Identification of Nutrition Risk in Hospitalised Older Adults at North Shore and Waitakere Hospitals, Auckland, New Zealand

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Abstract

Background:

The proportion of older adults in the New Zealand population is increasing, and due to the significant increase in chronic diseases and disability with age, the demand for health and disability support services is also likely to increase. A key aim of the Health of Older People Strategy is improving the health of older New Zealanders' and assisting them to continue living safely in their communities. Adequate nutrition is an essential factor in promoting health and managing chronic diseases in older adults, however many changes associated with ageing predispose older adults to nutrition risk. Poor nutrition status is associated with many adverse consequences, especially for hospitalised older adults in rehabilitation wards. However, nutrition risk screening is a simple method of using nutrition risk factors to identify individuals with poor nutrition status, prompting dietetic referral and intervention.

Aim and Objectives:

The aim of this study is to determine the prevalence of nutrition risk among older adults in the Assessment, Treatment and Rehabilitation (AT&R) wards at North Shore and Waitakere Hospitals. This study has three main objectives:

Objective one: to determine nutrition risk prevalence and associated risk factors, using the Mini Nutritional Assessment-Short Form (MNA-SF).

Objective two: to determine dysphagia risk using the Eating Assessment Tool-10 (EAT-10).

Objective three: to identify sociodemographic, health, and support service factors associated with nutrition risk.

Methods:

This study was a cross-sectional, observational study. Participants were consecutively recruited according to the eligibility criteria, within five days of admission. Face-to-face interviews were conducted on the AT&R wards using a questionnaire developed for the study. This questionnaire incorporated sociodemographic, health and support service questions, as well as three previously validated screening tools: MNA-SF (nutrition risk), EAT-10

(dysphagia risk), and the Montreal Cognitive Assessment (cognitive function).

Results:

This study had 57 participants with a median age of 83 years (range, 66-95 years). Nutrition risk was evident in 81 percent of the study participants (23% were 'malnourished,' and a further 58% were 'at risk of malnutrition'). Therefore, only 19 percent of the study participants had 'normal' nutrition status on admission to the AT&R wards.

Using the MNA-SF nutrition risk factors, those at nutrition risk vs. those not at risk had a higher prevalence of decreased food intake (37% vs. 18%); weight loss (57% vs. 9%); underweight BMI (13% vs. 0%); reduced mobility (87% vs. 64%); mild dementia (22% vs. 9%); and psychological stress or acute disease (94% vs. 18%). In relation to sociodemographic risk factors, those at nutrition risk were more likely to be widowed (46% vs. 36%), receive a pension only income (65% vs. 36%), and have primary as their highest level of education (52 % vs. 36%). Participants who were not at nutrition risk were more likely to take nutrition supplements (46% vs. 24%) and receive regular support services (55% vs. 46%). Overall, dysphagia risk was low, and the prevalence was similar between the two nutrition status groups.

Conclusion:

The current study suggests a high prevalence of older adults admitted to AT&R wards may be at nutrition risk. This highlights the importance of patients being screened for nutrition risk on admission to AT&R wards, since poor nutrition status has far-reaching consequences. Patients can then be promptly referred to a dietitian for nutrition intervention to improve patient outcomes.

Key Words:

Older adults, AT&R, nutrition risk, nutrition screening, dysphagia.

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Abbreviations

AMDR	Acceptable Macronutrient Distribution Range
AT&R	Assessment, Treatment and Rehabilitation
BMI	Body Mass Index
CC	Calf Circumference
COPD	Chronic Obstructive Pulmonary Disease
DNA	Deoxyribonucleic Acid
EAR	Estimated Average Requirement
EAT-10	Eating Assessment Tool-10
HOPS	Health of Older People Strategy
IHD	Ischaemic Heart Disease
MMSE	Mini-Mental State Examination
MNA	Mini Nutrition Assessment
MNA-SF	Mini Nutrition Assessment-Short Form
MoCA	Montreal Cognitive Assessment
MOW	Meals on Wheels
NHANES	National Health and Nutrition Examination Survey
NICE	National Institute for Health and Care Excellence
NZANS08/09	New Zealand Adult Nutrition Survey 2008/09
NZHS12/13	New Zealand Health Survey 2012/13
SENECA	Survey in Europe on Nutrition and the Elderly: a Concerted Action
WDHB	Waitemata District Health Board
WHO	World Health Organisation

Chapter 1 - Introduction

The New Zealand population is ageing, with the proportion of older adults (people aged over 65 years) projected to increase from 12 percent in 2001, to 26 percent by 2051 (Ministry of Health, 2002a). Due to the significant increase in chronic diseases and disability with ageing, the ageing population will increase the demand for and expenditure on health and disability support services (Te Pou, 2011). To respond to this challenge, the health sector must focus on supporting this population to maintain their health, independence and quality-of-life for as long as possible. In accordance with this, the Health of Older People Strategy (HOPS) (Ministry of Health, 2002b) was adopted by the New Zealand government, with the aim of improving the health of older New Zealanders' and assisting them to continue living safely in their communities.

Nutrition is an essential factor in promoting health and preventing illness among older adults, as well as in managing chronic diseases. Nutrition supports the physiological well-being of older adults, in addition to positively impacting social and psychological quality-of-life (Pirlich, 2001). However, ageing involves many changes that can compromise nutrition status, including physiological, psychological and social changes (American Dietetic Association, 2005). The potential subsequent poor nutrition status may be further reduced by chronic disease states. Therefore, ageing can increase nutrition risk and its associated consequences, which include reduced physical function, poorer quality-of-life, impaired immune response, cognitive impairment, and decreased independence (Barker, Gout, & Crowe, 2011; Phillips, Foley, Barnard, Isenring, & Miller, 2010). These considerations, along with the HOPS, have led to an increased focus on approaches to prevent development of poor nutrition status in older adults.

Poor nutrition among hospitalised older adults is particularly concerning, as this can lead to more complications, longer length of hospital stay, increased mortality, and greater health costs (Middleton, Nazarenko, Nivison-Smith, & Smerdely, 2001; Thomas et al., 2002). Furthermore, patients in rehabilitation wards with poor nutrition status are at increased risk of reduced functional

independence, muscle function, and respiratory function; and increased risk of infections, pressure areas, falls and fractures (Edington et al., 2000; Pirlich et al., 2006; Sullivan & Walls, 1995; Thomas et al., 2002). This study will therefore evaluate the prevalence of nutrition risk in hospitalised older adults in rehabilitation wards, and investigate the factors that may predispose to poor nutrition status.

1.1 Background

Nutrition risk in older adults can progress to malnutrition, a state of being poorly nourished due to a lack of energy, protein and other nutrients, which can lead to adverse effects on body composition, function and clinical outcome (British Association for Parenteral and Enteral Nutrition, 2012). Malnutrition is one of the most significant conditions that adversely affect the health of older adults. It is common with ageing and despite its well-known consequences, it often goes undiagnosed and therefore untreated (Kaiser, 2010). Among hospitalised older adults, previous research has indicated high levels of malnutrition and the preceding nutrition risk. A review by Guigoz (2006) of 36 international studies in over 8500 hospitalised older adults, found the average prevalence of malnutrition was 23 percent, with a further 46 percent at risk of malnutrition. In New Zealand, nutrition status of hospitalised older adults has previously been evaluated at Christchurch hospital in 1996 where42 percent of older patients were found to be malnourished (Hanger, 1999), and at Middlemore hospital in 2001 where24 percent of patients were malnourished, and a further 44 percent were at risk of malnutrition (Van Lill, 2002). This indicates poor nutrition status is prevalent among international, as well as New Zealand hospitalised older adults.

Numerous individual factors have been identified that appear to increase the risk of poor nutrition status in older adults. These factors include involuntary weight loss, sarcopenia, living alone, low socioeconomic status, requiring support with activities-of-daily living, poor dentition, and polypharmacy (Skates & Anthony, 2012; World Health Organisation, 2002b). Dysphagia has also been associated with poorer nutrition status (Takeuchi et al., 2014). Older adults demonstrate an increased frequency of dysphagia due to reductions in muscle

mass and connective tissue elasticity, and age-related diseases that can reduce swallowing function (Sura, Madhavan, Carnaby, & Crary, 2012). Additionally, cognitive impairment increases with age, and can cause problems with eating, leading to weight loss, and therefore increased nutrition risk (Johansson, 2009). Finally, if older adults are hospitalised, their nutrition status can deteriorate further during admission (Gariballa, Parker, Taub, & Castleden, 1998; Klipstein-Grobusch, Reilly, Potter, Edwards, & Roberts, 1995; Larsson et al., 1990). This is due to a number of associated factors including catabolism associated with acute illness (Gariballa, 2003), low intake of unappetising or unfamiliar foods, lack of flexibility in hospital catering, and interruption or withholding of meals for procedures (Gary & Fleury, 2002; Pennington, 1998).

Nutrition risk screening, a key clinical outcome of the United Kingdom National Institute for Health and Care Excellence (NICE) guidelines, is a simple and quick way of using the nutrition risk factors to identify individuals with poor nutrition status (NICE, 2006). This allows referral to a dietitian for nutrition intervention, in order to prevent progression to malnutrition, and therefore improves patient outcomes (Skates & Anthony, 2012).

1.2 Statement of the Problem

In New Zealand the nutrition status of hospitalised older adults appears to have only been examined by Hanger (1999) and Van Lill (2002), both of which were over 10 years ago. Additionally, neither of these studies analysed the association between the participants' nutrition status and predisposing nutrition risk factors. Therefore, our understanding of nutrition risk factors comes from either community-based studies in New Zealand, or international hospital studies. Consequently, there is a gap in the current knowledge of the nutrition risk in New Zealand hospitalised older adults.

With the present New Zealand over 65 year old population likely to double by 2040 (Statistics New Zealand, 2013), it is imperative to address the problem of declining nutrition status with age. As older adults, especially those who are hospitalised, are vulnerable to poor nutrition and the associated complications, it is pertinent to conduct research to provide a clearer picture on how many

older adults are at nutrition risk. Furthermore, in support of the government's 'Ageing in Place' policy (Ministry of Social Development, 2001), there is a need to identify the factors that could lead to poor nutrition status and intervene accordingly. This is because poor nutrition status has a major influence on the health and well-being of older adults, and their ability to continue living independently in their communities.

This study will address this gap in the current knowledge by determining the prevalence of nutrition risk in the Assessment, Treatment and Rehabilitation (AT&R) wards of two hospitals in Auckland, New Zealand. The sociodemographic, health and support service factors placing these older adults at risk of poor nutrition status will also be explored. This may lead to a better understanding of the nutrition status of hospitalised older adults, and contribute towards improving the care and clinical outcomes of these patients. Identifying predictive factors for poor nutrition status may enable targeted interventions to be developed from a primary care level. Knowledge gained from this study can be transferred to general practitioners, community health nurses, dietitians and other health professionals to increase their awareness of the prevalence and factors contributing to declining nutrition status with age.

1.3 Aims and Objectives

The aim of this study is to determine the prevalence of nutrition risk among older adults in the AT&R wards at North Shore and Waitakere Hospitals. This study has three main objectives:

Objective one: to determine nutrition risk prevalence and associated risk factors, using the Mini Nutritional Assessment-Short Form (MNA-SF).

Objective two: to determine dysphagia risk using the Eating Assessment Tool-10 (EAT-10).

Objective three: to identify sociodemographic, health, and support service factors associated with nutrition risk.

