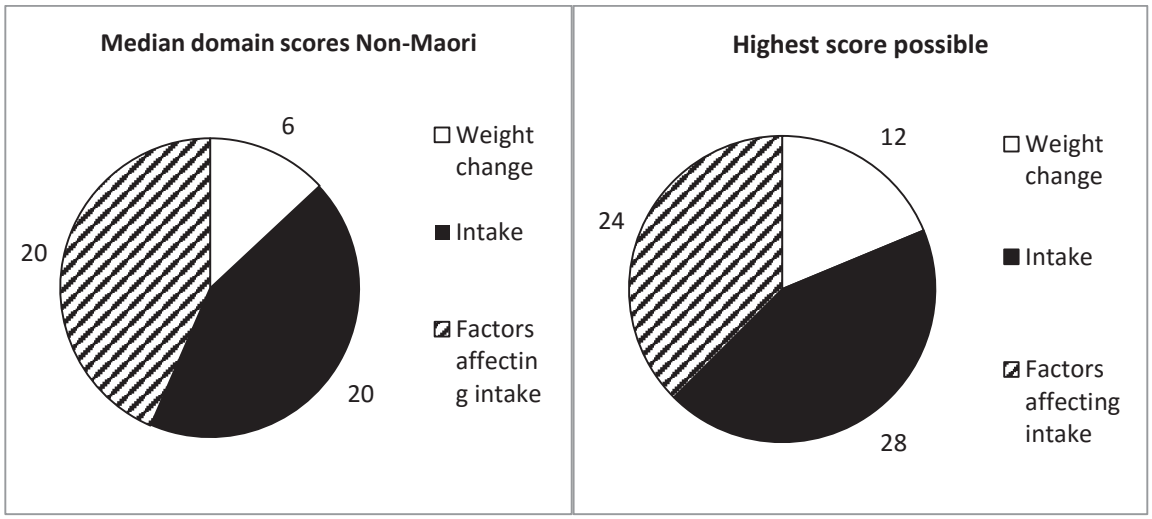


Figure 4.2-1: Proportion of median SCREEN II points from each of the three domains compared to highest SCREEN II score possible

4.2.9 Hospital admission data

Hospital admission data for non-Māori men and women 12 months prior enrolling in the and over the 24 month study period is shown in Table 4.2-9. All-cause admissions are reported as median number of hospitalisations and as the percentage of participants who were hospitalised.

Table 4.2-9: All-cause and specific-cause hospitalisations for non-Māori men and women 12 months prior baseline interview and at 24 months follow-up.

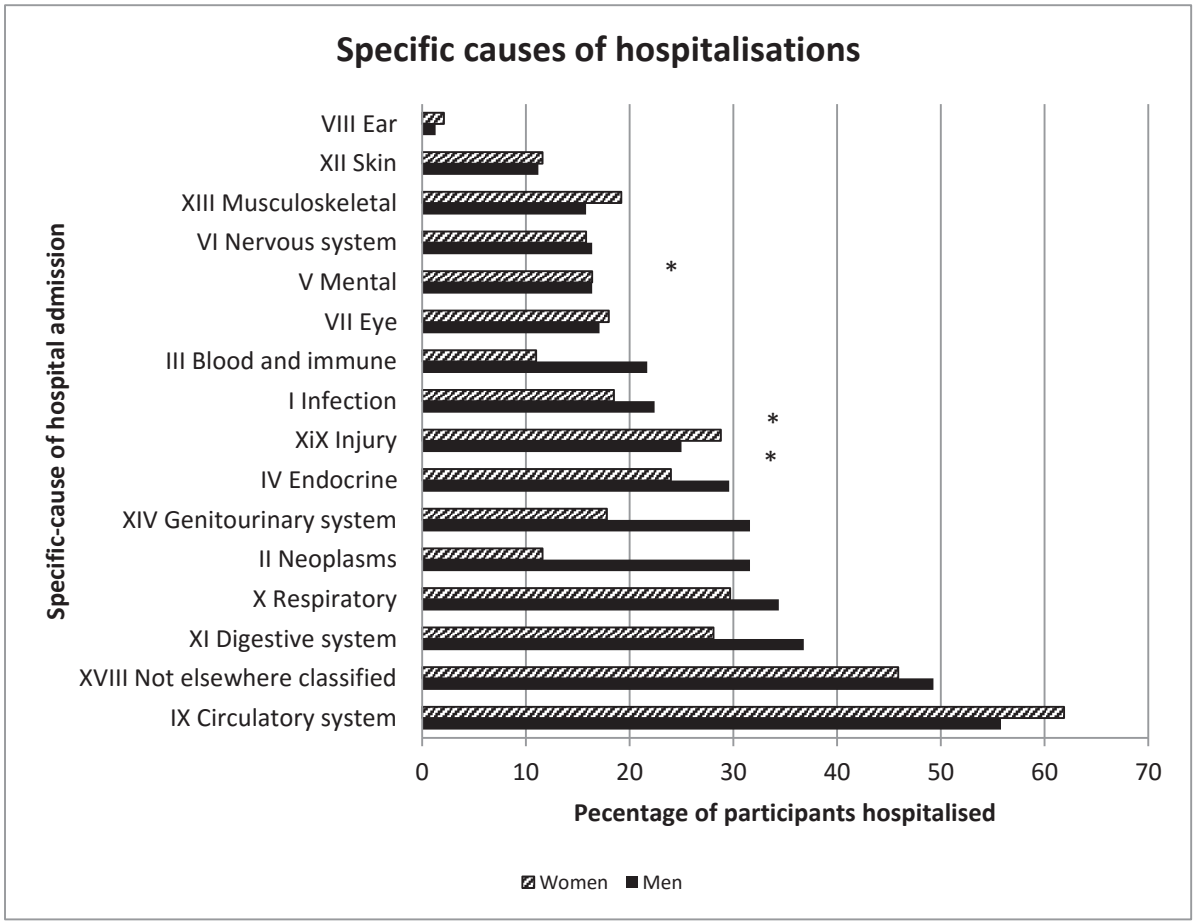
	Men n (%)	**Women n (%)**	**Total n (%)**	**P value**
	n=237	**n=279**	**n= 516**	
All-cause hospital admission 12 months prior study				
-None	153 (64.6)	190 (68.1)	343 (66.5)	0.396
-Yes	84 (35.4)	89 (31.9)	173 (33.5)	
All-cause hospital admission 24 months				
Median (IQR)	1 (3)	1 (2)	1 (2)	<0.001
-None	83 (35.0)	132 (47.3)	215 (41.7)	0.005
-Yes	154 (65.0)	147 (53.7)	301 (58.3)	

Gender differences for the number of hospital admissions over 24 months, expressed at median (IQR), were analysed using Mann-Whitney tests. Categories for being hospitalised, expressed as count (%), were analysed with Chi-square tests. The p value of <0.05 was used to indicate significance.

Three-hundred and one participants were admitted to hospital over the twenty-four month study period. The median number of hospital admission was one (IQR 2). There were significant differences between non-Māori men and women for both being hospitalised (men: 154, 65.0%; women: 147, 53.7%, p=0.005) and total number hospitalisations (median (IQR); men: 1(3); women: 1(2), p<0.001).

Specific-cause admissions are shown as number of admissions in Figure 4.2-2 according to the top 10 ICD codes (World Health Organisation, 2010) for board causes of hospitalisations. Diseases of the “Circulatory system” were the leading cause of hospitalisations accounting for 58.7% (n=145), with no significant differences between men and women. Nearly half (n=142, 47.7%) of hospital admissions involved signs or symptoms that could not elsewhere be classified. Men showed a higher prevalence of admissions for neoplasms (n=48, 31.6%), more than twice that of women (n=17, 11.6%, p=<0.001). Diseases of the digestive system, the prevalence of which was similar between men and women, involved nearly a third of admissions (n=97, 32.6%).

Figure 4.2-2: Specific-cause hospitalisations according to the top 10 ICD coded broad causes



for non-Māori men and women at 24 months

Categories for specific-causes were analysed with Chi-square test using the level of significance *p<0.05. Frequency of specific-cause hospitalisations expressed as count (%).

4.2.10 All-cause hospitalisation logistic regression model

Univariate analysis showed a greater number of conditions ($p<0.001$), greater number of medications ($p=0.048$) and previous hospital admission ($p<0.001$) were significantly associated with 24-month all-cause hospital admission. Multiple logistic regression models were constructed to examine independent associations between nutrition risk scores from the three key domains and 24-month all-cause hospitalisations adjusting for gender, NZ deprivation index, education level and the aforementioned univariate predictor.

There was no significant relationship between SCREEN II domain scores and hospitalisation in both the unadjusted and adjusted models (Table 4.2-10).

Table 4.2-10: Logistic regression model showing the relationship between SCREEN II domain scores and 24-month all-cause hospital admission for non-Māori participants, unadjusted and adjusted models

Independent variables	Unadjusted model		Adjusted model			
			Model 1		Model 2	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
SCREEN II domain score: Weight change	0.95 (0.82-1.11)	0.535	0.94 (0.80-1.10)	0.445	0.95 (0.80-1.12)	0.515
SCREEN II domain score: Dietary intake	0.92 (0.78-1.08)	0.312	0.94 (0.79-1.11)	0.438	0.91 (0.76-1.10)	0.342
SCREEN II domain score: Factors affecting intake	1.04 (0.91-1.19)	0.576	1.00 (0.79-1.17)	0.948	1.04 (0.87-1.24)	0.667
Gender			0.87 (0.33-2.31)	0.774	1.47 (0.46-4.68)	0.514
NZ deprivation index quintile			0.84 (0.57-1.22)	0.351	0.69 (0.44-1.07)	0.100
Education			1.13 (0.78-1.63)	0.513	1.09 (0.74-1.61)	0.654
Previous hospital admission (12 months)					6.49 (2.01-20.9)	0.002
Comorbidities					0.96 (0.77-1.19)	0.684
Nutrition supplement usage					0.32 (0.12-0.89)	0.029

Regression analyses adjusted for age, gender, socioeconomic deprivation (NZ Dep index quintile), highest level of education, comorbidities and hospital admission 12 months prior study. Also adjusted for univariate predictors with a significance level $p<0.05$ and informed by knowledge from the literature (nutrition supplement usage).

4.2.11 Mortality data

Forty-one men and thirty-five women died over the twenty-four month study period. There were no significant differences in mortality rates between men and women (p=0.136).

Table 4.2-11: All-cause mortality for non-Māori men and women at 24 months

	Men n (%)	Women n (%)	Total n (%)	P value
	n=237	**n=279**	**n= 516**	
All-cause mortality				
-Deceased	41 (17.3)	35 (12.5)	76 (14.7)	0.136

Categories describing mortality status , expressed as count (%), were analysed with Chi-square tests using the level of significance p<0.05 Quantitative characteristics are expressed as median (IQR).

4.2.12 Logistic regression model

Univariate analysis showed living alone (p=0.024), smoking (p=0.001), moderate or severe depression (GDS-15, p=0.001), lower NEADL score (p=0.021), a greater number of conditions (p<0.001), a greater number of medications (p=0.019), previous hospital admission (p=0.002), BMI (p=0.022), difficulty getting to shops (p=0.001), and insufficient support (p=0.011) were significantly associated with 24-month all-cause mortality. Multiple logistic regression models were constructed to examine independent associations between nutrition risk scores from the three key domains and 24-month all-cause mortality. Adjusting for gender, NZ deprivation index, education level, and the aforementioned univariate predictors.

In the unadjusted model, there was a trend toward a negative relationship between SCREEN II weight change domain score and all-cause mortality, though without statistical significance (p=0.180). In the final model (adjusted for gender, NZ deprivation index, education level, hospitalisations, and comorbidities) there was a trend toward a positive relationship between SCREEN II factors affecting intake domain score and all-cause mortality, though without statistical significance (p=0.080) (Table 4.2-12).