1.4 Structure of the Thesis

This thesis is divided into six chapters. This first chapter provides context to the problem of declining nutrition status with age, and the associated consequences for the ageing New Zealand population. This chapter also explains the importance of conducting this research, in order to form strategies to optimise nutrition status and clinical outcome of hospitalised older adults. The literature is then critically reviewed in Chapter two relating to the health and nutrition of the ageing population, and the prevalence and risk factors for poor nutrition status. Chapter three provides a description of the methods utilised in the execution of this study. This is followed by Chapter four, which reports the results of the study following data analysis, which are discussed in greater detail in Chapter five. Chapter five also includes the study strengths and limitations. Finally, Chapter six provides recommendations for future research, and a summary of the present study.

Chapter 2 - Literature Review

Chapter two has four sections; firstly the changing age structure in New Zealand, followed by the health of the older population. Thirdly nutritional health of New Zealand older adults is reviewed, and finally nutrition status and nutrition risk factors for older adults.

2.1 Ageing in New Zealand

In New Zealand, both life expectancy and the proportion of older adults in the population are increasing. The population is becoming top-heavy with the median age increasing from 29 years in 1951, to 37 years in 2011 to 2012, and is projected to be 44 years by 2061 (Bascand, 2012). This trend is driven by declining fertility rates, lower infant and child mortality, and increasing survival in older age. The result is an ageing population, with predictions of a greater proportion of the population aged over 65 years, than under 15 years, by 2051 (**Figure 1**) (Ministry of Health, 2002a; Statistics New Zealand, 2009; World Health Organisation, 2012).

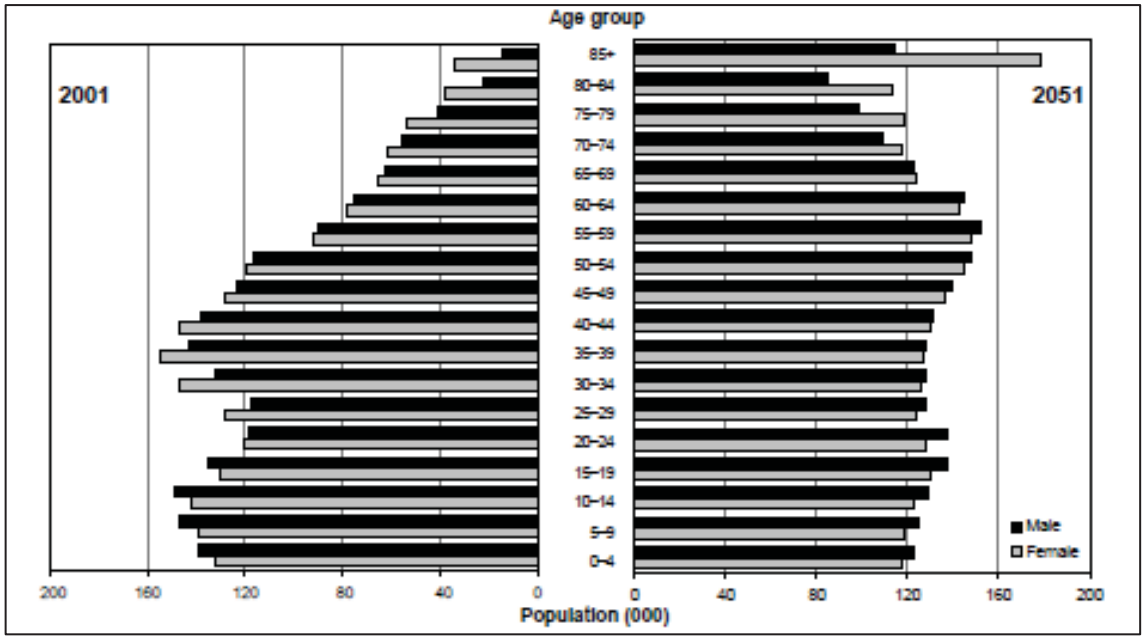

Figure 1: *Projected Population Age Structure Changes in New Zealand from 2001 to 2051* (Ministry of Health, 2002a).

Ethnic disparities exist in the growth of the ageing population: between 2001 and 2021 the older Maori population is expected to grow by 185 percent, the older Pacific Islander population by 178 percent, and the Asian older adult population by 400 percent (Cornwall & Davey, 2004). These increases are significantly greater than the estimated growth of 72 percent for the total population.

The proportion of those aged over 65 years in New Zealand has doubled since the early 1980's, now making up 14 percent of the population, and it is projected to double again by 2040 (Statistics New Zealand, 2013). An expected 1.18 million people will be aged over 65 years in 2051, representing an increase of 165 percent from 1999. By 2051, older adults are expected to comprise 26 percent of the New Zealand population (**Figure 2**).

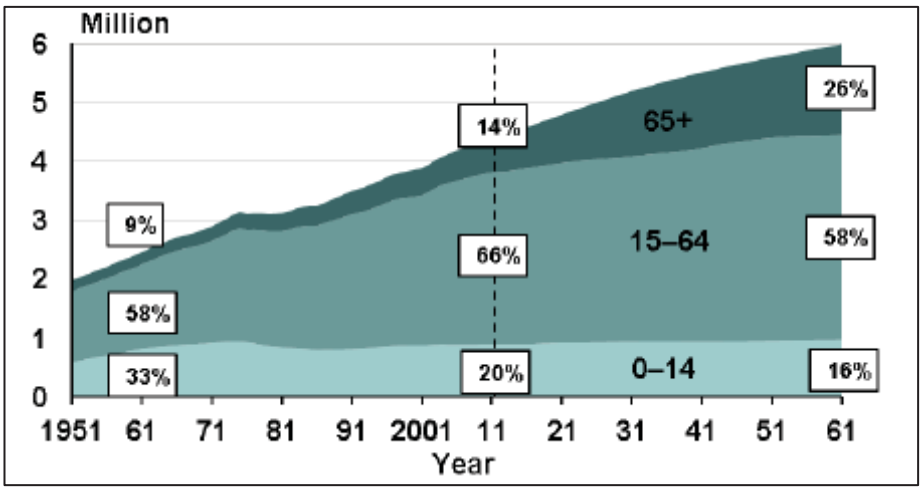

Figure 2: *Projected Change in the Proportion of Age Groups from 1961 to 2061* (Bascand, 2012).

The 'old-old,' those over 85 years (Statistics New Zealand, 2000), are the fastest growing segment of the population; they are projected to have a six fold increase by 2051, to total over 250,000 people. This group will then comprise 22 percent of those aged over 65 years, compared to nine percent in 1996 (Statistics New Zealand, 2000). In contrast, the number of children (zero to 15 years) is projected to decrease from 33 to 16 percent of the population from 1961 to 2061 (**Figure 2**). Therefore, growth of the working age group, 15 to 64 years, is likely to slow with fewer people entering the labour force than those

exiting. The proportion of the population made up by the working age group is projected to decrease from around 66 percent currently, to 58 percent by 2061 (Statistics New Zealand, 2000). These demographic shifts may cause downward pressure on the labour force and the need to increase productivity to support the ageing population. However, the percentage of those aged over 65 years still in the labour force, is projected to increase from three percent in 2006, to 10 to 18 percent in 2061 (Bascand, 2012). This increase however, is unlikely to be great enough to support the increase in health care costs with the ageing population.

2.1.1 Health Care Service and Cost Implications

The increase in the number of older adults in New Zealand has direct implications for future health service demand and expenditure, with this population known to use health services at three to four times their share of the population (Cornwall & Davey, 2004; Statistics New Zealand, 2000). This is because the ageing process is associated with functional decline, and chronic diseases disproportionately affect older adults (Te Pou, 2011). These conditions contribute to on-going disability, and diminished independence and quality-of-life.

In New Zealand public health funding comes from Vote Accident Compensation Corporation and Vote Health Expenditure. In 2001/2002 it was estimated that the over 65 year old population group would use 39 percent of the Vote Health Expenditure, despite comprising only 12 percent of the total population (Ministry of Health, 2002a). Further, in 2010 it was estimated that the 1.3 percent of the population aged over 85 years used over 10 percent of expenditure on health and disability support services; by 2021 it is estimated that this group will comprise 2.3 percent of the population, and use 15 percent of health service expenditure (Ministry of Health, 2006a).

Figure 3 displays the exponential increase in health costs with advancing age for 2051 as projected by Bryant, Teasdale, Tobias, Cheung, and McHugh (2004).

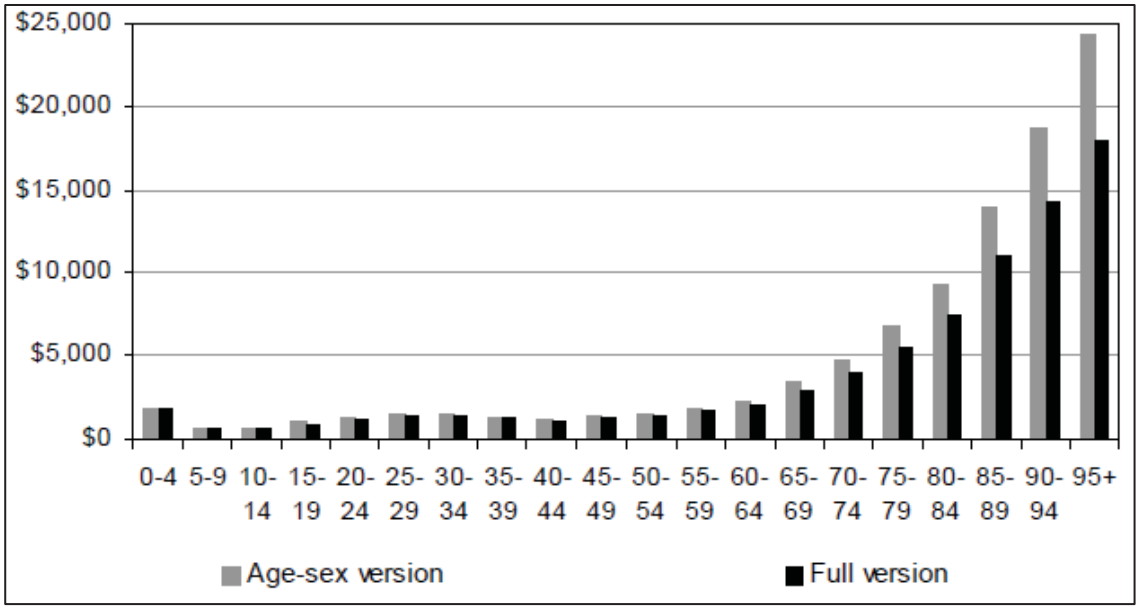

Figure 3: *Projected Health Expenditure Per Capita in 2051 by Age Group* (Bryant et al., 2004).

To offset the economic impact of the ageing population, an important focus for the health sector is to support this population group to maintain their health, independence and quality-of-life for as long as possible. Unfortunately, healthy life expectancy has not increased at the same rate as actual life expectancy (Stanner & Denny, 2009). Only two-thirds of the life years gained over the decade from 2006 to 2016 are projected to be lived in good health (Ministry of Health, 2013c); therefore old age itself may not have the greatest effect on health costs, but rather increasing years of poor health.

2.1.2 Positive Ageing Strategy

While an estimated three quarters of those aged 65 to 74 years live independently without any assistance, the ageing population may increase the number of older adults who are frail, vulnerable and require a high level of health care and disability support (Ministry of Health, 2002a, 2002b). To address this issue, the Positive Ageing Strategy was adopted by the New Zealand government in 2001. This strategy promotes participation and empowerment of older people, and a society that recognises and values the skills, knowledge and experience that this population has to offer (Ministry of Social Development, 2001). Similarly, the World Health Organisation (WHO) recognises older people as important family members, volunteers and active

participants in the workforce. Also, that increasing life expectancy can provide significant social and economic resources if 'active ageing' policies and programmes are enacted (World Health Organisation, 2002a, 2012). The HOPS (Ministry of Health, 2002b) is a key action within the New Zealand Positive Ageing Strategy, and aligns with the WHO 'active ageing' approach. The HOPS focuses on improving health status, promoting quality-of-life, reducing inequalities, and promoting participation of older adults in social life and decisions about their care and support. One of the priority goals of the HOPS is 'ageing in place,' where older adults are given the opportunity to continue living safely in their communities. This is because keeping older adults contributing productively to society, rather than only being users of health care services, increases their economic and social participation, as well as health and well-being.