Table 4.2-12: Logistic regression model showing the relationship between SCREEN II domain scores and 24-month all-cause mortality of non-Māori participants, unadjusted and adjusted models

Independent variables	Unadjusted model		Adjusted model					
			Model 1		Model 2		Model 3	
	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value	OR (95% CI)	P value
SCREEN II domain score: Weight change	0.87 (0.71-1.07)	0.180	0.90 (0.73-1.11)	0.320	0.92 (0.72-1.16)	0.462	0.89 (0.71-1.12)	0.308
SCREEN II domain score: Dietary intake	1.01 (0.83-1.23)	0.950	0.97 (0.79-1.20)	0.789	1.00 (0.79-1.28)	0.984	0.97 (0.78-1.19)	0.741
SCREEN II domain score: Factors affecting intake	1.06 (0.90-1.26)	0.471	1.16 (0.95-1.42)	0.154	1.17 (0.92-1.49)	0.193	1.22 (0.98-1.51)	0.080
Gender			1.26 (0.38-4.12)	0.706	2.34 (0.49-11.2)	0.287	1.45 (0.40-5.20)	0.573
NZ deprivation index quintile			0.97 (0.61-1.53)	0.879	0.91 (0.52-1.59)	0.750	0.97 (0.58-1.63)	0.910
Education			0.98 (0.63-1.54)	0.943	0.90 (0.53-1.52)	0.680	0.90 (0.53-1.52)	0.688
Hospital admission over 24 months					10.5 (1.15-95.7)	0.037	8.31 (1.01-68.5)	0.049
Comorbidities					1.17 (0.92-1.48)	0.193	1.26 (1.01-1.57)	0.037
Living situation					2.30 (0.93-5.68)	0.071		
Smoking					1.55 (0.73-3.30)	0.252		

Regression analyses adjusted for age, gender, socioeconomic deprivation (NZ Dep index quintile), highest level of education, comorbidities and hospital admission over the 24 months study period. Also adjusted for univariate predictors with a significance level $p<0.05$ and informed by knowledge from the literature (living situation, smoking status).

5.0 Discussion

In this study there was a high prevalence of nutrition risk among older community-living Māori (49.4%) and non-Māori (38.3%, as determined by SCREEN II score ≤49). A similar high prevalence of nutrition risk among older Māori (62.5%) and non-Māori (30.0%) was also reported in the Hawke's Bay. For this younger population group (over 65 years), it was found older Māori were 5.2 times more likely to be at nutrition risk than non-Māori (McElnay et al., 2012). The overall prevalence of nutrition risk observed for both Māori and non-Māori cohorts in the current study, was similar to other studies of older adults in New Zealand and Canada ranging from 31 to 51% (Broeska, Lengyel, & Tate, 2013; Keller, 2006; Watson, Zhongxian, & Wilkinson, 2010; Wham, Carr, & Heller, 2011; Wham, Dyall, Teh, & Kerse, 2011; Wham, Redwood, & Kerse, 2014).

Overall, a marginally larger proportion of Māori women were at higher nutrition risk (54.2%) compared to Māori men (42.0%, $p=0.057$). The same gender differences applied for non-Māori; the prevalence of high nutrition risk among non-Māori women (48.6%) was nearly twice that of non-Māori men (26.6%, $p<0.001$). As women tend to live longer than men and have a greater likelihood of becoming widowed and living alone in old age (Statistics New Zealand, 2015a), they are also vulnerable to nutrition risk (Locher et al., 2008). Loss of spouse and nutrition risk among older people is related to the choice of less quality food (e.g. fewer vegetables and fruit) and altered dietary behaviours (e.g. eating alone more often, skipping meals, and having reduced dietary variety)(Rosenbloom & Whittington, 1993; Stahl & Schulz, 2014). For widowed older people, there is an increased risk of having lower overall energy intake which also increases their risk of dietary inadequacies and weight loss (Heuberger & Wong, 2014). Fewer social connections on becoming widowed can contribute to social isolation and can physically limit an older person's access to healthy food and food preparation abilities (Johnson, 2002; Stahl & Schulz, 2014). In addition, the social significance of eating may become less for widowed women and result in a lower food intake or a less varied diet (Johnson, 2002; Stahl & Schulz, 2014).

The Māori participants in the current study are likely to represent an advanced age population that has survived successfully. Among wider New Zealand, Māori over 80 years represent less than one percent (0.75%) of the total population (Statistics New Zealand, 2013). Of the participants, a third of Māori men (35.5%) and Māori women (30.6%) lived with extended family (whanāu) or non-relatives, and while over half (60.5%) were widowed only 41.2% of the Māori participants were living alone. This is common in Māori culture, community connectedness may

provide the capacity to belong, care, and share, which then for older Māori enables physical, mental, and spiritual health (Durie, 1994). It is well established that older people with close, supportive communities are more likely to share meals with others which is associated with higher overall dietary intake (Locher et al., 2008). Community connections also facilitate access to a wider variety of nutritious food which correlates with overall better nutritional intake (Locher et al., 2008). Over half (61.2%) of the Māori men and women in this study felt extremely or very connected with their community. Most (81.6%) felt they had sufficient help for daily tasks while difficulty getting to the shops was uncommon (10.3%). These findings suggest the close whanāu and community supports among the Māori participants may be protective from nutrition risk by enhancing meal sharing and dietary intake.

Nearly half (46.2%) of the Māori participants in the current study lived in areas of high socioeconomic deprivation. Socioeconomic deprivation is known to increase risk of food insecurity and limit dietary choices which increases risk of malnutrition among older adults (Russell, Flood, Yeatman, & Mitchell, 2014; Simsek, Meseri, Sahin, & Ucku, 2013). Having to choose smaller portions or cheaper items at the cost of dietary quality because of limited money was a common theme among older non-Māori men living alone in New Zealand (Wham & Bowden, 2011). However, among the Māori participants in this study there was a low prevalence of food insecurity: most (98.4%) reported they could always or sometimes afford to eat properly. Community connectedness among Māori participants may negate the effects of socioeconomic hardship through cultural connections and social supports.

Non-Māori participants in the current study, were recruited at the age of 85 years and having lived one to five years past the average life expectancy for women and men (respectively) in New Zealand (Statistics New Zealand, 2015). The majority identified as New Zealand European ethnicity (90.1%) and were New Zealand born (80.4%). Living independently in the community, this participant group represented a population of non-Māori who have aged successfully.

The current study examined various lifestyle factors that are known to contribute to overall nutritional health and successful ageing (Ministry of Health, 2013). For non-Māori, two thirds (66.7%) of women and nearly a third (32.1%) of men were widowed and a similar prevalence lived alone (62.6% of women and 32.1% of men). Living alone and widowhood have been previously associated with high nutrition risk (Hanna & Collins, 2015; Heuberger & Wong, 2014) and this relationship was also confirmed in the baseline assessment of LiLACS NZ (Wham et al., 2015). Those who are socially isolated are more likely to eat meals alone which can negatively affect caloric intake (Locher et al., 2005). In addition, more opportunities taken to share meals

with others has a positive effect on nutritional intake (McHugh, Lee, Aspell, Lawlor, & Brennan, 2015). The high prevalence of widowhood and living alone among the participants are known risk factors and an important finding in this study. Other non-dietary factors such as reduced social support, lack of access to community resources, poor health, and functional impairment (Locher et al., 2008) may also contribute to nutrition risk of community-living older adults in New Zealand.

A high prevalence of chronic health conditions and medication use was observed among the Māori participants of this study; more than half had five or more comorbidities (50.6%) and were prescribed more than four medications (polypharmacy, 53.9%). This was not unexpected; Māori over 65 years have significantly higher rates of cardiovascular disease, cancer (registrations and mortality), respiratory diseases, and diabetes compared to non-Māori (Ministry of Health, 2011). Of the Non-Māori participants, more than half (53.9%) had five or more conditions which is higher than the wider 85+ New zelanad population with four of more chronic health conditions; 18.1% of women over 85 years and less than 10% of older men (Ministry of Health, 2006). In addition, polypharmacy was common among non-Māori participants (56.4%). Both comorbidities and taking multiple medications are associated with nutrition risk in community-living older adults (Wham et al., 2014). Having multiple chronic conditions impacts a person's nutritional needs in old age, in addition, having chronic conditions can also make it more difficult to access adequate nutritious food (Keller, 2007).

Physical function limitations can make it difficult for older people to access adequate nutritious food (Payette, 2005). Despite the high rate of chronic health problems, overall self-rated physical health was fair among both Māori and non-Māori (SF-12 physical median (IQR), Māori: 45.5 (18) versus non-Māori: 43.0 (19), out of a total score of 100), respectively, however a need for support with daily tasks was common (Māori: 43.3% versus non-Māori: 52.9%). For the Māori and non-Māori participants, many had independence in basic activities of daily living (ADL); on average, the participants had difficulty with only three of twenty-two ADLs (median (IQR), Māori: 19 (4) versus non-Māori: 19 (4)). This reflects a positive outlook for older Māori and non-Māori; it suggests many have the physical ability to prepare food and eat well independently.

Concerning psychological health of the participants, symptoms of severe depression among Māori and non-Māori was low (Māori 1.2% versus non-Māori 0.5%) as was the evidance of moderate depression (Māori: 13.7% versus non-Māori: 10.2%). Depression is associated with declining physical health and quality of life (Wada et al., 2005) which can also affect appetite

and cause a decline in food intake (Ávila-Funes et al., 2008). The relationship between depressive symptoms and high nutrition risk is stronger for non-Māori; for Māori the value of community life and connection is thought to have a positive effect of emotional health (Wham et al., 2015). The current study showed depressive symptoms were significantly related to risk of mortality for non-Māori (p=0.001).

An interesting finding from this study was despite high nutrition risk usually being associated wilth low body weight (BMI ≤18.5kg/m^2) and weight loss (Beck, 2015), there was a high proportion of participants who were overweight (BMI 25.0-29.9kg/m^2; Māori: 41.3% versus non-Māori: 48.3% %) or obese (BMI ≥30.0 kg/m^2; Māori: 37.7% versus non-Māori: 19.0%) (World Health Organisation, 2007). This finding was consistent with the 2006/07 New Zealand Health Survey which showed the majority of Māori and non-Māori over 65 years tend to have a BMI of 25kg/m^2 or greater (Māori 79.6-91.6% versus non-Māori 66.3-75.9%). While being overweight or obese between the ages of 70-75 years may negatively affect health and survival in old age (de Hollander, Van Zutphen, Bogers, Bemelmans, & De Groot, 2012), the relationship between BMI and nutrition risk has become decreasingly J-shaped in recent years. Corrada et al. (2006) showed that, unlike their younger counterparts, obesity (BMI ≥25kg/m^2) was not associated with greater risk of mortality for adults over 75 years. Further, a recent meta-analysis identified that for adults over 65 years in the community, having a BMI between 23 and 33kg/m^2 is associated with the lowest mortality and may be a protective factor for nutritional problems in old age (Winter, Wattanapenpaiboon, Nowson, & MacInnis, 2014). Obese and normal weight older people (BMI ≥18.5kg/m^2) may have better nutrient reserves than those who are underweight (BMI <18.5kg/m^2) and may be at lower risk of becoming ill and requiring medical intervention (Buys et al., 2014; Yang et al., 2011). The current study showed BMI was not significantly related to hospitalisations for both Māori and non-Māori, but lower BMI was associated with higher risk of mortality over 24 months for non-Māori men and women (p=0.022). These findings suggest lower BMI may have a greater effect on health consequences for older non-Māori than Māori.

A particular consideration is that Māori are known to have a higher proportion of lean body mass resulting in a higher BMI (Swinburn, Ley, Carmichael, & Plank, 1999). Maintaining lean body mass with advancing age is a protective factor for nutrition risk as it is associated with improved independence and physical function (Hao & Guo, 2012; Keller, 2007). Unfortunately, BMI used alone during nutrition assessment is not a good indicator of nutritional issues as it does not reflect body composition. One study in Australia has shown that while older people at high nutrition risk tend to have a lower BMI, a third of those at high nutrition risk had a BMI

indicating overweight or obesity (BMI ≥25kg/m^2) (Winter, Flanagan, McNaughton, & Nowson, 2013). The findings from the current study suggest BMI may be a less pertinent factor for assessing nutrition risk among older Māori, risk assessment therefore requires a holistic approach considering multiple domains of nutritional health.

5.0.1 Domains of Nutrition Risk

Nutrition risk among the participants in this study was examined according to three domains of nutrition risk identified in the Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II (SCREEN II) tool (Keller, Goy, & Kane, 2005). The three domains which collectively assess nutrition risk status by providing nutrition risk score are 1) Weight change, 2) Dietary intake, and 3) Factors affecting intake. The distribution of scores across each of the three domains do not contribute evenly to the total SCREEN II score (0-64 maximum); from the "weight change" domain there is a maximum score of 12, from the "dietary intake" domain the maximum score is 24, and from the "factors affecting intake" domain the maximum score is 28. The significance of each of the domain scores for the Māori and non-Māori participants is demonstrated in the following discussion.

5.0.1.1 Weight Change Domain

Change in body weight is a key indicator of nutritional problems as it marks a turning point by which nutrition risk factors manifest as sub-clinical and clinical malnutrition (Keller, 2007). The SCREEN II tool provides three items which contribute to the identification of unintentional weight change. The most prevalent item scored as potentially leading to nutrition risk (i.e. item score ≤2) from the "weight change domain" among both the Māori and non-Māori participants was "perception of own weight being more or less than it should be" (Māori: 44.8% versus non-Māori: 38.8%). This risk factor was most common among women in both cohorts (Māori women: 49.7%, p=0.055 versus non-Māori women: 42.9%, p=0.075). However, this is in contrast to findings from the Hawkes Bay, where a higher proportion of Māori (67.9%) and non-Māori (61.9%) aged 65 and older identified with this nutrition risk factor (McElnay et al., 2012). In this study, given the majority Māori (79.0%) and non-Māori (67.5%) participants had a BMI in the overweight or obese weight range; it is likely that many perceived their weight as "more" rather than "less than it should be". Regardless, both are equally scored at nutrition risk factors in SCREEN II as both high and low body weight are associated with excess mortality among older adults (Winter, Wattanapenpaiboon, Nowson, & MacInnis, 2014).

"Weight change in the last 6 months" was the second most prevalent item scored as potentially leading to nutrition risk from the "weight change" domain for both the Māori and non-Māori – 36.1% and 28.1%, respectively."Weight loss of more than 2.5kg" (rather than weight gain) was

predominant among both Māori and non-Māori -23.5% and 18.5%, respectively. Older people are vulnerable to weight loss with advancing age (Miller & Wolfe, 2008). While some weight loss, as a normal part of aging, can have minimal effect of health and function (Jackson, Janssen, Sui, Church, & Blair, 2012), the disproportionate loss of lean mass over time can make an older person increasingly vulnerable to disease-related sarcopenia, associated functional losses, and increased risk of falls and fractures (Bales & Ritchie, 2002). Loss of physical function and independence perpetuates the nutrition risk process leading to further nutritional and health problems (Keller, 2007). There is evidence to suggest, however, that obese older adults who intentionally lose weight can gain functional and clinical benefits for long term health (Waters et al., 2013). For adults in advanced age, the possible benefits of weight loss must be considered against the risk of adverse consequences from caloric restriction and nutritional inadequacies (Miller & Wolfe, 2008).

5.0.1.2 Dietary Intake Domain

From the "dietary intake" domain of SCREEN II, the most prevalent nutrition risk factors for both Māori and non-Māori men and women were low "fruit and vegetable", "meat and alternatives", and "milk product" intake. It suggests participants may not have met the minimal recommended intake of foods from each of these food groups (Ministry of Health, 2013) which increases the likelihood of nutritional inadequacies (Donini et al., 2013; Keller & Hedley, 2002). Three quarters of the participants of this study (Māori: 77% versus non-Māori: 72%) were consuming less than two servings of meat or meat alternatives daily and over a third (Māori: 41% versus non-Māori: 37%) were consuming less than three servings of milk products daily. Meat, meat alternatives, and dairy products are important sources of energy, high biological value protein, vitamins (A, B_{12}, niacin, thiamine, riboflavin), and minerals (calcium, phosphorus, magnesium, zinc) (University of Otago & Ministry of Health, 2011). Even more so in advanced age, protein is important for maintaining muscle and bone mass. Higher intakes have been shown to preserve lean mass with age (Houston et al., 2008) and are associated with maintaining good physical function among adults over 70 years (Zoltick et al., 2011). Further, dairy products provide nearly half of the dietary calcium for adults over 65 in New Zealand (University of Otago & Ministry of Health, 2011). It is likely that participants with low dairy product intake also have inadequate calcium intake which increases the risk of low bone mineral density and osteoporotic fractures (Nieves et al., 2008).

Nearly two thirds of Māori (60.5%) and nearly a quarter (19.4%) of non-Māori participants consumed less than four servings of vegetables and fruit daily. This prevalence is high when compared to results from the 2008/09 NZANS; 23.1% of men and 18.6% of women over 71

years consumed less than three servings of vegetables per day, with the prevalence among older Māori nearly two-times that of non-Māori (Ministry of Health, 2015a). Low intake of vegetables and fruit in advanced age is particularly noteworthy as these foods deliver to the diet many micronutrients which serve various roles for optimising cell function (such as antioxidants and enzyme cofactors) (NHMRC & Ministry of Health, 2006). They are also key sources of dietary fibre and phytonutrients (NHMRC & Ministry of Health, 2006). Low vegetable and fruit intake increases the risk of dietary inadequacies for various micronutrients which could compromise nutritional status and health.

Limiting or avoiding certain foods was a nutrition risk factor item for over a third of both Māori (38.4%) and non-Māori (42.3%), the prevalence being even greater among non-Māori women (48.6%) compared to non-Māori men (35.1%, p=0.006). Low dietary variety is associated with inadequate intake from the four main food groups and, therefore, is associated with risk of dietary inadequacies (Keller & Hedley, 2002; Wham et al., 2014). Frail elderly in residential care who consume a more varied diet have been shown to have higher high-density lipoprotein, higher total body potassium, higher blood folate, and higher mid-arm circumference, therefore indicating better nutritional status (Bernstein et al., 2002). Meat and alternatives, vegetables, and fruit have been identified as the most common foods avoided by older adults with low dietary intakes and signs of anorexia (Donini et al., 2013). The reasons for limiting or avoiding certain foods is not clear. Older people who live alone may limit food intake as a means of economising, such as by purchasing cheaper cuts of meat or only purchasing fresh vegetables and fruit when prices are low enough (Wham & Bowden, 2011). Those who intentionally limit their food intake to lose weight also have a greater risk of nutritional problems. For example, limiting protein rich foods (such as meat or dairy products) often leads to loss of lean mass which can have adverse functional consequences for muscle strength, agility, and an increased risk of falls, fractures, and reduced independence (Miller & Wolfe, 2008).

5.0.1.3 Factors affecting intake domain

The final domain of SCREEN II, "factors affecting intake" examines social and behavioural predisposing nutrition risk factors which play an integral role in the complex construct of nutrition risk (Keller, 2006). More than half of Māori (53.9%) and non-Māori (57.3%) women frequently ate alone, and over a third of non-Māori women (36.8%) found cooking a chore. These gender differences are not surprising; there were significantly more Māori and non-Māori women widowed and living alone, both of which are nutrition risk factors (Vesnaver & Keller, 2011; Wham et al., 2011). Older people who eat alone are more likely to have a low BMI and consume less varied diets (Kimura et al., 2012). A unique recommendation made in the New

Zealand Food and Nutrition Guideline Statements for Healthy Older People is to "take opportunities to eat meals with other people" (Ministry of Health, 2013). Indeed, social connection has an integral role in enabling successful ageing; not only do older people eat more in the presence of others (Locher et al., 2005), but engagement in the community can create a high perceived value of healthy living and is considered a protective factor for nutrition risk (Foster & Neville, 2010).

5.0.2 Consequences of nutrition risk

Nutritional health plays an important role in health and successful ageing which allows older people to live relatively independently with minimal chronic disease and minimal contact with acute care (Keller, 2007). In younger years, healthy eating and exercise is promoted with the aim of minimising risk of lifestyle related diseases such as cardiovascular disease and Type 2 diabetes. With advancing age, nutritional health is also important for maintaining lean body mass, and minimising risk of functional impairment and infection (Keller, 2007). Thus, the relationship between nutritional health, ageing, physical function, and chronic disease is bidirectional; just as malnutrition can make an individual vulnerable to poor outcomes such infection, having a chronic condition can affect food intake (Keller, 2007). The objectives of this study were to investigate all-cause hospitalisations, specific-cause hospitalisations, and all-cause mortality for the Māori and non-Māori participants. Outcome investigations and their relationship with nutrition risk are discussed below.

5.0.2.1 All-cause Hospitalisations

Over the twenty-four months study period more the half of Māori (55.1%) participants were admitted to hospital, over half of whom were women. Such a high prevalence was expected as public hospital discharge and procedure rates for Māori are highest among older age groups and peak for the 75-84 age grouping (Ministry of Health, 2012). In this study there was a trend toward a higher prevalence of hospital admissions among Māori men compared to women (59.3% versus 52.0%, respectively, p=0.139). By contrast to national data, age standardised hospital discharge and procedure rates tend to be higher among Māori women compared to men (Ministry of Health, 2015b). This could be attributed to Māori women having a longer life expectancy (Statistics New Zealand, 2015b) than Māori men, thus in advanced age having more encounters with health care services.

For non-Māori, more than half (58.3%) of participants were hospitalised over the twenty-four month study period. This was also an expected finding as New Zealand public hospital discharge and procedure rates are high among older adults, with the highest being in the 85 and over age group (Ministry of Health, 2015b). We observed significantly more hospitalisations among non-

Māori men (65.0%) compared to women (53.7%) for both prevalence (p=0.005) and number of admissions (p<0.001); consistent with national data for age-specific hospital discharge and procedure rates (Ministry of Health, 2015b).

5.0.2.2 Specific-cause Hospitalisations

In the current study, diseases of the circulatory system (ICD IX) were the leading specific cause of hospital admissions for Māori men (79.5%) and women (74.3%). These findings are consistent with national data; in the year 2012/13, although only 16.5-18.1% (hospital discharges for Māori men and women were classified under this cause, it was one of the highest ranked causes of hospital admission (Ministry of Health, 2015b). Cardiovascular diseases (including ischaemic heart disease and stroke) are among the top major causes of death for Māori over 65 years (Ministry of Health, 2011). The third highest ranked cause of hospital admission for Māori (47.0%) was ICD IV Endocrine, Nutritional, and Metabolic Diseases. This was an expected finding given ICD IV encompasses Diabetes Mellitus (World Health Organisation, 2010), which is diagnosed among 22.9-28.4% of Māori over 65 in New Zealand (Ministry of Health, 2011). Further, diabetes complications involving renal failure and amputations are highly prevalent and represent significant health disparities encountered by older Māori (Ministry of Health, 2011).

For non-Māori, diseases of the circulatory system (ICD IX) were the leading specific cause of hospital admissions for men (55.8%) and women (61.9%). Although this is higher national rates (16.5-16.8%), ICD IX is also the leading cause of hospital discharges for adults over 85 years in New Zealand (Ministry of Health, 2015b). Cardiovascular diseases (including ischaemic heart disease and stroke) are among the top major causes of death of adults over 85 years in New Zealand (Ministry of Health, 2011). They are ranked second in the top broad causes of health loss in New Zealand, accounting for 17% of total Disability Adjusted Life Years lost.