2.1.3 Determinants of Health

Good health has been defined as a state of complete physical, social and mental well-being, not merely the absence of disease (World Health Organisation, 2003b). There are many factors that determine the health of older adults. Firstly, income is the single most important determinant of health, with lower income consistently associated with poorer health (Diez-Roux, Link, & Northridge, 2000; Kahn, 2000; Soobader & LeClere, 1999). Adequate income is a prerequisite for many other determinants of health, such as acceptable housing, a nutritious diet, and education opportunities. The main determinant of income is paid employment, this in turn also provides social contact and regular activity, which enhance health and well-being. Unemployed people in New Zealand consistently report poorer health status than people who are employed (Ministry of Social Development, 2010; National Health Committee, 1998).

Connectedness in society is also consistently associated with better health, lower risk of disease and increased survival (Greenwood, Muir, Packham, & Madeley, 1996; Kawachi et al., 1996). Social networks provide support, value, and empowerment to participate in decisions that affect health and well-being. Conversely, social isolation and loneliness significantly increase the risk of disability, morbidity, and early death (World Health Organisation, 2002a).

It is uncertain how influential cultural and ethnic factors may be to health status, however in New Zealand there are clear ethnic disparities in health, chiefly attributed to inequalities in the underlying socioeconomic health determinants (National Health Committee, 1998).

Lastly, the physical environment, including safe water and clean air, healthy workplaces, safe housing, communities and roads, also contribute significantly to health status (National Health Committee, 1998). Therefore the health of the current ageing population is determined not only by individual lifestyle choices and the provision of health services, but also by socioeconomic, cultural and environmental conditions. With many determinants of health, as well as variations within those determinants, there is a large spectrum of health status among older adults in New Zealand.

2.2 Health of Older Adults

Older adults are a heterogeneous population; ranging from healthy and active with minimal health problems and taking no prescribed medications, to extremely frail, vulnerable and dependent people with chronic diseases and severe disabilities (Hickson, 2006). 'Successful ageing' is defined by the American Dietetic Association as the ability to maintain three key behaviours: (1) low risk of disease and disease-related disability; (2) high mental and physical function; and (3) active engagement in life (American Dietetic Association, 2005). Nutrition is one of the major determinants of successful ageing as food extends beyond providing physiological well-being, nourishment and satisfying hunger, to contributing to social, cultural and psychological quality-of-life (Pirlich, 2001). Nutrition plays a role in primary prevention and promotion of health and functionality, as well as at secondary and tertiary level through medical nutrition therapy to manage chronic diseases (American Dietetic Association, 2005; Moseley, 2001). Therefore nutrition is an important factor not only in postponing chronic diseases and associated morbidity, but also in keeping older adults living independently in their communities.

2.2.1 Chronic Disease and Health Loss with Ageing

Ageing is associated with an accumulation of risk factor exposure which causes degenerative processes and increases the prevalence of chronic conditions with age (Khaw, 2008). In the 2002/2003 New Zealand Health Survey, adults aged over 65 years were significantly more likely to have four or more chronic conditions, than those aged 50 to 64 years (Ministry of Health, 2004a). These conditions include cancer, cardiovascular diseases, musculoskeletal disorders, diabetes mellitus and respiratory conditions. The resultant morbidity from chronic conditions includes declining physical function, limited mobility, frailty, self-care deficit, dependence, and a poorer quality-of-life.

The New Zealand Burden of Diseases, Injuries and Risk Factors Study 2006 to 2016 (Ministry of Health, 2013c) examined how much healthy life is lost due to death, illness or disability. In this study, disability-adjusted-life-years were the measure of 'health loss': the gap between the population's current health state and that of an ideal population where members enjoy a long life free from poor health. This study predicted that adults aged over 65 years suffered 37 percent of the total health loss, despite comprising only 12 percent of the population. This demonstrates the greater burden of disease experienced by older adults. Additionally, the burden of disease was projected to increase by 13.4 percent from 2006 to 2016, due to the ageing population. This study also found that overall health loss was almost 1.8 times higher for Maori than non-Maori. Although, health loss among Maori is not dominated by older adults, with over half of healthy life lost before middle age (Ministry of Health, 2013c). The 2013 Health and Independence Report also revealed ethnic disparities in health are persisting; Maori people compared to non-Maori were experiencing worse outcomes in almost every health condition (Ministry of Health, 2013a). Given that the proportion of Maori older adults is increasing at over twice the rate of the total older adult population (Cornwall & Davey, 2004), this will have implications for future health care delivery and expenditure.

In the New Zealand Burden of Diseases, Injuries and Risk Factors Study, the leading causes of health loss for those aged 65 to 74 years were cancers (29%) and vascular disorders (24%), followed by musculoskeletal conditions (11%). In

adults aged 75 years and over, vascular disorders (35%) overtook cancers (18%) as the leading cause of health loss, with neurological conditions ranked third (10%) (Ministry of Health, 2013c). Risk of these chronic conditions may be reduced through modifying diet and lifestyle risk factors (World Health Organisation, 2002b); collectively high salt intake, high saturated fat intake, low vegetable and fruit intake, and excess energy intake accounted for 11.4 percent of health loss for the New Zealand population in 2006 (Ministry of Health, 2013c). Reducing these dietary risk factors can in turn reduce the risk of intermediate conditions, such as high blood pressure, high cholesterol, high blood glucose and high body mass index (BMI) (World Health Organisation, 2002b). It was previously thought that no benefit would be conferred from changing dietary habits in older age. However, a longitudinal study with a ten year follow up in Europe (n=2339), found 50 percent lower mortality among individuals aged 70 to 90 years who adopted healthy dietary practices (using the Mediterranean diet, moderate alcohol use, physical activity and non-smoking) (Knoops et al., 2004). Therefore, although the burden from nutrition related chronic diseases is large, the potential benefits from modest improvements in nutrition are also considerable. Some of these important health issues for older adults and their dietary risk factors are discussed below.

2.2.1.1 Cancer

Cancer was the leading cause of health loss for those aged 45 to 74 years in 2006, with a burden 1.7 times higher for Maori than non-Maori (Ministry of Health, 2013c). Among adults aged 75 years and above, cancer was displaced by vascular disorders as the leading cause of health loss. In 2010, cancer accounted for 30 percent of all deaths, 72 percent of which occurred among those aged 65 years and over (Ministry of Health, 2013a, 2013d). The increased incidence with age may be partly explained by increased carcinogen exposure, accumulation of genetic mutations, immune system and hormonal alterations, and the long latency period of some cancers (Ministry of Health, 2013b). High BMI and physical inactivity are estimated to account for 20 to 30 percent of all cancers (World Health Organisation and Food and Agriculture Organization, 2003). Additionally, non-starchy vegetables and fruit are probable protective factors against certain cancers (World Cancer Research Fund and

American Institute for Cancer Research, 2007). These reports indicate the high incidence of cancer may increase further with the current ageing population; however, consuming the recommended servings of vegetables and fruit, and maintaining a healthy BMI, may help to reduce the risk of older adults developing cancer.

Older adults with cancer may experience side effects such as a reduced appetite, low mood, malabsorption or pain (Argiles, 2005). These factors may contribute to decreased food intake, and coupled with the increased nutrient requirements of cancer, may increase the risk of poor nutrition status (Izaola, 2005). In a French study of 1903 cancer patients, 55 percent of the participants had experienced decreased food intake due to anorexia, loss of taste, nausea, dysphagia, oral pain, constipation or vomiting (Hebuterne et al., 2014). Furthermore, over half of the participants had lost more than five percent of their body weight since disease onset. The presence of cancer was also considered a significant risk factor for malnutrition (OR 2.94) in a study of 9348 hospitalised patients in Latin America (Correia & Campos, 2003). Therefore, a nutrient-dense diet is important for older adults with cancer to assist with meeting nutrition requirements during times of low energy intake.

2.2.1.2 Cardiovascular Diseases

Cardiovascular diseases, including ischaemic heart disease (IHD) and cerebrovascular disease (stroke) have been estimated to cause one third of global deaths (World Health Organisation and Food and Agriculture Organization, 2003). These diseases also cause significant morbidity, with IHD and strokes accounting for 9.3 and 3.9 percent of health loss respectively in 2006 (Ministry of Health, 2013c).

In the New Zealand Health Survey 2012/2013 (NZHS12/13), five percent of all adults reported having been diagnosed with IHD, however this increased to 22 percent in the over 75 year old group. Maori people were 1.8 times more likely than non-Maori to have IHD (Ministry of Health, 2012a, 2013d). The Asia Pacific Cohort Studies Collaboration (n=582,134) showed the risk of IHD increased substantially with age, and was associated with high blood pressure, high triglycerides, high cholesterol and diabetes status (Asia Pacific Cohort

Studies Collaboration, 2006).

Cerebrovascular diseases were the third leading cause of death in the New Zealand population in 2010, after cancer and IHD (Ministry of Health, 2013d). Two percent of all adults in the NZHS12/13 reported having had a stroke, however this increased to 10 percent in the over 75 year old group. Maori were 1.4 times more likely than non-Maori to have had a stroke (Ministry of Health, 2012a). Although cardiovascular diseases are a major cause of health loss and mortality in New Zealand, 70 to 80 percent of the burden from these diseases is potentially modifiable through diet and lifestyle changes (World Health Organisation and Food and Agriculture Organization, 2003).

High blood pressure, which accounted for 6.4 percent of health loss in 2006, is an important risk factor for heart disease and stroke, and the third largest risk factor to health after tobacco and high BMI (Ministry of Health, 2013b, 2013c; Prospective Studies Collaboration, 2002). The 2008/2009 New Zealand Adult Nutrition Survey (NZANS08/09) showed blood pressure increased with age (University of Otago and Ministry of Health, 2011). Additionally, over half of adults aged over 75 years were on medication for high blood pressure in the NZHS12/13, with Maori 1.4 times more likely than non-Maori (Ministry of Health, 2013e). It has been estimated that a 10mmHg reduction in systolic blood pressure can decrease the risk of IHD and stroke by 15 to 40 percent (University of Otago and Ministry of Health, 2011). Therefore, reducing blood pressure in older adults is an important factor in decreasing the risk of cardiovascular diseases.

High salt intake may be a risk factor for high blood pressure (Cutler, Follmann, & Allender, 1997; Midgley, Matthew, Greenwood, & Logan, 1996). High salt intake caused 1.7 percent of all heath loss in the New Zealand population in 2006, of which 91 percent of the impact was due to this effect on blood pressure and subsequently cardiovascular diseases (Ministry of Health, 2013c). However, high salt intake is less likely to be a risk factor for older adults; the NZANS08/09 showed those over 71 years are the age group most likely to choose low- or reduced-salt varieties of food.

Blood cholesterol is another important risk factor for cardiovascular diseases. The rate of New Zealanders medicated for high cholesterol increases markedly with age, to one third of adults aged over 65 years (Ministry of Health, 2013e). Dietary fats are the most important modifiable determinant of blood cholesterol. However, older people have been found to be more likely than those aged 15 to 64 years to choose low or reduced fat varieties of food (University of Otago and Ministry of Health, 2011). Vegetables and fruit have also been shown to protect against heart disease, stroke and high blood pressure (World Health Organisation and Food and Agriculture Organization, 2003). Therefore, although cardiovascular diseases are a major cause of death and health loss in older adults, a nutrient-dense diet that is low in salt and fat, and high in fruits and vegetables may help to reduce the burden of these diseases.