5.0.2.3 Mortality

There were 84 (20.0%) of Māori participants who deceased over the twenty-four months study period. Higher mortality rates among Māori men (26.6%) compared to Māori women (15.2%) was expected as Māori women tend to live longer than their male counterparts (Ministry of Health, 2011).

For non-Māori, there were seventy-six (14.7%) participants who deceased over the twenty-four months study period. There were no significant differences in mortality rates between non-Māori men (17.3%) and women (12.5%). Women tend to have a longer life expectancy than men, although this gender gap narrows with increasing age (Ministry of Health, 2002).

5.0.3 Association between the three domains of SCREEN II and twenty-four months all-cause hospitalisation and mortality

This was the first study to examine the relevance of three domains from the SCREEN II tool as they relate to hospitalisations and mortality for community-living older adults. We identified among Māori participants, the SCREEN II dietary intake domain score was independently related to all-cause mortality (OR (95% CI), 0.74 (0.56-0.98), p=0.034) but not with all-cause hospital admissions at 24-month follow-up (p=0.150). This is an important finding. The SCREEN II dietary intake domain score is a reflection of a person's nutrition risk as it relates to meal patterns, appetite, and dietary adequacy of fruit and vegetables, meat and alternatives, dairy products, and fluid. Findings from this study therefore highlight that regardless of body weight change and other social and functional risk factors from the SCREEN II domains, for older Māori, low intake of nutritious foods has the greatest influence on risk of mortality and, potentially, risk of hospitalisation.

It was clear in this study there was a very high prevalence of Māori men and women who identified with risk factors from the dietary intake domain. Particularly noteworthy were 77% of Māori participants with low meat or meat alternative intake, and 61% with low fruit and vegetable intake. Vegetables and fruit, meat and meat alternatives, dairy products, and fluid are sources of several essential nutrients all which play a critical role in maintaining good health and supporting successful ageing (Ministry of Health, 2013). Older people who thus identify with nutrition risk factors from the dietary intake domain of SCREEN II have an increased risk of multiple nutritional inadequacies. Inadequate or impaired food intake is best understood as an early initiation phase along the continuum of malnutrition (Keller, 2007). Older people who eat less or have less varied diets have an increased risk of developing subclinical malnutrition which, through a process, may manifest as overt changes in body weight and altered biochemistry (Keller, 2007). A relationship between nutrition risk, risk of mortality, and poor outcomes has been demonstrated in a number of longitudinal studies (Broeska et al., 2013; Buys et al., 2014; Charlton et al., 2012). Our findings support this relationship and provide further insight for the relevance of the nutrition risk process as described by Keller (2007).

Linear regression analysis for the cohort of non-Māori men and women demonstrated no significant relationship between any of the three SCREEN II domain scores and twenty-four months hospitalisation or mortality. However, we did observe in the adjusted model a positive trend for the "factors affecting intake" domain score and all-cause mortality (p=0.080). These findings confirm what was established in a structure equation model created for the original SCREEN tool version I (Keller, 2006). Using a four-factor model, the aforementioned study

demonstrated relatively equal weighting among various factors (e.g. dietary intake, risk factors affecting food intake) and the construct of nutrition risk. The model by Keller (2006) alongside our findings supports the notion that no single factor adequately explains the complex construct of nutrition risk. For non-Māori community-living octogenarians, all three domains of nutrition risk are relevant.

5.1 Strengths

The most significant strength of this study was in being a sub-study of the large cohort study: LiLACS NZ, for which robust methodology and protocols were followed (Hayman et al., 2012). The opportunity to access data from both baseline (wave one) and twenty-four months follow-up (wave three) provided opportunities to investigate multiple variables. Many of our findings were consistent with population data and previous publications which helps to confirm the efficacy of this research. Ongoing study of this cohort presents prospects for further nutritional investigations.

An additional strength of this study was the use of the SCREEN II which had been previously validated among non-Māori octogenarians prior to the commencement of this sub-study (Wham et al., 2014). The SCREEN II nutrition risk screening tool was also validated among older adults in Canada and was shown to have excellent test-retest validity and inter-rater reliability (Beath & Keller, 2007; Keller et al., 2005; Keller, McKenzie, & Goy, 2001).

5.2 Limitations

Limitations in this study include, firstly, the chosen participant group was limited to a concise population: Māori aged 80-90 and non-Māori aged 85. Among non-Maori, as the majority were New Zealand European, few other ethnicities were represented which when compared to the New Zealand population, may have under represented Asian and Pacifica ethnic groups. Further, these participants all lived within a defined geographical area of New Zealand. It is possible for nutrition risk factors and food-related behaviours to differ across regions of the country and between community structures. Thus, it is difficult to extrapolate our findings to a broader New Zealand population. In addition, compared to those who completed the comprehensive questionnaire (included the SCREEN II), those who completed the brief questionnaire were more likely to be living in residential care and have greater likelihood of disabilities (Dyal et al., 2014) therefore increasing the likelihood of skewed data.

Concerning the assessment of nutrition risk, the SCREEN II tool has not been validated among community-living older Māori. A process evaluation of the feasibility study for LiLACS NZ

indicated certain items within the tool were interpreted differently for Māori and non-Māori (Wham et al., 2011). This leads to the possibility for over or under estimation of nutrition risk among the Māori participants in this study. In addition, no other study to our knowledge has examined nutrition risk according to the three domains of risk within the SCREEN II thus providing no margin for comparison. A further limitation to using the SCREEN II tool among this age group is the incidence of underreporting and reliance on memory for retrospective dietary assessment. SCREEN II is reliant on subjective self-reported nutrition risk factors (Wham et al., 2014).

Generalised measures of health (SF-12, GDS-15, and NEADL) were used for both Māori and non-Māori cohorts. We recognise this is a limitation as health is considered by Māori from a broader holistic perspective (Barlow, 1991). The need for indigenous-specific measures developed by indigenous peoples has been recognised previously (Wham et al., 2015). The use of the body mass index to classify body size is a limitation as it provides limited insight to body composition and fat distribution. Māori tend to be leaner at a higher body weight due to a higher proportion of lean mass (Rush, Freitas, & Plank, 2009). Further, height loss with advancing age may also lead to overestimation of body size in older people (Snijder, van Dam, Visser, & Seidell, 2006). In this study we used identical cut-off criteria as in the New Zealand Health Survey to allow for population comparison (Ministry of Health, 2011).

For investigating the consequences of nutrition risk, there was a relatively small sample of participants hospitalised and even fewer deceased. A larger sample size may have drawn more significant associations on multiple regression analysis, in particular for non-Māori where no significant association was found. Further, there was limited insight for the causes of hospital admissions. As specific-cause data was not available for all participants hospitalised, we used the first three diagnoses to determine cause of hospitalisation to provide the closest estimates for the precise causes of hospitalisations.

6.0 Conclusions

There was a high prevalence of nutrition risk among both the Māori and non-Māori participants in this study, with the prevalence similar to what has been observed in other studies of community living older adults in Canada and New Zealand. Nutrition risk was higher among women for both cohorts, which was not surprising as women tend to be more vulnerable to nutrition risk with advancing age. Becoming widowed and living alone presents many social challenges for older women and can affect dietary intake and nutrition risk.

The Māori and non-Māori participants of this study were in relatively good health; despite high levels of comorbidity, many had good self-rated health and physical function. These participants thus represented older adults who had survived successfully to advanced age. Although many of the participants were overweight or obese, this may convey a protective effect against nutritional problems in advanced age.

On investigating nutrition risk factors within the three key domains of SCREEN II, the most common nutrition risk factors from the "weight change "domain were "perception of own weight being more or less than it should be" and "weight change in the last six months." This was an expected finding as older people are vulnerable to weight change as they age. Overt body weight changes are strongly related to nutritional problems.

Many participants scored as high nutrition risk for items from the "dietary intake" domain of SCREEN II with "low fruit and vegetable intake," "low meat and alternative intake," "low milk product intake," and "limiting or avoiding certain foods" being the most common. Having low dietary intake of foods from all the main food groups increases an older person's risk of nutritional inadequacies and worsening nutritional status. A particular concern was the high prevalence of older Māori and non-Māori with low intake from the "meat and alternatives" and "dairy products" food groups which both serve as important sources of dietary protein. Inadequate intake increases the likelihood of lean mass losses over time and is associated with loss of physical function and independence.

Among Māori participants, findings from the multiple regression analysis models identified the SCREEN II dietary intake domain score was significantly related to all-cause mortality and may be related to all-cause hospital admissions. This was an important finding, as it suggests dietary adequacy, meal patterns, and appetite may be the most significant factors associated with nutrition risk. It suggests that nutrition promotion initiatives should emphasise the improvement of dietary intake in the prevention of poor outcomes. For older Māori, community connectedness was identified as having a strong protective effect against nutrition risk. Partnering with local communities to improve the dietary intake of older Māori may enhance nutritional status and play an important role for enabling physical, mental, and spiritual health.

From the "factors affecting intake" domain, frequently "eating alone" and finding "cooking is a chore" were the most common nutrition risk factor items, in particular among women for both Māori and non-Māori. Women tend to live longer than their male counterparts and are therefore more likely to becomes widowed and live alone with advancing age. Fewer meals

shared with others may be result in reduced energy intake of lower nutrient density, therefore increasing the risk of nutritional inadequacies.

For non-Māori, there was no significant relationship between SCREEN II domain scores and hospitalisations or mortality. These findings suggest all domains of SCREEN II encompass relevant aspects of nutrition risk and, therefore, all nutrition risk factors should be considered among non-Māori community-living older adults at high nutrition risk.

6.1 Recommendations

Our study suggests nutrition risk screening is an important component in understanding consequences (hospital admissions and mortality) encountered by Māori community living octogenarians. The purpose of screening is to identify nutrition-related characteristics associated with malnutrition, and to intervene where appropriate to prevent worsening nutritional status and poor outcomes (Keller, 2007). Specifically, we suggest for older Māori at high nutrition risk, emphasis should be placed on adequacy of dietary intake. Older adults in New Zealand are recommended to consume a variety of food from the four main foods groups which include: at least three servings of vegetables, at least two serving of fruit, at least six serving of breads and cereals (preferably wholegrain), at least two servings of milks and milk products, and at least one serving or meat or meat alternatives (Ministry of Health, 2013). Older adults also require plenty of fluids (preferably water) throughout the day. We recommend that for older Māori at high nutrition risk, the dietitian (or health care practitioner) should collaborate with the patient, whanau, and local community to consider potential barriers and enablers for optimal intake of culturally appropriate foods.

For non-Māori our study suggests all areas of nutrition risk are equally important. We recommend for older non-Māori at high nutrition risk, the dietitian (or health care practitioner) work alongside these older adults and their families to explore opportunities to improve social facilitation of food intake in order to plan the most appropriate nutrition intervention.

We recommend further research is needed to confirm the relationship between SCREEN II nutrition risk domain scores and outcomes - including, but not limited to hospitalisations and mortality. Further research is also recommended to explore the role of the local community for enabling Māori and non-Māori adults in advanced age to eat well and remain living independently in their communities.

7.0 References

American Dietetic Association. (2005). Position paper of the American Dietetic Association: nutrition across the spectrum of aging. *Journal of the American Dietetic Association*(4), 616.

Anlasik, T., Sies, H., Griffiths, H. R., Mecocci, P., Stahl, W., & Polidori, M. C. (2007). Dietary habits are major determinants of the plasma antioxidant status in healthy elderly subjects. *British Journal of Nutrition, 94*(05), 639.

Aparicio, A., Andrés, P., Perea, J.M., López-Sobaler, A.M., Ortega, R.M. (2010). Influence of the consumption of fruits and vegetables on the nutritional status of a group of institutionalized elderly persons in the Madrid region. *The Journal of Nutrition, Health & Aging, 14*(8), 615-620.

Asp, M.L., Richardson, J.R., Collene, A.L., Droll, K.R., Belury, M.A. (2012). Dietary protein and beef consumption predict for markers of muscle mass and nutrition status in older adults. *The Journal of Nutrition, Health & Aging, 16*(9), 784-790.

Atlantis, E., Browning, C., & Kendig, H. (2010). Body mass index and unintentional weight change associated with all-cause mortality in older Australians: the Melbourne Longitudinal Studies on Healthy Ageing (MELSHA). *Age & Ageing, 39*(5), 559-565.

Australian and New Zealand Society for Geriatric Medicine. Position Statement - Dysphagia and aspiration in older people. (2011). *Australasian Journal on Ageing, 30*(2), 98-103.

Auyeung, T., Lee, J., Kwok, T., & Woo, J. (2011). Physical frailty predicts future cognitive decline - A four-year prospective study in 2737 cognitively normal older adults. *Journal of Nutrition, Health & Aging, 15*(8), 690-694.

Ávila-Funes, J. A., Payette, H., & Gray-Donald, K. (2008). Association of nutritional risk and depressive symptoms with physical performance in the elderly: The Quebec longitudinal study of nutrition as a determinant of successful aging (NuAge). *Journal of the American College of Nutrition, 27*(4), 492-498.

Baker, M., Telfar Barnard, L., Zhang, J., Lanumata, T., Keall, M., Verrall, A., & Howden-Chapman, P. (2010). Close-contact infectious diseases in New Zealand: Trends and ethnic inequalities in hospitalisations, 1989 to 2008 (2nd Edition) . Wellnington: Ministry of Helath.

Bales, C. W., & Ritchie, C. S. (2002). Sarcopenia, weight loss, and nutritional frailty in the elderly. *Annual Review of Nutrition, 22*, 309-323.

Barlow, C. (1991). *Tikanga whakaaro : key concepts in Māori culture*: Auckland, N.Z. : Oxford University Press, 1991.

Beath, H., & Keller, H. H. (2007). Nutrition screen showed good agreement when self- and interviewer administered. *Journal of Clinical Epidemiology*(10), 1085.

Beck, A. M. (2015). Weight loss, mortality and associated potentially modifiable nutritional risk factors among nursing home residents -- A Danish follow-up study. *The Journal of Nutrition, Health and Aging*(1), 96.

Bernstein, M. A., Tucker, K. L., Ryan, N. D., O'Neill, E. F., Clements, K. M., Nelson, M. E., . . . Fiatarone Singh, M. A. (2002). Higher dietary variety is associated with better nutritional status in frail elderly people. *Journal of the American Dietetic Association, 102*, 1096-1104.

Best, R. L., & Appleton, K. M. (2013). The Consumption of Protein-Rich Foods in Older Adults: An Exploratory Focus Group Study. *Journal of Nutrition Education and Behavior, 45*(6), 751-755.

Bloem, B. R., Lagaay, A. M., van Beek, W., Haan, J., Roos, R. A. C., & Wintzen, A. R. (1990). Prevalence Of Subjective Dysphagia In Community Residents Aged Over 87*,* 721.

Bombois, S., Derambure, P., Pasquier, F., & Monaca, C. (2010). Sleep disorders in aging and dementia. *The Journal of Nutrition, Health and Aging, 14*(3), 212-217.

Brazier, J. E., & Roberts, J. (2004). The Estimation of a Preference-Based Measure of Health from the SF-12. *Medical Care*(9), 851.

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 & Geriatrics, 32*(4), 317-329.

Buchman, A. S., Boyle, P. A., Wilson, R. S., Tang, Y., & Bennett, D. A. (2007). Frailty is associated with incident Alzheimer's disease and cognitive decline in the elderly. *Psychosomatic Medicine, 69*(5), 483-489.

Buys, D. R., Roth, D. L., Ritchie, C. S., Sawyer, P., Allman, R. M., Funkhouser, E. M., . . . Locher, J. L. (2014). Nutritional risk and body mass index predict hospitalization, nursing home admissions, and mortality in community-dwelling older adults: results from the UAB study of aging with 8.5 years of follow-up. *The Journals of Gerontology, Series A*(9), 1146.

Cabrera, M. A. S., Mesas, A. E., Garcia, A. R. L., & de Andrade, S. M.. (2007). Malnutrition and depression among community-dwelling elderly people. *Journal of the American Medical Directors Association, 8*(9).

Carter, K. N., Lanumata, T., Kruse, K., & Gorton, D. (2010). What are the determinants of food insecurity in New Zealand and does this differ for males and females? *Australian & New Zealand Journal of Public Health, 34*(6), 602-608.

Charlton, K., Nichols, C., Bowden, S., Milosavljevic, M., Lambert, K., Barone, L., . . . Batterham, M. (2012). Poor nutritional status of older subacute patients predicts clinical outcomes and mortality at 18 months of follow-up. *European Journal of Clinical Nutrition, 66*(11), 1224-1228.

Cherubini, A., Nistico, G., Rozzini, R., Liperoti, R., Di Bari, M., Zampi, E., Ferrannini, L., Aguglia, E., Pani, L., Bernabei, R., Marchionni, N., Trabucchi, M. (2012). Subthreshold depression in older subjects: An unmet therapeutic need. *The Journal Of Nutrition, Health and Aging*, 16(10), 909-913 5p.

Chevalier, S., Saoud, F., Gray-donald, K., & Morais, J. (2008). The physical functional capacity of frail elderly persons undergoing ambulatory rehabilitation is related to their nutritional status. *The Journal of Nutrition, Health and Aging, 12*(10), 721-726.

Chodzko-Zajko, W. J. (2014). Exercise and Physical Activity for Older Adults. *Kinesiology Review, 3*(1), 101-106.

Cobiac L, & Syrette J. (1995). What is the nutritional status of older Australians? *Proceedings Nutrition Society of Australia*. 1995;19:139-45.

Cochen, V., Arbus, C., et al. (2009). Sleep disorders and their impacts on healthy, dependent, and frail older adults. *JNHA - The Journal of Nutrition, Health and Aging, 13*(4), 322-329.

Corrada, M. M., Kawas, C. H., et al. (2006). Association of body mass index and weight change with all-cause mortality in the elderly. *American Journal of Epidemiology, 163*(10), 938-949 912p.

Crengle S, L.-Y. R., Davis P, & Pearson J. (2005). A Comparison of Māori and Non-Māori Patient Visits to Doctors: The National Primary Medical Care Survey NatMedCa): 2001/02. Report 6. . Wellington: Ministry of Health.

de Hollander, E., Van Zutphen, M., Bogers, R. P., Bemelmans, W. J. E., & De Groot, L. C. (2012). The impact of body mass index in old age on cause-specific mortality. *The Journal of Nutrition, Health and Aging, 16*(1), 100-106.

Diehr, P., & Beresford, S. A. A. (2003). The relation of dietary patterns to future survival, health, and cardiovascular events in older adults. *Journal of Clinical Epidemiology, 56*(12), 1224-1235.

Dietitians Association of Australia. (2009). Evidence based practice guidelines for the nutritional management of malnutrition in adult patients across the continuum of care. *Nutrition & Dietetics, 66*, S1-S34.

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

Donini, L. M., Poggiogalle, E., Piredda, M., Pinto, A., Barbagallo, M., Cucinotta, D., & Sergi, G. (2013). Anorexia and Eating Patterns in the Elderly. *PLoS ONE, 8*(5), 1-8.

Dunstan, K., & Thomson, N. (2006). *Demographic Aspects of New Zealand's Ageing Population*

Durie, M. (1994). *Whaiora : Māori health development*: Auckland, N.Z. : Oxford University Press, 1994.

Dyall, L., Kepa, M., Hayman, K., Teh, R., Moyes, S., Broad, J. B., Kerse, N. (2013). Engagement and recruitment of Maori and non-Maori people of advanced age to LiLACS NZ. *Australita and New ZealandJournal of Public Health 37(2*): 124-131.

Dyall, L., Kepa, M., Teh, R., Mules, R., Moyes, S. A., Wham, C., . . . Kerse, N. (2014). Cultural and social factors and quality of life of Maori in advanced age. Te puawaitanga o nga tapuwae kia ora tonu - Life and living in advanced age: a cohort study in New Zealand (LiLACS NZ). *New Zealand Medical Journal*, 127(1393), 62-79.

Edwards, M. H., Dennison, E. M., Aihie Sayer, A., Fielding, R., & Cooper, C. (2015). Osteoporosis and sarcopenia in older age. *Bone*(0).

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).

Engin, S., Ozturk, M., et al. (2010). Dark side of the town: depressive symptoms in disadvantaged senior citizens. *The Journal of Nutrition, Health and Aging, 14*(6), 483-487.

Essink-Bot, M.-L., Paul, F. M. K., Bonsel, G. J., & Aaronson, N. K. (1997). An empirical comparison of four generic health status measures: the Nottingham Health Profile, the Medical Outcomes Study 36-item Short-Form Health Survey, the COOP/WONCA charts, and the EuroQol instrument. *Medical Care*, 35(5), 522-537.

Fagerström, C., Palmqvist, R., Carlsson, J., & Hellström, Y. (2011). Malnutrition and cognitive impairment among people 60 years of age and above living in regular housing and in special housing in Sweden: A population-based cohort study. *International Journal of Nursing Studies, 48*, 863-871.

Faubel, R., Lopez-Garcia, E., Guallar-Castillón, P., Balboa-Castillo, T., Gutiérrez-Fisac, J. L., Banegas, J. R., & Rodríguez-Artalejo, F. (2009). Sleep duration and health-related quality of life among older adults: a population-based cohort in Spain. *Sleep, 32*(8), 1059-1068.

Fleishman, J. A., Selim, A. J., & Kazis, L. E. (2010). Deriving SF-12v2 Physical and Mental Health Summary Scores: A Comparison of Different Scoring Algorithms*,* 231.

Foley, D., Monjan, A. A., Brown, S. L., & Simonsick, E. M. (1995). Sleep complaints among elderly persons: An epidemiologic study of three communities. *Sleep: Journal of Sleep Research & Sleep Medicine, 18*(6), 425-432.

Foley, D., Ancoli-Israel, S., Britz, P., & Walsh, J. (2004). Sleep disturbances and chronic disease in older adults: Results of the 2003 National Sleep Foundation Sleep in America Survey. *Journal of Psychosomatic Research, 56*(5), 497-502.

Forbes, G. B. (1999). Longitudinal changes in adult fat-free mass: influence of body weight. *American Journal Of Clinical Nutrition*, 70(6), 1025-1031.

Foster, P., & Neville, S. (2010). Women over the age of 85 years who live alone: a descriptive study. *Nursing Praxis in New Zealand, 26*(1), 4-13.

Gallagher, D., Visser, M., Sepúlveda, D., Pierson, R. N., Harris, T., & Heymsfield, S. B. (1996). How useful is body mass index for comparison of body fatness across age, sex, and ethnic groups? *American Journal of Epidemiology, 143*(3), 228-239.

Genton, L., Graf, C. E., Karsegard, V. L., Kyle, U. G., & Pichard, C. (2013). Low fat-free mass as a marker of mortality in community-dwelling healthy elderly subjects†. *Age & Ageing, 42*(1), 33-39.

German, L., Feldblum, I., Bilenko, N., Castel, H., Harman-Boehm, I., & Shahar, D. R. (2008). Depressive symptoms and risk for malnutrition among hospitalized elderly people. *The Journal of Nutrition Health and Aging, 12*(5), 313-318.

German, L., Kahana, C., Rosenfeld, V., Zabrowsky, I., Wiezer, Z., Fraser, D., & Shahar, D. R. (2011). Depressive symptoms are associated with food insufficiency and nutritional deficiencies in poor community-dwelling elderly people. *The Journal of Nutrition, Health and Aging, 15*(1), 3-8.