2.2.1.3 Musculoskeletal Conditions

Musculoskeletal conditions are common in older adults, adversely affecting the body's muscles, joints, tendons and ligaments. International prevalence of osteoarthritis increase exponentially with age; around nine percent of all adults, 50 percent of people over 60 years, and almost all of those over 80 years have osteoarthritis to some degree (Harrison, 2008; Southern Cross Healthcare Group, 2013). Osteoarthritis is a degenerative joint disease involving thinning of the cartilage that cushions the ends of bones (Southern Cross Healthcare Group, 2013). This produces pain, stiffness, and reduced physical capacity and quality-of-life. Due to the high prevalence among older adults, osteoarthritis is a large contributor to morbidity and health loss in this population group.

Another musculoskeletal condition common in older adults is osteoporosis; this occurs when increased bone resorption is not followed by equivalent bone formation, causing bone loss and subsequent low density, weak, porous bones. One in 34 adults reported having been diagnosed with osteoporosis in 2006/2007 (Ministry of Health, 2008). The prevalence was found to increase with age; however, the rate was much higher in women than men over 75 years, at 22 and three percent respectively. Fractures are a common consequence of osteoporosis. In a longitudinal study in Australia (n=271), half of women and 30 percent of men were found to have had an osteoporotic fracture (Jones et al.,

1994). Osteoporosis and associated fractures are a major cause of disability, due to pain, reduced function, deformity, hospitalisation, on-going care and decreased quality-of-life (Brown, McNeill, Radwan, & Willingale, 2007; World Health Organisation, 2002b).

Inadequate calcium intake and vitamin D deficiency are both risk factors for osteoporosis. Increasing calcium intake can reduce the rate of bone loss and prevent fractures (Brown et al., 2007; World Health Organisation, 2003a). The NZANS08/09 showed that both men and women aged over 71 years had lower calcium intake than any other age group. Vitamin D exposure may also be lower in older adults due to reduced mobility and increased time spent indoors, malabsorption, and low dairy and meat intake (Gariballa, 2004). Furthermore, up to 50 percent of patients who have suffered a hip fracture are malnourished (Gariballa, 2004). Malnutrition may be associated with hip fractures due to factors including muscle wasting, reduced muscle power, impaired cardiac function resulting in falls, and mental apathy (Avenell & Handoll, 2004).

2.2.1.4 Diabetes Mellitus

The incidence of type two diabetes increases with age, and is prevalent among the obese. Maintaining a body weight within the normal BMI range throughout adult years may be an important protector against developing diabetes later in life (Bays, Chapman, & Grandy, 2007). Fifteen percent of adults aged over 75 years in New Zealand reported having been diagnosed with diabetes in the NZHS12/13, compared to six percent of all adults. The rate of diabetes was twice as high in Maori compared to non-Maori (Ministry of Health, 2013e). Older adults may be at increased risk as glucose tolerance declines with age due to reduced insulin sensitivity and impaired insulin secretion, coupled with increased weight and sedentary behaviour (Gambert & Pinkstaff, 2006). Diabetes and other endocrine disorders were the ninth largest cause of health loss in New Zealand, with diabetes accounting for three percent directly, and 4.7 percent indirectly (by contributing to IHD, stroke and vascular dementia) (Ministry of Health, 2013c). Diabetes can also cause blindness, kidney damage and vascular insufficiency which can lead to nerve damage and leg amputations. In older adults, diabetes can increase the risk of functional decline,

multiple comorbidities and poor quality-of-life (Gambert & Pinkstaff, 2006). High blood glucose, a consequence of poorly controlled diabetes, accounted for 4.6 percent of health loss in 2006 (Ministry of Health, 2013c). Diabetes has a wide range of associated complications and is therefore an increasingly important issue with the ageing population.

2.2.1.5 Respiratory Conditions

Respiratory conditions caused 6.3 percent of all health loss in 2006, of which chronic obstructive pulmonary disease (COPD) accounted for 3.7 percent, and asthma accounted for 1.6 percent (Ministry of Health, 2013c). COPD refers to several disorders characterised by non-reversible airflow restriction in and out of the lungs. Emphysema and chronic bronchitis are the two most common forms of COPD (Ministry of Health, 2004a). The prevalence of COPD doubles from approximately four percent in those aged 50 to 64 years, to around eight percent in those aged over 65 years (Ministry of Health, 2004a). For adults aged 65 to 74 years, COPD was the second largest specific condition contributing to health loss, and for those aged 75 years and over, it was the third largest contributor (Ministry of Health, 2013c). The main risk factor for COPD is tobacco smoking. The NZHS12/13 found that the prevalence of current smokers decreased from 24.4 percent in those aged 25 to 34 years, to 4.4 percent in those aged over 75 years (Ministry of Health, 2013e). A low BMI is also a known risk factor for and consequence of, COPD (Zhou, 2013); therefore, attention to diet quality and nutrition status may improve management and prognosis of older adults with COPD (Gooneratne, Patel, & Corcoran, 2010).

Asthma was the second most common respiratory condition contributing to health loss in 2006 (Ministry of Health, 2013c). Asthma is a reversible inflammatory disorder causing restricted airflow in and out of the lungs; around half of people with asthma are diagnosed before age 10 (Ministry of Health, 2004a). Therefore asthma is not specifically associated with ageing; eleven percent of older adults were medicated for asthma in the NZHS12/13, which was the same prevalence as the total population (Ministry of Health, 2013e).

2.2.2 Disability with Ageing

More people are living with chronic diseases without necessarily being disabled, however there is a sharp increase in the prevalence of disability with increasing age (**Table 1**); this reflects an accumulation of health risks.

Table 1: *Rate of Disabled People by Age in the Disability Survey 2013* (Statistics New Zealand, 2014).

	Under 15 years	15 to 44 years	45 to 64 years	65 years and over
Rate of disabled people (%)	11	16	28	59

In the 2013 Disability Survey, 59 percent of adults aged over 65 years were identified as being disabled, compared to 21 percent of those under 65 years (Statistics New Zealand, 2014). Ethnic disparities existed, with the rate of disability for Maori (32%) higher than non-Maori (27%). For adults over 65 years, physical impairment was the most common type of disability, at 49 percent compared to seven percent in those younger than 45 years (Statistics New Zealand, 2014). Sensory impairments were ranked second, with 29 percent of adults aged over 65 years experiencing hearing impairment, and 11 percent experiencing vision impairment.

Disabilities among older adults increase the need for assistance, health care support and specialised equipment. Many older adults with disabilities are able to continue living in their own home, and tend to experience greater well-being. However, the need for residential care increases with age, with one in four people aged over 85 years living in residential care in 2012/2013 (Ministry of Health, 2013a).

Disability and frailty associated with older age have also been consistently associated with negative impacts on nutrition status (Guigoz, 2006). Whether the impairments are physical, sensory, or related to cognitive functioning, they may all influence the individual's ability to procure, prepare or consume meals, negatively impacting nutrition status (Barker et al., 2011). With the ageing

population, there is likely to be an increase in the number of older adults with disabilities. This in turn will increase the health care and service requirements. Therefore it is important for older adults to maintain functional capacity above the disability threshold, to promote greater independence and quality-of-life.

2.2.3 Falls and Fractures

Injury was the fifth leading cause of health loss in New Zealand in 2006, at eight percent; falls accounted for over half of all injuries in the over 65 year old population (Ministry of Health, 2013c). Falls in older adults can result in serious injury, immobilisation, disability, loss of independence, and need for long term rehabilitation or transfer to aged residential care. Ageing also increases the risk of requiring hospitalisation after a fall. In 2005, falls accounted for 55 percent of all hospitalised unintentional injuries for those aged 65 to 69 years; 65 percent for those aged 70 to 74 years; and 82 percent for people aged 75 and older (Dyson, 2005). Older adults are at greater risk of falls due to weaker muscles, lower blood pressure, poor vision, medical conditions (such as stroke or Parkinson's Disease), or higher dosages of medications (Dyson, 2005). Additionally, the impact of falls may worsen with age due to the increased vulnerability and longer recovery time.

Falls in older adults often lead to fractures, due to decreasing bone density with age. Hips are the most common site of fracture in older adults post falls, and can lead to loss of quality-of-life and premature mortality. The average length of stay after a hip fracture in 2007 was 14 days, and the cost of hospitalisation was almost $15,000 (Brown et al., 2007). Furthermore, around 70 percent of older adults who suffered a hip fracture were admitted to a rehabilitation ward, resulting in a further 22 days in hospital, on average. Therefore falls and subsequent fractures are a significant issue in the older adult population, and have substantial individual and economic consequences.

Skates and Anthony (2012) identified that nearly half of older adults with hip fractures may be malnourished. Macro- and micronutrient deficiencies associated with malnutrition may accelerate age-related bone and muscle loss, increase falls risk by impairing movement coordination, and affect protective mechanisms that reduce the impact of falling (such as reaction time and soft

tissue padding) (Bonjour, Schurch, & Rizzoli, 1996). A higher weight and BMI has been associated with a decreased risk of hip fracture among 9516 women from the United States (Cummings et al., 1995). Adequate nutrition and weight maintenance with age are therefore important factors in reducing the risk of falls in older adults, and the associated injury and disability.

2.2.4 Hospitalisation with Ageing

The increase in chronic diseases and disability in older adults increases the rate of hospitalisation and therefore health care expenditure. Data on medical and surgical admissions found 26 percent of those aged 65 to 74 years, and 53 percent of those aged over 85 years had been hospitalised in 2000/2001 (Ministry of Health, 2002a). Also, 89 percent of hospitalisations in rehabilitation wards in 2000/2001 were for people aged over 65 years; rates for those over 85 were twice as high as those aged 75 to 84 years, and seven times the rate among those aged 65 to 74 years (Ministry of Health, 2002a). Furthermore, in 2005 at North Shore and Waitakere Hospitals, adults aged 65 and over made up 51 percent of all medical acute inpatients and 32 percent of all surgical inpatients (Waitemata District Health Board, 2006). Finally, in the 2006/2007 New Zealand Health Survey, 18 percent of all adults had used a hospital service in the previous 12 months, which increased to 32 percent in adults aged over 65 years (Ministry of Health, 2008). Older adults are therefore making up a percentage of admissions far greater than their share of the population. This is only likely to increase with the ageing population.

The cost of hospital admissions also increases exponentially with age; 40 percent of all expenditure was used on those aged over 65 years in 2000/2001 (Ministry of Health, 2002a). The longer length of hospital stay among older adults contributes to this, with older adult inpatients staying on average 2.3 days longer than patients under 65 years (Waitemata District Health Board, 2006). Additionally, the rehabilitation wards were the second highest category of disability support service expenditure in 1998/1999, at 20 percent of total expenditure (Ministry of Health, 2002a). Circulatory system and musculoskeletal conditions are the most common cause of hospitalisation in older adults (Ministry of Health, 2002a). The high frequency and cost of

hospitalisation in older adults highlights the importance of assisting this population to remain healthy and living independently in their communities.