Gibson, S., Sequeira, J., Cant, R., & Ku, C. (2012). Identifying malnutrition risk in acute medical patients: Validity and utility of Malnutrition Universal Screening Tool and Modified Malnutrition Screening Tool. *Nutrition & Dietetics, 69*(4), 309-314.

Griep, M. I., Mets, T. F., Collys, K., Ponjaert-Kristoffersen, I., & Massart, D. L. (2000). Risk of malnutrition in retirement homes elderly persons measured by the 'Mini-Nutritional Assessment.'. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences, 55A*(2), M57-M63.

Halil, M., Cemal Kizilarslanoglu, M., Emin Kuyumcu, M., Yesil, Y., & Cruz Jentoft, A. J. (2015). Cognitive aspects of frailty: Mechanisms behind the link between frailty and cognitive impairment. *The Journal of Nutrition, Health and Aging, 19*(3), 276-283.

Hanna, K. L., & Collins, P. F. (2015). Relationship between living alone and food and nutrient intake. *Nutrition Reviews,* 73(9), 594-611.

Hao, R., & Guo, H. (2012). Anorexia, undernutrition, weight loss, sarcopenia, and cachexia of aging. *European Reviews of Aging & Physical Activity, 9*(2), 119-127.

Harrington, M., Gibson, S., & Cottrell, R. C. (2010). A review and meta-analysis of the effect of weight loss on all-cause mortality risk. *Journal of Continuing Education Topics & Issues*(2), 84.

Hayman, K. J., Kerse, N., Dyall, L., Kepa, M., Teh, R., Wham, C., . . . Jatrana, S. (2012). Life and living in advanced age: a cohort study in New Zealand--e Puāwaitanga o Nga Tapuwae Kia Ora Tonu, LiLACS NZ: study protocol. *BMC Geriatrics, 12*, 33-33.

Heuberger, R., & Wong, H. (2014). The association between depression and widowhood and nutritional status in older adults. *Geriatric Nursing, 35*(6), 428-433.

Hirini, P. R., Flett, R. A., Kazantzis, N., Long, N. R., Millar, M. A., & MacDonald, C. (1999). *Health care needs for older Māori: A study of Kāumatua and kuia*. https://www.msd.govt.nz/about-msd-and-our-work/publications-resources/journals-and-magazines/social-policy-journal/spj13/health-care-needs-for-older-maori.html. Retrieved 10 July, 2015

Holliday, E. G., Magee, C. A., Kritharides, L., Banks, E., & Attia, J. (2013). Short Sleep Duration Is Associated with Risk of Future Diabetes but Not Cardiovascular Disease: a Prospective Study and Meta-Analysis. *PLoS ONE, 8*(11), 1-1.

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. *American Journal of Clinical Nutrition* (87), 150–5

Hsieh, Y., Sung, T., & Wan, K. S. (2010). A survey of nutrition and health status of solitary and non-solitary elders in Taiwan. *The Journal of Nutrition, Health and Aging, 14*(1), 11-14.

Hung, H. C., Joshipura, K. J., Jiang, R., Hu, F. B., Hunter, D., Smith-Warner, S. A., . . . Willett, W. C. (2004). Fruit and vegetable intake and risk of major chronic disease. *Journal of the National Cancer Institute, 96*(21), 1577-1584.

Jackson, A. S., Janssen, I., Sui, X., Church, T. S., & Blair, S. N. (2012). Longitudinal changes in body composition associated with healthy ageing: men, aged 20-96 years. *The British Journal Of Nutrition, 107*(7), 1085-1091.

Jelliffe, D. B. (1966). The assessment of the nutritional status of the community (with special reference to field surveys in developing regions of the world). *Monograph series. World Health Organization, 53*.

Johansson, L., Sidenvall, B., Malmberg, B., Christensson, L. (2009). Who will become malnourished? A prospective study of factors associated with malnutrition in older persons living at home. *The Journal of Nutrition, Health and Aging*, 1-7.

Johnson, C. S. (2002). Nutritional considerations for bereavement and coping with grief. *The Journal of Nutrition Health and Aging*, 6(3).

Johnson, M., Hausman, D. B., Davey, A., Poon, L. W., Allen, R. H., & Stabler, S. P. (2010). Vitamin B_{12} deficiency in African American and white octogenarians and centenarians in Georgia. *The Journal of Nutrition Health and Aging, 14*(5), 339-345.

Jung, H.-W., Kim, S.-W., Lim, J.-Y., Kim, K.-W., Jang, H. C., Kim, C.-H., & Kim, K.-i. (2014). Frailty Status Can Predict Further Lean Body Mass Decline in Older Adults. *Journal of the American Geriatrics Society, 62*(11), 2110-2117.

Jyrkkä, J., Enlund, H., Lavikainen, P., Sulkava, R., & Hartikainen, S. (2011). Association of polypharmacy with nutritional status, functional ability and cognitive capacity over a three-year period in an elderly population. *Pharmacoepidemiology And Drug Safety, 20*(5), 514-522.

Jyrkka, J., Mursu, J., Enlund, H., & Lonnroos, E. (2012). Polypharmacy and nutritional status in elderly people. *Current Opinion in Clinical Nutrition and Metabolic Care, 15*(1), 1-6.

Keller, H. H. (2006). Meal Programs Improve Nutritional Risk: A Longitudinal Analysis of Community-Living Seniors. *Journal of the American Dietetic Association*.

Keller, H. H. (2006). The SCREEN I (Seniors in the Community: Risk Evaluation for Eating and Nutrition) index adequately represents nutritional risk. *Journal of Clinical Epidemiology, 59*, 836-841.

Keller, H. H. (2007). Promoting food intake in older adults living in the community: a review. *Applied Physiology, Nutrition, and Metabolism*(6), 991.

Keller, H. H.(2002). Nutritional risk predicts adverse health outcomes in vulnerable community-living seniors. *The Gerontologist*, 46.

Keller, H. H., & Hedley, M. R. (2002). Nutritional risk needs assessment of community-living seniors: prevalence of nutrition problems and priorities for action. *Journal of Community Health, 27*(2), 121-132.

Keller, H. 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, 59*(10), 1149-1157.

Keller, H. H., Hedley, M. R., & Wong Brownlee, S. (2000). The Development of Seniors in the Community: Risk Evaluation for Eating and Nutrition (SCREEN). *Canadian Journal Of Dietetic Practice And Research,* 61(2), 67-72.

Keller, H. H., McKenzie, J. D., & Goy, R. E. (2001). Construct validation and test-retest reliability of the Seniors in the Community: Risk Evaluation for Eating and Nutrition questionnaire. *The Journals of Gerontology: Series A: Biological Sciences and Medical Sciences, 56A*(9), M552-M558.

Kim, W. Y., Hur, M., Sook, C. M., Lee, S. H. (2003). Effect of olfactory function on nutritional status of Korean elderly women. *Nutrition Research,* 23(6), 723-734.

Kimura, Y., Wada, T., Okumiya, K., Ishimoto, Y., Fukutomi, E., Kasahara, Y., . . . Matsubayashi, K. (2012). Eating alone among community-dwelling Japanese elderly: Association with depression and food diversity. *Journal of Nutrition, Health and Aging, 16*(8), 728-731.

Kowal, P., Towers, A., & Byles, J. (2014). Ageing across the Tasman Sea: the demographics and health of older adults in Australia and New Zealand. *Australian and New Zealand Journal of Public Health*(4), 377.

Kruizenga, H. M., Seidell J.C., de Vet H.C., Wierdsma N.J., van Bokhorst-de van der Schueren M.A. (2005). Development and validation of a hospital screening tool for malnutrition: the short nutritional assessment questionnaire (SNAQ©). *Clinical Nutrition, 24*(1), 75-82.

Kyle U.G., Genton L., Hans D., Karsegard V.L., Michel J.P., Slosman D.O., & Pichard C. (2001). Total Body Mass, Fat Mass, Fat-Free Mass, and Skeletal Muscle in Older People: Cross-Sectional Differences in 60-Year-Old Persons. *Journal of the American Geriatrics Society, 49*(12), 1633-1640.

Lee, M., Choh, A. C., Demerath, E. W., Knutson, K. L., Duren, D. L., Sherwood, R. J., . . . Czerwinski, S. A. (2009). Sleep disturbance in relation to health-related quality of life in adults: The fels longitudinal study. *JNHA - The Journal of Nutrition, Health and Aging, 13*(6), 576-583.

Locher, J. L., Ritchie, C. S., Roth, D. L., Baker, P. S., Bodner, E. V., & Allman, R. M (2005). The effect of the presence of others on caloric intake in homebound older adults. *Journals of Gerontology Series A: Biological Sciences & Medical Sciences, 60A*(11), 1475-1478.

Locher, J. L., Ritchie, C. S., Robinson, C. O., Roth, D. L., West, D. S., & Burgio, K. L (2008). A multidimensional approach to understanding under-eating in homebound older adults: The importance of social factors. *Gerontologist,* 48(2), 223-234.

Magee, C. A., Caputi, P., & Iverson, D. C. (2011). Relationships between self-rated health, quality of life and sleep duration in middle aged and elderly Australians. *Sleep Medicine, 12*, 346-350.

Martinez-Reig, M., Gomez-Arnedo, L., Alfonso-Silguero, S., Juncos-Martinez, G., Romero, L., & Abizanda Soler, P. (2014). Nutritional risk, nutritional status and incident disability in older adults. The FRADEA Study. *The Journal of Nutrition, Health and Aging, 18*(3), 270-276.

McElnay, C., Marshall, B., O'Sullivan, J., Jones, L., Ashworth, T., Hicks, K., & Forrest, R. H. (2012). Nutritional risk amongst community-living Māori and non-Māori older people in Hawke's Bay. *Journal of Primary Health Care, 4*(4), 299-305.

McHugh, J., Lee, O., et al. (2015). A Shared Mealtime Approach to Improving Social and Nutritional Functioning Among Older Adults Living Alone: Study Protocol for a Randomized Controlled Trial. *JIMR Research Protocols,* 4(2).

McKerchar, C., Bowers, S., Heta, C., Signal, L., & Matoe, L. (2014). Enhancing Māori food security using traditional kai. *Global Health Promotion*.

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.

Minister for Disability Issues. (2001). *The New Zealand Disability Strategy.* Wellington: Ministry of Health.

Minister of Health. (2000). *The New Zealand Health Strategy.* Wellington: Ministry of Health.

Ministry of Health. (2002). *Health of Older People in New Zealand. A Statistical Reference.* Wellington: Ministry of Health.

Ministry of Health. (2002a). *He Korowai Oranga. Maori Health Strategy*. Wellington: Ministry of Health.

Ministry of Health. (2002b). *Health of Older People Strategy. Health Sector Action to 2010 to Support positive Ageing. Draft for Consultation.* Wellington: Ministry of Health.

Ministry of Health. (2004). *Living with Disability in New Zealand: Summary Key results from the 2001 Household Disability Survey and the 2001 Disability Survey of Residential Facilities*. Wellington: Ministry of Health.

Ministry of Health. (2006). *Older People's Health Chart Book 2006*. Wellington: Ministry of Health.
Ministry of Health. (2011). *Tatau Kura Tangata: Health of Older Māori Chart Book*. Wellington: Ministry of Health.
Ministry of Health. (2012). Hospital Events 2008/09 and 2009/10. Wellington: Ministry of Health.
Ministry of Health. (2013a). *Food and Nutrition Guidelines for Healthy Older People: a background paper*. Wellington: Ministry of Health.
Ministry of Health. (2013b). *Injury-related Health Loss: A report from the New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006-2016*. Wellington: Ministry of Health.
Ministry of Health. (2015a). *2008/09 New Zealand Adult Nutrition Survey data tables.* Retrieved 16 September, 2015
Ministry of Health. (2015b). *Publicly funded hospital discharges - 1 July 2012 to 30 June 2013*. Accessed July 2015 from: http://www.health.govt.nz/publication/publicly-funded-hospital-discharges-1-july-2012-30-june-2013. Retrieved 5 August, 2015
Ministry of Social Development. (2001). *New Zealand Positive Ageing Strategy (2001): Executive Summary*. Retrieved 20 July, 2014
Mocchegiani, E., Romeo, J., Malavolta, M., Costarelli, L., Giacconi, R., Diaz, L.-E., & Marcos, A. (2013). Zinc: dietary intake and impact of supplementation on immune function in elderly. *Age, 35*(3), 839-860.
Montorio, I., & Izal, M. (1996). The Geriatric Depression Scale: a review of its development and utility. *International Psychogeriatrics / IPA, 8*(1), 103-112.
Morley, J. (2012). Anorexia of aging: A true geriatric syndrome. *The Journal of Nutrition Health and Aging, 16*(5), 422-425.
Morley, J. E., Vellas, B., van Kan, G. A., Anker, S. D., Bauer, J. M., Bernabei, R., . . . Walston, J. (2013). Frailty Consensus: A Call to Action. *Journal of the American Medical Directors Association, 14*(6), 392-397.
Mueller, C., Compher, C., & Ellen, D. M. (2011). A.S.P.E.N. clinical guidelines: Nutrition screening, assessment, and intervention in adults. *JPEN Journal of Parenteral & Enteral Nutrition, 35*(1), 16-24.
National Collaborating Centre for Acute Care (UK). (2006). *Nutrition Support for Adults: Oral Nutrition Support, Enteral Tube Feeding and Parenteral Nutrition* (Vol. No. 32.). London: National Collaborating Centre for Acute Care (UK): NICE Clinical Guidelines.
Newman, A. B., Yanez, D., Harris, T., Duxbury, A., Enright, P. L., & Linda P. F. (2001). Weight Change in Old Age and its Association with Mortality. *Journal of the American Geriatrics Society, 49*(10), 1309-1318.
NHMRC, & Ministry of Health. (2006). *Nutrient Reference Values for Australia and New Zealand*. Ministry of Health: Wellington.
Nieves, J. W., Barrett-Connor, E., Siris, E. S., Zion, M., Barlas, S., & Chen, Y. T. (2008). Calcium and vitamin D intake influence bone mass, but not short-term fracture risk, in Caucasian postmenopausal women from the National Osteoporosis Risk Assessment (NORA) study. *Osteoporosis International,* 19(5), 673-679.
Oubaya, N., Mahmoudi, R., Jolly, D., Zulfiqar, A.A., Quignard, E., Cunin, C., Nazeyrollas, P., Novella, J.L., Dramé, M. (2014). Screening for frailty in elderly subjects living at home: Validation of the modified Short Emergency Geriatric Assessment (SEGAm) instrument. *The Journal of Nutrition, Health and Aging*, 1-8.
Paine, S.-J., Gander, P. H., Harris, R. B., & Reid, P. (2005). Prevalence and consequences of insomnia in New Zealand: disparities between Maori and non-Maori. *Australian and New Zealand Journal of Public Health*(1), 22.

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.

Pereira, C. L. N., Baptista, F., & Infante, P. (2014). Role of physical activity in the occurrence of falls and fall-related injuries in community-dwelling adults over 50 years old. *Disability & Rehabilitation, 36*(2), 117-124.

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.

Posner, B., Jette, A., Smith, K.W., Miller, D. R. (1993). Nutrition and Health Risks in the Elderly: The Nutrition Screening Initiative. *American Journal of Public Health, 83*(7), 972-978.

Prado, C. M. M., Wells, J. C. K., Smith, S. R., Stephan, B. C. M., & Siervo, M. (2012). Sarcopenic obesity: A Critical appraisal of the current evidence. *Clinical Nutrition, 31*(5), 583-601.

Rizzoli, R., Branco, J., Brandi, M. L., Boonen, S., Bruyère, O., Cacoub, P., . . . Reginster, J. Y. (2014). Management of osteoporosis of the oldest old. *Osteoporosis International, 25*(11), 2507-2529.

Rolls, B. J. (1999). Do Chemosensory Changes Influence Food Intake in the Elderly? *Physiology & Behavior, 66*(2), 193-197.

Roque, M., Salva, A., & Vellas, B. (2013). Malnutrition in community-dwelling adults with dementia (Nutrialz Trial). *The Journal of Nutrition, Health and Aging, 17*(4), 295-299.

Rosenbloom, C. A., & Whittington, F. J. (1993). The effects of bereavement on eating behaviours and nutrient intakes in elderly widowed persons. *Journals of Gerontology*, 48(4), S223-S229.

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.

Rush, E. C., Freitas, I., & Plank, L. D. (2009). Body size, body composition and fat distribution: comparative analysis of European, Māori, Pacific Island and Asian Indian adults. *British Journal of Nutrition*.

Rush, E. C., Goedecke, J. H., Jennings, C., Micklesfield, L., Dugas, L., Lambert, E. V., & Plank, L. D. (2007). BMI, fat and muscle differences in urban women of five ethnicities from two countries. *International journal of obesity : journal of the International Association for the Study of Obesity*(8).

Russell, J., Flood, V., Yeatman, H., & Mitchell, P. (2014). Prevalence and risk factors of food insecurity among a cohort of older Australians. *The Journal of Nutrition, Health & Aging, 18*(1), 3-8.

Saarela, R. T., Soini, H., Hiltunen, K., Muurinen, S., Suominen, M., & Pitkala, K. (2014). Dentition status, malnutrition and mortality among older service housing residents. *The Journal of Nutrition, Health & Aging,* 18(1), 34-38.

Salmond C, Crapmton P, & Atkinson J. (2007). *NZDep2006 Index of Deprivation*. Wellington: Ministry of Health.

Scott, K. M., Marwick, J. C., & Crampton, P. R. (2003). Utilization of general practitioner services in New Zealand and its relationship with income, ethnicity and government subsidy. *Health services management research : an official journal of the Association of University Programs in Health Administration / HSMC, AUPHA, 16*(1), 45-55.

Shatenstein, B., Kergoat, M. J., & Reid, I. (2007). Poor Nutrient Intakes during 1-Year Follow-Up with Community-Dwelling Older Adults with Early-Stage Alzheimer Dementia Compared to Cognitively Intact Matched Controls. *Journal of the American Dietetic Association*.

Simsek, H., Meseri, R., Sahin, S., & Ucku, R.. (2013). Prevalence of food insecurity and malnutrition, factors related to malnutrition in the elderly: A community-based, cross-sectional study from Turkey. *European Geriatric Medicine, 4*(4), 226-230.

Skipper, A., Ferguson, M., Thompson, K., Castellanos, V. H., & Porcari, J. (2012). Nutrition screening tools: an analysis of the evidence. *JPEN Journal of Parenteral & Enteral Nutrition, 36*(3), 292-298.

Snijder, M. B., van Dam, R. M., Visser, M., & Seidell, J. C. (2006). What aspects of body fat are particularly hazardous and how do we measure them? *International Journal Of Epidemiology*, 35(1), 83-92.

Southgate, K. M., Keller, H. H., & Reimer, H. D. (2010). Determining knowledge and behaviour change after nutrition screening among older adults. *Canadian Journal of Dietetic Practice & Research, 71*(3), 128-133.

Speakman, J. R., & Westerterp, K. R. (2010). Associations between energy demands, physical activity, and body composition in adult humans between 18 and 96 y of age*,* 826.

Stahl, S. T., & Schulz, R. (2014). Changes in Routine Health Behaviors Following Late-life Bereavement: A Systematic Review. *Journal of Behavioral Medicine*, 37(4), 736-755.

Stanner, S., Thompson, R., & Buttriss, J. L. (2009). *Healthy ageing: the role of nutrition and lifestyle. The Report of a British Nutrition Foundation Task Force*. Wiley-Blackwell.

Statistics New Zealand. (2013) 2013 Census QuickStats about Māori. http://www.stats.govt.nz/Census/2013-census/profile-and-summary-reports/quickstats-about-maori-english.aspx. Retrieved 6 August, 2014

Statistics New Zealand. (2014). National Population Projections: 2014(base)–2068. Statistics New Zealand. http://www.stats.govt.nz/browse_for_stats/population/estimates_and_projections/NationalPopulationProjections_HOTP2014.aspx. Retrieved 6 August, 2014

Statistics New Zealand. (2015a). *2013 Census QuickStats about people aged 65 and over*. Retrieved 10 June, 2015

Statistics New Zealand. (2015b). *New Zealand Period Life Tables: 2012–14.* Retrieved 12 September, 2015

Suzuki, E., Yorifuji, T., Ueshima, K., Takao, S., Sugiyama, M., Ohta, T., . . . Doi, H. (2009). Sleep duration, sleep quality and cardiovascular disease mortality among the elderly: A population-based cohort study. *Preventive Medicine, 49*, 135-141.

Swinburn, B. A., Ley, S. J., Carmichael, H. E., & Plank, L. D. (1999). Body size and composition in Polynesians. International *Journal of Obesity & Related Metabolic Disorders,* 23(11), 1178.

Takeuchi, K., Aida, J., Ito, K., Furuta, M., Yamashita, Y., & Osaka, K. (2014). Nutritional status and dysphagia risk among community-dwelling frail older adults. *The Journal of Nutrition, Health and Aging, 18*(4), 352-357.

Tavassoli, N., Guyonnet, S., Abellan Van Kan, G., Sourdet, S., Krams, T., Soto, M. E., . . . Vellas, B. (2014). Description of 1,108 older patients referred by their physician to the “Geriatric Frailty Clinic (G.F.C) for assessment of frailty and prevention of disability” at the gerontopole. *The Journal of Nutrition Health and Aging, 18*(5), 457-464.

Taylor, R. W., Brooking, L., Williams, S. M., Manning, P. J., Sutherland, W. H., Coppell, K. J., . . . Mann, J. I. (2010). Body mass index and waist circumference cutoffs to define obesity in indigenous New Zealanders. *American Journal of Clinical Nutrition, 92*(2), 390-397 398p.

Teh, R. (2014). Self-rated health, health-related behaviours and medical conditions of Māori and non-Māori in advanced age : LiLACS NZ. *New Zealand medical journal (Online)*.

Thomas, D. R. (2007). Loss of skeletal muscle mass in aging: Examining the relationship of starvation, sarcopenia and cachexia. *Clinical Nutrition*(4), 389.

Tsai, A., & Chang, T. L. (2011). Association of dental prosthetic condition with food consumption and the risk of malnutrition and follow-up 4- year mortality risk in elderly Taiwanese. *The Journal of Nutrition, Health & Aging,* 15(4), 265-270.

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

Vellas, B., Balardy, L., Gillette-Guyonnet, S., Abellan Van Kan, G., Ghisolfi-Marque, A., Subra, J., . . . Cesari, M. (2013). Looking for frailty in community-dwelling older persons: The Gerontopole Frailty Screening Tool (GFST). *The Journal of Nutrition, Health and Aging,* (7), 629.

Vesnaver, E., & Keller, H. H. (2011). Social Influences and Eating Behavior in Later Life: A Review. *Journal of Nutrition in Gerontology & Geriatrics*, 30(1), 2.

Visvanathan, R., Macintosh, C., Callary, M., Penhall, R., Horowitz, M., & Chapman, I. (2003). The nutritional status of 250 older Australian recipients of domiciliary care services and its association with outcomes at 12 months. *Journal of the American Geriatrics Society*, 51(7), 1007-1011.

Volkert, D., Berner, Y. N., Berry, E., Cederholm, T., Coti Bertrand, P., Milne, A., . . . Lochs, H. (2006). ESPEN GUIDELINES: ESPEN Guidelines on Enteral Nutrition: Geriatrics. *Clinical Nutrition, 25*, 330-360.