2.3 Nutrition in Ageing

The process of ageing involves physiological, psychological and social changes. These alter metabolism, absorption, storage, and utilisation of nutrients; nutrient requirements; and the ability to choose, prepare and consume a variety of foods (American Dietetic Association, 2005; Ministry of Health, 2003). Ageing therefore inevitably affects the nutritional health of older adults. Good nutrition promotes health in older adults by providing the nutrients required to maintain body functions, and prevent deficiencies and their side effects. Maintaining good nutrition is vital for healthy ageing, and for reducing morbidity and early mortality. Older adults with a poorer nutrition status may experience decreased quality-of-life, reduced mobility, self-care deficit, reduction in usual activities, pain and discomfort, and anxiety and depression (Keller, Østbye, & Goy, 2004; Kvamme, Olsen, Florholmen, & Jacobsen, 2011). The increasing older adult population along with the many nutrition risk factors associated with ageing, highlight the importance of a nutrient-dense diet in advancing age.

2.3.1 Nutrition Requirements in Ageing

The Nutrient Reference Values for Australia and New Zealand include recommendations for adults aged 51 to 70 years, and adults aged over 70 years (National Health and Medical Research Council, 2006). These recommendations show increased requirements for older adults for a variety of nutrients including; protein, calcium, vitamin D, and vitamin B6. Additionally, older adults have reduced energy requirements. Overall, these nutrient requirements are not well defined. The NZANS08/09 (University of Otago and Ministry of Health, 2011) is used to determine whether the nutritional intake of all adults including older adults is adequate to meet nutritional requirements.

2.3.2 Energy

Energy requirements for older adults vary depending on gender, body size and composition, and physical activity. However, there is an overall decline with age. The reduction in basal metabolic rate due to reduced muscle mass and

increase in less metabolically active fat mass, is the main explanation for this (Ministry of Health, 2013b). Basal metabolic rate has been estimated to decline one to two percent per decade, with a more rapid decline at around age 40 to 50 years (Roberts & Dallal, 2005). Additionally, physical activity which contributes to energy requirements tends to decrease with age. Despite the reduction in energy requirements, many older adults struggle to have an adequate intake due to changes associated with ageing; for example decreased appetite, inability to procure and prepare food, dysphagia, chewing difficulties, or financial constraints. This decreased intake, and subsequent energy deficiency with age is widely documented (Elmstahl, Persson, Andren, & Blabolil, 1997; Hallfrisch, Muller, Drinkwater, Tobin, & Andres, 1990; Locher, 2005; Meydani, 2001; Mowe, Bohmer, & Kindt, 1994; Smithers, 1998; Wurtman, Lieberman, Tsay, Nader, & Chew, 1988). The NZANS08/09 revealed average energy intakes for men and women aged 65 to 74 years were 8412kJ and 6408kJ per day, respectively. As expected, lower intakes were found in men and women aged over 75 years at 7477 and 5569kJ per day, respectively (University of Otago and Ministry of Health, 2011). The decreased energy intake with ageing (**Figure 4**) requires the diet of older adults to be nutrient-dense in order to support adequate provision of essential nutrients.

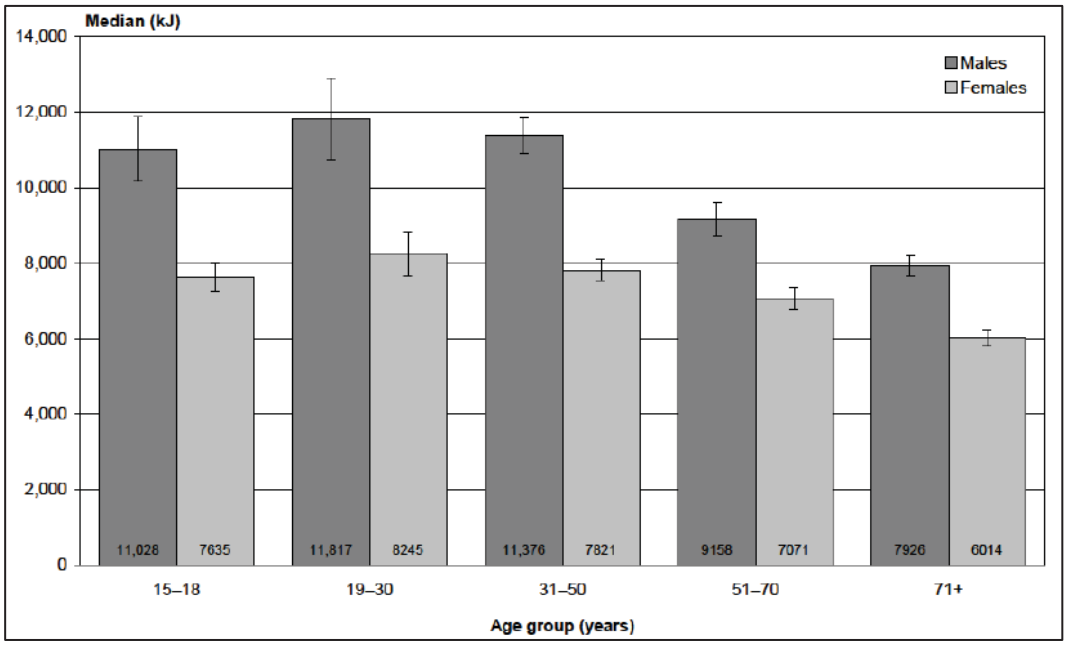

Figure 4**:** *Median Energy Intake (kJ) by Age and Gender Groups* (University of Otago and Ministry of Health, 2011).

However, it is not uncommon for older adults to have a diet high in carbohydrate snacks, narrowing their dietary diversity. This can be due to a combination of factors including medical, social, environmental, functional, and economic factors. Restricted diets may be associated with poor nutrition status through the inability to meet nutrition requirements. Whereas increased dietary variety may assist in promoting optimal nutrition; dietary variety has been associated with increased energy intake and preservation of BMI in older adults (Bernstein et al., 2002). A wide dietary diversity was also been associated with reduced risk of mortality in the first National Health and Nutrition Examination Survey (NHANES) (Kant, Schatzkin, Harris, Ziegler, & Block, 1993). By eating from the four main food groups (as per the New Zealand Food and Nutrition Guideline Statement two for older adults) (Ministry of Health, 2013b), and consuming three meals and two to three snacks per day, older adults should be able to meet their energy and nutrient requirements, and avoid poor nutrition.

2.3.3 Food Groups

Vegetables and fruit are an important source of a wide range of vitamins and minerals, as well as high in fibre and low in energy. In the NZHS12/13, 73 percent of adults aged over 65 years met the guideline for consuming three or more servings of vegetables per day (Ministry of Health, 2013e). Additionally, in this survey, the guideline of consuming two or more servings of fruit per day was met by 66 percent of those aged 65 to 74 years, and 70 percent of those aged over 75 years.

In New Zealand, breads and cereals provide energy, carbohydrates, fibre, protein, vitamin B6, magnesium, calcium, iron, zinc, selenium, and folate (Ministry of Health, 2003). Only 15 percent of men and eight percent of women over age 75 years met the guideline of consuming six or more servings of breads and cereals per day in the 1997 National Nutrition Survey (Ministry of Health, 1999a). Older adults were the least likely to meet this guideline.

The milk and milk products guideline for older adults is to include these in their diet but preferably reduced or low-fat options. The NZANS08/09 showed those over 71 years were the most likely age group to select low-fat milk. The NZANS08/09 also showed that milk, cheese and dairy products supply almost

half of the populations calcium intake (University of Otago and Ministry of Health, 2011). Dairy products also supply protein, fat, riboflavin, vitamin B12, vitamin A, phosphorus, zinc and iodine (Ministry of Health, 2003).

Animal products, including red and white meat, fish and seafood, and dairy products provide just over half of the daily protein intake of adults aged over 75 years (University of Otago and Ministry of Health, 2011). Meat and meat alternatives (including chicken, seafood, eggs, nuts, seeds and legumes) are also important sources of B vitamins, iron, magnesium, copper, potassium, selenium, phosphorus and zinc (Ministry of Health, 2003). The NZANS08/09 reported 44 percent of men and 42 percent of women over 71 years were consuming red meat three to four times per week (University of Otago and Ministry of Health, 2011). Furthermore, consuming chicken three to four times per week was 11 percent for men and 12 percent for women over age 71 years.

2.3.4 Macronutrients

Energy is supplied through protein, fat, carbohydrate and alcohol intake. The Acceptable Macronutrient Distribution Range (AMDR) is the estimated range of energy intake from these three macronutrients to lower chronic disease risk (National Health and Medical Research Council, 2006). These ranges were set to allow for an adequate intake of all the other nutrients, whilst maximising general health outcome.

2.3.4.1 Protein

Protein intake, including amount, type and timing is vital for preserving muscle mass and strength, and consequently, the functionality and independence of older adults. Dietary protein may also be a modifiable risk factor for sarcopenia; older adults with higher protein intakes, have been found to have less lean muscle loss over time (Houston et al., 2008). Inadequate protein intake in older adults is also associated with skin frailty, decreased immune function, and poor healing. The estimated average requirement (EAR) for protein is 52g for men aged 51 to 70 years, and 37g for women (National Health and Medical Research Council, 2006). The Estimated Average Requirement (EAR) was increased by 25 percent for adults aged over 70 years based on evidence suggesting an increased requirement, although data supporting this increase is

limited. Protein degradation may occur more rapidly than synthesis during trauma, sepsis, inflammation, or immobilisation, and therefore older adults suffering ill health or injury may require higher protein intakes (McCormack, 1997).

The NZANS08/09 found that men and women aged over 71 years consumed less protein than younger adults, with a median intake of 78g among men and 60g among women (University of Otago and Ministry of Health, 2011). The mean percentage energy from protein was similar across age groups, however at the lower end of the AMDR: 16.4 percent of energy for men and 16.5 percent for women. Therefore, with low energy intakes, and protein contributing the lowest recommended percentage to energy, inadequate protein intake may be common among older adults. The estimated prevalence of inadequate protein intake in the NZANS08/09 was 13.4 percent for men and 15.5 percent for women aged over 71 years (University of Otago and Ministry of Health, 2011). However this must be interpreted with caution due to the high level of imprecision relative to the estimate from the nutrition survey and also due to the limited evidence for the increase in requirements for older adults. Furthermore, a study of older adults (n=473) in New Zealand found that only 36 percent of older adults understood that they required more protein-rich foods than younger adults, which may be further exacerbating the problem (McElnay, Marshall, O'Sullivan, & Jones, 2012). A 10 year longitudinal study of 304 adults with a median age of 72 years in New Mexico, found those who consumed more protein than the recommended amount experienced fewer health problems (Vellas et al., 1997). Furthermore, protein intakes greater than the recommended amounts in older adults have shown to increase muscle mass, strength and function, as well as immune status, wound healing and blood pressure (Ahmed & Haboubi, 2010). Protein intake is therefore very important for health and functionality of older adults, and many older adults could benefit from increasing consumption of meat, poultry, pulses and dairy products.

2.3.4.2 Fat

Fat aids in the absorption of fat soluble vitamins, is the precursor to many hormones, and is an important structural component of cell membranes. Fat

also carries foods flavour, assists with satiety and enhances palatability (Ministry of Health, 2013b). The NZANS08/09 showed the mean percentage energy contribution from total fat was 31.8 to 34.1 percent for all adults aged over 51 years. This falls within the AMDR, of 20 to 35 percent of energy from total fat (National Health and Medical Research Council, 2006). There was little variation across age groups; however fat intakes were lower in older adults compared to those aged 15 to 64 years. Epidemiological studies have found higher intakes of omega-3 fatty acids are associated with protection against cardiovascular events, diabetes and cognitive decline (Institute of Medicine, 2010).