Wada T, Ishine M, Sakagami T, Kita T, Okumiya K, Mizuno K., . . . Matsubayashi K. (2005). Depression, activities of daily living, and quality of life of community-dwelling elderly in three Asian countries: Indonesia, Vietnam, and Japan. *Archives of Gerontology and Geriatrics,* 41(3), 271-280.

Waters, D. L., Hale, L., Grant, A. M., Herbison, P., & Goulding, A. (2010). Osteoporosis and gait and balance disturbances in older sarcopenic obese New Zealanders. *Osteoporosis International: A Journal Established As Result Of Cooperation Between The European Foundation For Osteoporosis And The National Osteoporosis Foundation Of The USA, 21*(2), 351-357.

Waters, D. L., Vawter, R., Qualls, C., Chode, S., Armamento-Villareal, R., & Villareal, D.T. (2013). Long-term maintenance of weight loss after lifestyle intervention in frail, obese older adults. *The Journal of Nutrition, Health and Aging,* 17(1): 3-7.

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

Weekes, C. E., Elia, M., & Emery, P. W. (2004). The development, validation and reliability of a nutrition screening tool based on the recommendations of the British Association for Parenteral and Enteral Nutrition (BAPEN). *Clinical Nutrition*, 23(5), 1104-1112.

Westergren, A., Hagell, P., & Sjödahl Hammarlund, C. (2014). Malnutrition and risk of falling among elderly without home-help service — A cross sectional study. *The Journal of Nutrition, Health & Aging, 18*(10), 905-911.

Wham, C. A., & Bowden, J. A. (2011). Eating for health: Perspectives of older men who live alone. *Nutrition & Dietetics, 68*(3), 221-226.

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

Wham, C. A., Dyall, L., Teh, R., & Kerse, N. M. (2011). Nutrition risk: Cultural aspects of assessment. *Asia Pacific Journal of Clinical Nutrition, 20*(4), 632.

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

Wham, C. A., Redwood, K. M., & Kerse, N. (2014). 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 and Aging, 18*(1), 39-43.

Wham, C. A., Teh, R., Redwood, K. M., & Kerse, N. (2011). What is associated with nutrition risk in very old age? *The Journal of Nutrition Health and Aging*, 15(4), 247-251.
Wham, C. A., Teh, R., Moyes, S., Dyall, L., Kepa, M., Hayman, K., Kerse, N.. (2015). Health and social factors associated with nutrition risk: Results from life and living in advanced age: A cohort study in New Zealand (LILACS NZ). *The Journal of Nutrition Health and Aging*, 19(6), 637-645.
Wham, C. A., Teh, R., Moyes, S., Dyall, L., Kepa, M., Hayman, K., & Kerse, N. (2015). 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 and Aging, 19*(6), 637-645.
Wham, C. A., Teh, R., Robinson, M., & Kerse, N. (2011). What is associated with nutrition risk in very old age? *Journal of Nutrition, Health and Aging, 15*(4), 247-251.
White, J. V. (2012). Consensus Statement of the Academy of Nutrition and Dietetics/American Society for Parenteral and Enteral Nutrition: Characteristics Recommended for the Identification and Documentation of Adult Malnutrition (Undernutrition) (vol 112, pg 730, 2012). *Journal of the Academy of Nutrition and Dietetics, 112*(11), 1899-1899.
Wijnhoven, H. A. H., Schilp, J., van Bokhorst-de van der Schueren, M.A., de Vet, H.C., Kruizenga, H.M., Deeg, D.J., Ferrucci, L., & Visser, M.. (2012). Development and validation of criteria for determining undernutrition in community-dwelling older men and women: The Short Nutritional Assessment Questionnaire 65+. *Clinical Nutrition, 31*(3), 351-358.
Winter, J. E., Wattanapenpaiboon, N., Nowson, C. A., & MacInnis, R. J. (2014). BMI and all-cause mortality in older adults: A meta-analysis. *American Journal of Clinical Nutrition*, 99(4), 875-890.
Winter, J., Flanagan, D., et al. (2013). Nutrition screening of older people in a community general practice, using the MNA-SF. *The Journal of Nutrition Health and Aging*, 17(4), 322-325.
World Health Organisation & FAO. (2003). Diet, nutrition and the prevention of chronic diseases. Report of a Joint WHO/FAO Expert Consultation WHO Technical Report Series. http://whqlibdoc.who.int/trs/who_trs_916.pdf. Retrieved 10 July, 2014
World Health Organisation, National Institute on Ageing, National Institutes of Health, & US National Institute of Aging. (2011). *Global Health and Aging.* http://www.who.int/ageing/publications/global_health/en/. Retrieved 10 July, 2014
World Health Organisation. (2002). Keep fit for life. Meeting the nutritional needs of older persons. Geneva: World Health Organisation.
World Health Organisation. (2007). Global Database on Body Mass Index. Geneva: World Health Organization.
World Health Organisation. (2010). International Statistical Classification of Diseases and Related Health Problems. http://www.who.int/classifications/icd/ICD10Volume2_en_2010.pdf. Retrieved 16 August, 2015
Writing Group of the Nutrition Care Process/Standardized Language Committee. (2008). Nutrition care process and model part I: the 2008 update. *Journal of the American Dietetic Association, 108*(7), 1113-1117.
Xiao, Q., Arem, H., Moore, S. C., Hollenbeck, A. R., & Matthews, C. E. (2013). A Large Prospective Investigation of Sleep Duration, Weight Change, and Obesity in the NIH-AARP Diet and Health Study Cohort. *American Journal of Epidemiology, 178*(11), 1600-1610.
Yang, Y. B., Brown, C. J., Burgio, K. L., Kilgore, M. L., Ritchie, C. S., Roth, D. L., . . . Locher, J. L. (2011). Undernutrition at Baseline and Health Services Utilization and Mortality Over a 1-Year Period in Older Adults Receiving Medicare Home Health Services. *Journal of the American Medical Directors Association*, 12(4), 287-294.

Yesavage J, & Sheikh J. (1986). Geriatric Depression Scale (GDS) Recent Evidence and Developmemnt of a Shorter Version. *Clinical Gerontology*(5), 165-173.

Yesavage, J. A., Brink, T. L., Rose, T. L., Lum, O., Huang, V., Adey, M., & Leirer, V. O. (1983). Development and Validation of a Geriatric Depression Screening Scale - A preliminary report. *Journal of Psychiatric Research, 17*(1), 37-49.

Kim, W. Y., Hur, M., Sook Cho, M., & Sook Lee, H (2003). Effect of olfactory function on nutritional status of Korean elderly women. *Nutrition Research*, 23(6), 723-734.

Youngjohn, J. R., Larrabee, G. J., & Crook, T. H. (1991). First–Last Names and the Grocery List Selective Reminding Test: Two computerized measures of everyday verbal learning. *Archives of Clinical Neuropsychology, 6*(4), 287-300.

Zoltick, E., Sahni, S., McLean, R., Quach, L., Casey, V. A., & Hannan, M. T. (2011). Dietary protein intake and subsequent falls in older men and women: The Framingham study. *The Journal of Nutrition Health and Aging*, 15(2), 147-152 146p.

Appendicies

Appendix 1: Seniors in the Community: Risk evaluation for eating and nutrition, Version II (SCREEN II)

SCREEN II Score

(14 items)

- *I'm now going to ask you some questions about your eating habits*
- *I want to find out about your normal habits – so we'll talk about a **typical** day*
- *There are no right or wrong answers to any of these questions*

Note: Several questions on SCREEN II use value judgement responses. When scoring these questions the following interpretation is appropriate

'Rarely' means once a week or less
'Sometimes' means 2-4 times a week
'Often' means 5-6 times a week
'Always' means at least daily

1a. Has your weight changed in the past 6 months?

- ❑ No, my weight has stayed within a <u>few</u> kilos 4
- ❑ I don't know how much I weigh or if my weight has changed 0

Yes, I gained…

- ❑ More than 5kg 0
- ❑ 2½ - 5kg 1
- ❑ About 2-2½ kg 2

Yes, I lost…

- ❑ More than 5kg 0
- ❑ 2½ - 5kg 1
- ❑ About 2-2½ kg 2

1b. Have you been <u>trying</u> to change your weight in the past 6 months?

- ❑ Yes 4
- ❑ No 4
- ❑ No, but it changed anyway 0

1c. Do you think your weight is…

- ❑ More than it should be 0
- ❑ Just right 4
- ❑ Less than it should be 0

2. Do you skip meals?

- ❑ Never or rarely 4
- ❑ Sometimes 2
- ❑ Often 1
- ❑ Almost every day 0

3. Do you limit or avoid certain foods?

- ❑ I eat most foods 4
- ❑ I limit some foods and I am managing fine 2
- ❑ I limit some foods and I am finding it difficult to manage 0

4. How would you describe your appetite?

- ❑ Very good 4
- ❑ Good 3

- ❑ Fair 2
- ❑ Poor 0

5. How many pieces or servings of fruit and vegetables do you eat in a day? *Can be canned, fresh, frozen or juice.*

- ❑ Five or more 4
- ❑ Four 3
- ❑ Three 2
- ❑ Two 1
- ❑ Less than two 0

6. How often do you eat meat, eggs, fish, poultry OR meat alternatives?

Meat alternatives are dried peas, beans, lentils, nuts, peanut butter or tofu.

- ❑ Two or more times a *day* 4
- ❑ One to two times a *day* 3
- ❑ Once a *day* 1
- ❑ Less than once a *day* 0

7. How often do you have milk products?

Includes fluid milk, cooking with milk, milk puddings, ice cream, cheese, yoghurt and milk alternatives like soy beverages.

- ❑ Three or more times a *day* 4
- ❑ Two to three times a *day* 3
- ❑ One to two times a *day* 2
- ❑ Usually once a *day* 1
- ❑ Less than once a *day* 0

8. How much fluid do you drink in a day?

Includes: water tea, coffee, herbal drinks, juice, and soft-drinks but not alcohol

- ❑ Eight or more cups 4
- ❑ Five to seven cups 3
- ❑ Three to four cups 2
- ❑ About two cups 1
- ❑ Less than two cups 0

9. Do you cough, choke or have pain when swallowing food OR fluids?

- ❑ Never 4
- ❑ Rarely 3
- ❑ Sometimes 1
- ❑ Often or always 0

10. Is biting or chewing food difficult for you?

- ❑ Never 4
- ❑ Rarely 3
- ❑ Sometimes 2
- ❑ Often or always 0

11. Do you use commercial meal replacements or supplements? (Shakes, puddings, energy bars)

- ❑ Never or rarely 4
- ❑ Sometimes 2
- ❑ Often or always 0

12. Do you eat one or more meals a day with someone?

- ❑ Never or rarely 0

- ❑ Sometimes 2
- ❑ Often 3
- ❑ Almost always 4

13a. Who usually prepares your meals?

- ❑ I do
- ❑ I share my cooking with someone else
- ❑ Someone else cooks most of my meals

13b. Which statement best describes meal preparation for you?

- ❑ I enjoy cooking most of my meals 4
- ❑ I *sometimes* find cooking a chore 2
- ❑ I *usually* find cooking a chore 0
- ❑ I'm *satisfied* with the quality of food prepared by others 4
- ❑ I'm *not satisfied* with the quality of food prepared by others 0

14. Do you have any problems getting your groceries?
Can be poor health or disability, limited income, lack of transportation, weather conditions, or finding someone to shop

- ❑ Never or rarely 4
- ❑ Sometimes 2
- ❑ Often 1
- ❑ Always 0

Maximum Score 64

Risk Cut Point <50

<50 cut off recommended for screening which would result in referrals to Dietitians or physicians for further assessment and treatment (Keller et al 2005)

<54 cut off recommended for health promotion and nutrition promotion efforts