2.3.4.3 Carbohydrate

Carbohydrate foods are an important energy source for older adults. The mean contribution of carbohydrates in the NZANS08/09 to daily energy intake was 45.5 to 48.8 percent for adults over 51 years, which lies within the AMDR of 45 to 65 percent (National Health and Medical Research Council, 2006; University of Otago and Ministry of Health, 2011). Those aged 71 years and above had higher percentage energy from carbohydrates compared to adults aged 31 to 71 years. An important aspect of carbohydrate intake for older adults is fibre; for bowel function, and reduced risk of cardiovascular disease and diabetes mellitus by improving blood lipids and blood glucose and reducing inflammation (American Dietetic Association, 2008). The median intake of fibre in the NZANS08/09 for adults over 51 years was 17.1 to 22.1g per day, compared to the recommended adequate intake levels of 30g per day for men, and 25g per day for women (National Health and Medical Research Council, 2006; University of Otago and Ministry of Health, 2011). Furthermore, a dietary survey of a population of older adults (n=712) in Mosgiel, New Zealand found that only around 14 percent had fibre intakes of 30g per day (Horwath, Campbell, & Busby, 1992). Therefore, older adults appear to have greater intakes of carbohydrates than younger adults, however their choice of carbohydrate does not appear to be fibre-rich. Rather, is more likely to be higher in refined sugar.

2.3.5 Micronutrients

If energy intake does not meet a particular threshold, micronutrient intakes can become inadequate. Added to this is the increased incidence of illness and

disease with ageing that interferes with intake, absorption, metabolism and utilisation of micronutrients. Some evidence also suggests that requirements for some micronutrients are higher in older adults due to a reduced metabolic efficiency and bioavailability (Drewnowski & Evans, 2001). Therefore it can be particularly hard for some older adults to meet micronutrient requirements. However, a dietary survey of an older adult New Zealand population (n=712) showed most mean intakes of micronutrients were above the recommended levels (Horwath et al., 1992). The exceptions were zinc, copper, calcium and magnesium. The micronutrients that are especially important to older adults that will be discussed below are iron, zinc, selenium, calcium, vitamin D, B vitamins, and vitamin C.

2.3.5.1 Iron

Iron is important for oxygen transport, muscle function, and a variety of enzymes necessary for oxidative metabolism and other cell functions. For all adults aged over 51 years the EAR is 5mg per day (National Health and Medical Research Council, 2006). However, older adults may have health issues that reduce iron absorption such as atrophic gastritis or post gastrectomy syndromes; or have blood loss associated with hiatus hernias, peptic ulcers, haemorrhoids or non-steroidal anti-inflammatory drugs (Gariballa & Sinclair, 1998). These factors may increase iron requirements. In the NZANS08/09, men and women aged over 71 years were consuming a median intake of 11.4 and 8.9mg of iron per day, respectively (University of Otago and Ministry of Health, 2011). Therefore, although these adults consumed less iron than younger adults, recommended iron intakes were still largely being met.

2.3.5.2 Zinc

Among older adults, zinc is needed for immune function, age-related changes in bone mass, cognitive function, deoxyribonucleic acid (DNA) repair, healing of damaged tissues, and oxidative stress. Zinc deficiency is common in older adults due to long term marginal intakes, coupled with a decreased absorptive efficiency (Gariballa, 2004; Meunier et al., 2005). For men aged over 51 years the EAR for zinc is 12mg per day, and for women over 51 years is 6.5mg per day (National Health and Medical Research Council, 2006). The NZANS08/09 showed adults aged over 71 years had lower intakes than younger adults,

which were also below the EAR; median intakes for men aged over 71 years were 9.7mg and intakes for women were 7.6mg per day (University of Otago and Ministry of Health, 2011). Inadequate zinc intakes can lead to a loss of appetite which is concerning for older adults who are already struggling to meet energy requirements. Increasing consumption of lean meats, seafood and oysters could increase zinc status in older adults, preventing deficiencies and associated complications.

2.3.5.3 Selenium

Inadequate selenium intakes were found in 63.8 percent of men and 78.5 percent of women aged over 71 years in the NZANS08/09. These levels should however be interpreted with caution due to the high level of imprecision in the intake estimates from the survey, and also the limited evidence for recommended intake levels. Median intake of selenium was 52.0µg per day among men over 71 years, compared to the EAR of 60µg per day. The median intake for women over 71 years was also below the EAR of 50µg per day, at 39.5µg. Low soil levels in New Zealand lead to lower intakes than many other countries. Furthermore, in New Zealand the main dietary sources of selenium are seafood, poultry and eggs, and intake of these foods tends to decline with age (University of Otago and Ministry of Health, 2011). In older adults selenium plays a role in antioxidant selenoproteins, thyroid metabolism, and immune function. Low selenium status has also been linked to heart disease and cancer (Tinggi, 2008). Selenium intake can be increased by eating foods from geographic regions that have higher selenium levels, such as bread from Australia (University of Otago and Ministry of Health, 2011).

2.3.5.4 Calcium

Adequate calcium intake in older adults is important for bone health and reducing the risk of osteoporosis and fractures; when calcium intake falls below losses, it is mobilised from the skeleton (McCormack, 1997). Calcium is also needed for proper neuromuscular and cardiac functioning (Ministry of Health, 2013b). In the NZANS08/09, median calcium intakes for older adults were lower than younger adults, at 743mg per day for men and 676mg for women aged over 71 years. This level of intake falls below the EAR of 840 to 1100mg per day for adults aged over 71 years (University of Otago and Ministry of Health,

2011). The prevalence of inadequate intake was estimated to be 86.0 percent for men over 71 years and 92.8 percent for women. However this level of inadequate intake should be interpreted with caution due to the lack of evidence for the high increase in the EAR for older adults. Studies in Britain (Smithers, 1998) and the United States (Meydani, 2001) also show that on average older adults do not have sufficient calcium intakes. The British study (n=1687) (Smithers, 1998), showed that 89 percent of adults aged over 71 years had inadequate intakes. Added to insufficient intakes, is the decline in calcium absorptive capacity that appears to occur with age (Blumberg, 1997). Absorption may be reduced in the presence of atrophic gastritis, resulting in reduced secretions of gastric acid, intrinsic factor and pepsin from the stomach (Ministry of Health, 2013b). Daily calcium intake among older adults can be increased by increasing consumption of dairy products, dark green vegetables, bony fish, legumes and certain nuts.

2.3.5.5 Vitamin D

The major function of vitamin D is to maintain calcium concentrations within the body. Vitamin D is also thought to play a role in maintaining the immune system, healthy skin and muscle strength. It is almost impossible to meet requirements from food alone, with vitamin D status generally maintained by sun exposure (National Health and Medical Research Council, 2006). Age-related renal impairment may reduce the effectiveness of converting vitamin D into its active form. Additionally, sunlight deprivation, low intake of meat and dairy products and malabsorption may contribute to inadequate vitamin D status; this is seen in up to 50 percent of older adults (Ahmed & Haboubi, 2010; Gariballa, 2004). Poor vitamin D status reduces the efficiency of calcium absorption and leads to osteomalacia, which is common in older adults and significantly increases the risk of fractures (McCormack, 1997). The adequate intake level was raised to 10µg per day for adults aged 51 to 70 years to account for the reduced capacity of the skin to produce vitamin D, and further raised to 15µg per day for over 70 years due to limited sun exposure (National Health and Medical Research Council, 2006). The NZANS08/09 estimated vitamin D deficiency in 5.2 percent of adults aged 65 to 74, and 6.6 percent aged over 75 years (Ministry of Health, 2013b). Encouraging older adults to increase sunlight exposure, as well as

vitamin D and calcium supplements may be required to prevent osteomalacia and associated fractures in some older adults.

2.3.5.6 B Vitamins

Inadequate intake of vitamin B6, B12 or folate can lead to hyperhomocysteinaemia, which has an independent positive association with vascular disease and is a strong predictor of mortality in older adults (Vollset et al., 2001). Data from the Normative Ageing Study in the United States shows a significant association between cognitive decline and low intakes of B vitamins (Tucker, Qiao, Scott, Rosenberg, & Spiro, 2005). Vitamin B6 deficiencies are also associated with depression, and low vitamin B12 status is linked to nerve-related effects, balance disturbances, cognitive decline, and greater bone density loss (Institute of Medicine, 2010). Additionally, vitamin B12 is involved with DNA synthesis and regulation, and normal blood and neurological function, however it is poorly absorbed in older adults due to the reduced stomach acidity (National Health and Medical Research Council, 2006). Adequate intake of vitamin B6 and B12 is therefore vital in older adults to avoid a range of complications. In the NZANS08/09 men and women aged over 71 years had median vitamin B6 intakes of 1.6mg and 1.3mg per day respectively, which was lower than the total population intake of 1.9mg per day. The median intake for men was just above the EAR of 1.4mg per day, and the median intake for women was the same as the EAR of 1.3mg per day. The estimated level of inadequate intake was 28.8 percent for men and 53.0 percent for women aged over 71 years, however this must be interpreted with caution due to the high level of inaccuracy in estimating intake levels from the survey, and also the limited evidence to support the recommended intake levels. The NZANS08/09 showed the median intake of vitamin B12 was 4.2µg per day for men and 2.7µg per day for women aged over 71 years. These levels were above the EAR of 2.0µg per day for this age group (National Health and Medical Research Council, 2006; University of Otago and Ministry of Health, 2011).

2.3.5.7 Vitamin C

Vitamin C assists in the formation of connective tissue, and low dietary intakes can lead to haemorrhage, spontaneous bruising, failure of wounds to heal, infection and swelling of the gums. Vitamin C is an important soluble anti-

oxidant which protects against disorders of immune response, vascular conditions and cancer (McCormack, 1997). Vitamin C also aids the absorption of iron. Intake from the NZANS08/09 showed little variability across age groups with a median daily intake of 99mg for the total population (University of Otago and Ministry of Health, 2011). This is well above the EAR of 30mg per day (National Health and Medical Research Council, 2006). Vitamin C intake is important for older adults, however inadequate intakes are not of huge concern for older adults (inadequate intake estimated to be 2.2% for men and 4.1% for women aged over 71 years), likely due to consuming more fruit and vegetables than any other age group.

2.4 Malnutrition

Malnutrition can be defined as a state of being poorly nourished due to an excess (overnutrition), or a lack (undernutrition) of energy, protein and other nutrients. This may result in adverse effects on body composition, function and clinical outcome (British Association for Parenteral and Enteral Nutrition, 2012; NICE, 2006).

2.4.1 Overnutrition

Overnutrition, or obesity, is a condition where energy intake exceeds energy expenditure over time. The consequences in an increasing BMI; people exceeding 30kg/m^2 are considered obese (Ministry of Health, 2013b). The NZANS08/09 found older adults consume less energy than younger adults (University of Otago and Ministry of Health, 2011). However, this is accompanied by a lower resting metabolic rate, and increased sedentary behaviour due to muscle loss, chronic disease or declining functionality. Nevertheless, obesity in older adults is affected by many complex and diverse factors other than dietary intake, including physical activity, alterations in body composition and metabolism, and changes in physical, socioeconomic, and cultural environments (World Health Organisation, 2000).

A third (31 percent) of all adults were obese in the NZHS12/13 and the percentage increased with age until peaking at 65 to 74 years (39 percent) (Ministry of Health, 2013e). The percentage of adults who are obese may

decrease after age 74 years due to premature mortality of obese younger adults (Heiat, Vaccarino, & Krumholz, 2001; McTigue, Hess, & Ziouras, 2006; Villareal, Apovian, Kushner, & Klein, 2005). Obesity in older adults is associated with hypertension and cardiovascular disease, certain cancers, diabetes mellitus, gall bladder disease, osteoarthritis and gout, pulmonary diseases, sleep apnoea, surgery complications, and social problems (World Health Organisation, 2000). There is also evidence that older adults who are obese are more likely to become disabled; higher BMI has been associated with poorer physical function (Apovian et al., 2002; Davison, Ford, Cogswell, & Dietz, 2002; Jenkins, 2004). However, potential beneficial effects of obesity in older adults include increased bone mineral density, lower risk of osteoporosis and subsequent hip fractures (Villareal et al., 2005).

Obesity (high BMI) accounted for 7.9 percent of health loss in New Zealand in 2006, and is expected to overtake tobacco to become the leading cause of health loss by 2016 (Ministry of Health, 2013c). This is particularly significant for Maori people, who were 1.8 times more likely to be obese than non-Maori (Ministry of Health, 2013e). With an increasing prevalence of obesity, the ageing population are likely to experience a greater burden from associated complications. When obesity is caused by continued consumption of high energy and nutrient-poor foods, nutrient requirements may not be met and malnutrition can occur.

2.4.2 Undernutrition

Undernutrition, or malnutrition, is one of the most significant conditions that adversely affects the health of older adults. It is common among older adults and despite its well-known consequences, often remains undiagnosed (Kaiser, 2010). Malnutrition causes impairment at cellular, physical and psychological levels. It is therefore associated with impaired immune function and wound healing, reduced muscle mass and physical function, cognitive impairment, increased fatigue, frequent falls and longer length of hospital stay, and higher treatment costs (Barker et al., 2011; Phillips et al., 2010; Skates & Anthony, 2012; Stratton et al., 2004). These factors can lead to a downward spiral of poor health, causing decreased independence and quality-of-life, and early

mortality. Malnutrition is preceded by a state of nutrition risk, which has also been associated with functional decline, loss of independence, reduced quality-of-life, increased health care costs and hospitalisation (Johansson, 2009; Keller et al., 2004; Kvamme et al., 2011; Skates & Anthony, 2012; Visvanathan, Newbury, & Chapman, 2004; Watson, 2010; Yang et al., 2011).

Ageing increases the risk of poor nutrition because it is associated with many changes that can negatively impact nutrition status. These include physiological changes such as loss of muscle, limited activity and sensory impairment, and socioeconomic changes such as financial or living situation (Skates & Anthony, 2012). These changes, added to the effects of illness and disease, increase the risk of poor nutrition status in older adults. However, malnutrition is not an inevitable part of ageing.

Nutrition risk can arise from three main mechanisms: 1) inadequate dietary intake due to poor appetite, loss of taste and smell, poor dentition, dysphagia, needing assistance with meals, social isolation, lack of access to food, cognitive impairment, or depression; 2) increased requirements associated with infection, post-surgery, wound healing, pressure injuries, hospitalisation, or trauma; and 3) complications of illness such as poor nutrient absorption or excessive nutrient losses, and polypharmacy (Amarantos, Martinez, & Dwyer, 2001; Barker et al., 2011).

2.4.2.1 Nutrition Risk in Hospitalised Older Adults

Malnutrition has been described as the “skeleton in the hospital closet” (p.519) (Barker et al., 2011) because it is often unrecognised and therefore remains untreated. Poor nutrition status in hospitalised older adults is associated with increased complications during admission, and poorer health and quality-of-life post discharge.

Nutrition status is likely to deteriorate while in hospital (Gariballa et al., 1998; Klipstein-Grobusch et al., 1995; Larsson et al., 1990) due to a number of associated factors including catabolism associated with acute illness (Gariballa, 2003); low intake of unappetising or unfamiliar foods, lack of flexibility in hospital catering, interruption or withholding of meals for procedures (Gary &

Fleury, 2002; Pennington, 1998); or low appetite due to unpleasant sights and smells (Hickson, 2006). Johansson (2009) found that more hospital stays in the two months prior to the study increased the likelihood of malnutrition.

Malnutrition and its complications are exacerbated by weight loss which is common while in hospital. A Danish cross-sectional study by Rasmussen et al. (2004) found that of the 590 participants, 26 percent lost weight during their hospital stay. Another study found that 75 percent of the 55 patients who were undernourished lost weight during their hospital stay, compared to only 39 percent of those who were normally nourished (McWhirter & Pennington, 1994). Therefore those who already have poor nutrition status may lose the most weight. However, a United States study of 837 patients in sub-acute care found that even patients who had no current nutrition deficits or predicted risk of developing deficits, had significant decreases in markers of malnutrition after three weeks of hospitalisation (Thomas et al., 2002). Weight loss and poor nutrition in hospitalised older adults can lead to complications during admission.

Poor nutrition status significantly impacts the speed and efficacy of recovery and rehabilitation in hospital (Moseley, 2001). Malnourished hospitalised older adults usually have longer stays, and develop more complications such as pneumonia, pressure ulcers, poor wound healing, impaired muscle and respiratory function (Edington et al., 2000; Hill, 1992; Pirlich et al., 2006; Sullivan & Walls, 1995; Thomas et al., 2002). Naber (1997) also found that those who were malnourished were more likely to require more medications and have decreased functional capacity when compared to well-nourished patients. Nutrition status during admission therefore significantly affects clinical outcome. Furthermore, a study of 819 hospital patients in Australia found that the incidence of mortality during admission was significantly higher in those who were malnourished (2.7% vs. 1.0%, p=0.04) (Middleton et al., 2001). Poor nutrition status during admission has many adverse consequences which may continue after discharge.

Malnourished patients have a higher rate of discharge into residential care than those who have normal nutrition status (American Dietetic Association, 2005; Davalos et al., 1996; Neumann, 2005). After hospitalisation, older adults remain

nutritionally vulnerable due to reduced reserves and repeated episodes of ill health. A study of 417 older adults in Norway showed that poor nutrition status in the community was more common in those who were recently hospitalised compared to those who were not (31.3% vs 6.6%, $p<0.001$) (Mowe et al., 1994). Poorer function and quality-of-life has been found 90 days post discharge (Neumann, 2005), and the incidence of mortality after 12 months is significantly higher in those who are malnourished compared to well-nourished (Middleton et al., 2001; Sullivan, Walls, & Bopp, 1995). Poor nutrition status is therefore associated with complications during hospital admission, and poorer health and quality-of-life post discharge. There are many factors associated with ageing that lead to this poor nutrition status.

2.4.3 Nutrition Risk Factors

Poor nutrition status clearly affects the health and well-being of older adults, however preventing malnutrition during ageing is immensely challenging. Therefore with a growing older adult population, it is important to understand the factors influencing poor nutrition status in order to form preventative strategies.

Nutrition risk factors associated with ageing include sociodemographic factors: living situation, income and education; health factors: weight and body composition changes, dentition, polypharmacy, dysphagia, and cognition; and support service factors.

2.4.4 Sociodemographic Factors

2.4.4.1 Living Arrangements

Social factors play an important role in promoting optimal nutrition status. Food contributes to enhanced quality-of-life and well-being, and meals may give a sense of security, meaning, independence and structure to an older person's day (Amarantos et al., 2001). Eating is a social activity and the opportunity to share meal preparation and dining increases food intake; older adults have been found to consume 23 percent more food when dining with others (American Dietetic Association, 2005). Four other factors that may increase food consumption in the presence of others include meal times being extended

when others are around, the guest eating more and this being subconsciously mimicked, an expression of gratitude for a meal if the deliverer eats with them, or by being provided encouragement to eat (Locher, 2005). Those who live alone may therefore be more likely to have inadequate dietary intakes, and consequently a compromised nutrition status. A study of 250 older adults in Australia found that people who lived alone were 1.5 times more likely to be 'not well nourished,' than those who lived with others (Visvanathan et al., 2003). Another study among 201 hospitalised older adults in the United Kingdom found that on admission to hospital, patients who lived alone had poorer nutrition status than those who lived with others (Gariballa et al., 1998).

The 1996 New Zealand Census found around 30 percent of adults aged 65 to 75 years lived alone, with the proportion twice as high for adults aged over 85 years (Statistics New Zealand, 2000). Therefore the association between living alone and poor nutrition is likely to significantly affect older adults in New Zealand. Gender differences were seen among the living arrangements of older New Zealand adults in 2001; of adults aged 65 to 74 years, 80 percent of men and 59 percent of women were living with partners. By their late 80's around half of men and almost 90 percent of women were not partnered, largely attributable to women experiencing greater life expectancy than their male counterparts (Statistics New Zealand, 2004). This was similar to a British study (n=369) where the odds of women living alone was twice that of men (Donkin et al., 1998). The rates of poor nutrition status may therefore be higher among women.

A prevalence study of 152 community-living older adults in Christchurch, New Zealand found that 72 percent in the 'at high nutrition risk' group ate alone, compared to only 33 percent of those in the 'not at nutrition risk' group (Watson, 2010). Similarly, in another New Zealand study (n=112), 60 percent of adults who were at significant nutrition risk lived alone, compared to 29 percent of adults with normal nutrition status (Wham, 2011). This was supported by a third New Zealand study (n=473) that found older people who lived alone were 3.5 times more likely to be at nutrition risk, than those who lived with others (McElnay et al., 2012). Living alone is therefore a significant risk factor for poor nutrition status among older adults in New Zealand.

Eating alone may lead to poor nutrition status due to lower food intake, as older adults who eat in the presence of others have been found to have significantly larger meal sizes (de Castro & de Castro, 1989). Not only has living alone been associated with lower food intake, but also poorer dietary variety. Bernstein et al. (2002) suggested that a diet of little variety is associated with worse nutrition status, and that increased food intake with meal sharing is positively correlated with nutrition quality. Living alone may negatively affect nutrition status of older adults through decreased enjoyment and motivation, forgetting to eat, inability to buy or prepare food. (Johansson, 2009; McCormack, 1997; Teo, 2001; Walker, 1991). Living alone may also lead to feelings of loneliness and depression which can decrease willingness or desire to eat. This was found in a study in the United States (n=837) where the Geriatric Depression Scale score was significantly higher in malnourished participants compared to those at risk of malnutrition (Thomas et al., 2002; Visvanathan et al., 2003).

Living arrangements are generally influenced by partnership status, and being married has been associated with better health (House, 1988). Older adults who are married may have a better nutrition status as they are less likely to skip meals and may be better able to afford food (Locher et al., 2005). Conversely, older adults who are widowed have been found to be at increased risk of weight loss, likely due to decreased appetite and enjoyment of food (Shahar, 2001). Men who are widowed may be less confident with shopping or cooking for themselves, if they have rarely completed these tasks previously. A study of 2195 older adults in Australia showed that men living alone, when compared to married men, were less like to eat fruit and vegetables and more likely to have a restricted diet, made up of high fat and high salt convenience foods (Horwath, 1989). Although women are more likely than men to consume fruit and vegetables, the issue for women who lose their spouse may be higher levels of food insecurity and difficulty accessing food (Baker & Wardle, 2003; Locher et al., 2005). A lack of social support, living alone or being divorced or widowed are therefore important risk factors for poor nutrition status in older adults.

2.4.4.2 Education and Income

Numerous studies have identified an association between higher

socioeconomic status and better health and diet quality (Elia & Stratton, 2005; Lantz et al., 1998; McKay, Houser, Blumberg, & Goldberg, 2006; Muennig, Sohler, & Mahato, 2007; Shahar, 2005). A lower level of education has been associated with poorer health and nutrition status (National Health Committee, 1998). This may be through its relationship with subsequent occupation and income, or that adults who are better educated are better informed about the nutritional quality of their diet and how this effects their health (Callen & Wells, 2003). Furthermore, nutrient intake and thus, nutrition status, is affected by food skills. A lack of education around practical cooking skills may also limit food choices and the ability to improve dietary behaviours. Older adults with better cooking skills are not only able to prepare meals, but may also have a greater knowledge about ready-prepared meal options (Caraher, Dixon, Lang, & Carr-Hill, 1999). Furthermore, it has been suggested that more highly educated people may have greater access to health resources within the community that may assist in improving nutrition status (Locher et al., 2005).

Income is the most important modifiable determinant of health; a lower income may be associated with poorer nutrition status. The NZANS08/09 revealed that over 92 percent of people aged over 71 years could always afford to eat properly (University of Otago and Ministry of Health, 2011). This suggests good food security among older adults in New Zealand. However, those with a lower socioeconomic status may be more vulnerable if they are unable to afford transport to purchase food, unable to purchase enough or nutrient-dense food, or forced to choose foods they would rather not eat because they are cheaper (Locher et al., 2005). Older adults with less income may therefore have smaller meals or skip meals, and consequently have significantly lower energy and micronutrient intakes (Guthrie & Lin, 2002; Smithers, 1998). This was found in data from the NHANES 1999 to 2002 which analysed the association between income, food choice and nutrition status; intakes of macronutrients and many micronutrients increased from low- to medium- to high-income groups (Bowman., 2007). Additionally, those in the low-income group generally consumed less fruit, vegetables, milk, meat, poultry and fish than the high-income group. Therefore older adults with a higher socioeconomic status may consume a greater variety of highly nutritious foods, making socioeconomic

status an important indicator of nutrition status.

2.4.5 Health Factors

2.4.5.1 Weight Change with Ageing

Body weight generally increases during adult life until age 50 to 59 years after which it declines, with weight loss common in older adults (Kuczmarski., 1994). A 25 year longitudinal study of 973 adults from age 70 to 95 years found significant decreases in mean body weight (Dey, Rothenberg, Sundh, Bosaeus, & Steen, 1999). This is of concern for frail older adults where even a small weight loss of three percent can increase the risk of mortality and disability (Payette, Coulombe, Boutier, & Gray-Donald, 1999; Tully & Snowdon, 1995). This pattern of weight loss is reflected in the prevalence of underweight women in New Zealand which was found to increase in the NZANS08/09 from 0.8 percent in the 51 to 70 year old group, to 2.6 percent in women over 71 years old (University of Otago and Ministry of Health, 2011).

Weight loss leads to a declining BMI, which in older adults has been associated with poorer physical function and mobility, disability, increased risk of hip fracture, compromised immune system, increased risk of health complications and mortality (Bannerman et al., 2002; Janssen, Heymsfield, & Ross, 2002; Langlois et al., 1998; Seidell & Visscher, 2000). Gazewood and Mehr (1998) reported a 10 percent loss of body weight over 10 years is consistently associated with increased mortality and functional decline. This was supported by the Survey in Europe on Nutrition and the Elderly: a Concerted Action (SENECA) study (n=2600); during the first five years of the study, the absence of weight loss was predictive of survival (de Groot, Verheijden, de Henauw, Schroll, & van Staveren, 2004). Weight loss is a significant issue for older adults and thus, it is important to understand causes of weight loss.

Three main reasons have been proposed to account for unintentional weight loss among older adults: 1) cachexia initiated by an immune response causing catabolism, increased metabolic rate and protein degeneration; 2) sarcopenia; and 3) wasting caused by inadequate oral intake (Ahmed & Haboubi, 2010; Roubenoff, 2000). The most common cause of weight loss in older adults is

reduced food intake, which may be due to physiological causes including loss of appetite, taste and smell alterations, poor oral health, gastrointestinal changes, dementia, and reduced ability to regulate appetite; or non-physiological causes, such as psychosocial factors, and financial constraints (Bales & Ritchie, 2002). Not only does reduced food intake lead to negative energy balance and weight loss, but micronutrient deficiencies and malnutrition can occur. Older adults who have experienced unintentional weight loss have been found to have other risk factors for malnutrition. These include swallowing difficulties, decreased appetite, reduced social activity, and lower cognition (Sorbye et al., 2008). A New Zealand study of 152 community living older adults found that 79 percent of participants in the high nutrition risk group had experienced unintentional weight change, compared to only three percent of participants not at nutrition risk (Watson, 2010). Additionally, among 60 hospitalised older adults, those who were well-nourished had significantly higher BMI's than those who were malnourished (27.2 vs. 22.9kg/m^2, p=0.001) (Thorsdottir, 2005). Therefore it is important for older adults to maintain their weight as they age, as weight loss is a strong predictor of poor nutrition status.

2.4.5.2 Body Composition Changes with Ageing

As well as the loss of weight, significant body composition changes occur with ageing. While there is an approximate doubling of body fat mass between age 20 to 60 years, body fat percentage remains stable or decreases after approximately age 75 years (World Health Organisation, 2002b). However, the problem with ageing is the redistribution of fat within the body; accumulation around the trunk increases. The resultant fat centralisation has been associated with hypertension, hyperlipidaemia, stroke, myocardial infarction, diabetes, and possibly some cancers (Kuczmarski, 1989).

Muscle mass is reported to decline at five percent each decade from age 40 years (Greenlund & Nair, 2003), and by one to two percent per year after the age of 50 years (Rolland et al., 2008). This inevitable loss of muscle mass and strength with ageing is defined as sarcopenia. If this reaches a certain threshold, functionality is negatively affected and disability increased (Rolland et al., 2008). Prevalence of sarcopenia among adults aged 60 to 70 years has been reported

at five to 13 percent, with an increase to 11 to 50 percent in those aged over 80 years (Morley, 2008). Data on over 4500 older adults from the third NHANES survey showed that sarcopenia was common (52 percent of men and 69 percent of women had moderate to severe sarcopenia), and significantly and independently associated with functional impairment and disability (Janssen et al., 2002). The exact cause of sarcopenia is unknown; however it has been suggested that sarcopenia is primarily due to ageing itself (hormonal, neural and cytokine activity all may play a part), and secondarily when another cause is evident, such as reduced activity, disease or nutrition-related causes (Cruz-Jentoft et al., 2010; Hickson, 2006). Resistance activity has been shown to slow the effects, however does not prevent sarcopenia (Roubenoff, 2000).

The loss of muscle due to sarcopenia can lead to reduced activity, which further accelerates muscle and function loss (disuse atrophy) (Hickson, 2006). Declining muscle mass has consistently been linked to reduced functional capacity, including walking speed, aerobic capacity and flexibility (Evans, 1995). Gait and balance are also affected by muscle loss, and therefore risk of falls and fractures increases. Sarcopenia also reduces function of other muscles in the body including respiratory (Arora & Rochester, 1982), and cardiac muscles (Heymsfield et al., 1978). Furthermore, reduced immune function can result which increases the risk of infection (Windsor & Hill, 1988). Therefore sarcopenia has many potential negative effects on the health of older adults.

Sarcopenia also causes lower protein stores, which is particularly detrimental for hospitalised older adults with acute illness where gluconeogenesis increases in importance for energy supply. This can initiate or exacerbate malnutrition during hospital admission. The limited dietary intake in hospital further exacerbates this, by reducing protein intake. Protein stores are crucial in determining the availability of metabolic substrate for the body to recover from and survive an illness (Roubenoff, 2000). Inadequate nutrition is therefore an important contributor to sarcopenia. Likewise, the reduced muscle mass and physical activity with sarcopenia may make shopping and cooking too exhausting and therefore reduce food intake, leading to poor nutrition status. Malnutrition and sarcopenia therefore mutually amplify one another. Due to

many patients presenting with both conditions simultaneously, Vandewoude, Alish, Sauer, and Hegazi (2012) proposed the clinical Malnutrition-Sarcopenia Syndrome. Malnutrition and loss of muscle mass are accelerated in hospitalised older adults and increased length of stay worsens these conditions, creating a vicious cycle of disease, increased complications and rehospitalisation (Volkert, 2011).

2.4.5.3 Oral Health and Dentition

Poor dentition can be a major determinant of food choice, and therefore nutrients that are consumed (Phillips., 2003). The loss of teeth or ill-fitting dentures impacts the ability to chew food and may lead to restricting the variety of foods consumed. There may be a preference for soft and bland foods, avoiding fruits, vegetables, nuts and some meats. Chewing difficulties may also reduce the enjoyment of eating and therefore the amount of food eaten. Older people with fewer teeth tend to also have higher fat and lower fibre intakes (Stanner & Denny, 2009). Therefore inadequate dietary intakes or micronutrient deficiencies may result from poor oral health, leading to poor nutrition status. Micronutrient deficiencies may then lead to inadequate remineralisation of teeth or protection against caries, worsening the problem. Dentures that are not cleaned properly may also contribute to poor oral health by causing painful mouth infections, and undernutrition impairs the ability of the immune system to fight oral infections (Stanner & Denny, 2009). Furthermore, those who are edentulous are at nutrition risk due to difficulty masticating food, and have been found to have lower energy, protein and fibre intakes, as well as calcium, iron, and vitamin A, C, E and some B vitamins (Hickson, 2006).

A nutritious diet is important for oral health, and in turn oral health will enhance nutrition status. A study of 110 patients in a United States geriatric rehabilitation unit found that the number of oral problems was a greater predictor of significant unintentional weight loss than income, education, age, smoking status, or adequacy of nutrient intake prior to admission (Sullivan, Martin, Flaxman, & Hagen, 1993). Furthermore, in a study of 259 hospitalised older adults in Israel, chewing difficulties were twice as common in the malnourished group compared to those at risk of malnutrition (Feldblum et al., 2007). Another

study of 563 older adults in the United States found that edentulousness was an independent predictor of 10 percent or more weight loss in the previous year (Ritchie, Joshipura, Silliman, Miller, & Douglas, 2000).

Dental problems in New Zealand older adults are prevalent, and therefore pose a significant risk to nutrition status. A longitudinal study in New Zealand found 76 percent of people aged over 80 years wore dentures, and 24 percent had chewing difficulties (mostly due to ill-fitting dentures or missing teeth). Additionally, painful teeth, gum disease or other pain in the mouth were frequently reported. However, less than one third (28 percent) of older adults had visited a dentist in the previous year (Kerse., 2014). Dentures and dental problems are therefore common amongst older adults, however many people live with ill-fitting dentures and do not visit the dentist regularly. Poor oral health and endentulousness are important contributing factors to weight loss and malnutrition through food aversions and reduced intake.

Xerostomia is also common in older adults due to reduced salivary gland function, less chewing, or medication side effects (such as antihistamines, opiates, hypertension medications, diuretics, and antidepressants) (New Zealand Dental Association, 2010). Xerostomia makes food difficult to chew and tasteless, as food needs to be dissolved in order to stimulate taste receptors (Coutts, 2001). Older adults with a dry mouth may prefer foods higher in oil, fat or sugars as they can be easier to chew and swallow. Xerostomia is therefore another oral health problem that can contribute to nutrition risk.

2.4.5.4 Polypharmacy

Chronic diseases and illness become more prevalent with age, and consequently older adults are prescribed many medications. Polypharmacy can be defined as taking five or more medications (Martin, Hall, & Gardner, 2002; Shum, Hui, Chu, Chai, & Chow, 2005). The mean number of medications from 139,359 patients around New Zealand increased from 16 in those aged 65 to 69, to 23 in those aged 80 to 84 years (Martin et al., 2002). The 1996/1997 New Zealand Health Survey also found a significant increase in prescriptions with age (Ministry of Health, 1999b). The high prescribing rate suggests a high chance of potential medication interactions and side effects, which can

adversely affect nutrition status (McCormack, 1997).

Possible medication side effects which impact on nutrition status include cognition changes, xerostomia, taste reduction, anorexia, depression, dehydration, and electrolyte abnormalities (Ministry of Health, 2013b). Medications may also adversely affect nutrition status through drug-nutrient interactions. For example through reducing appetite and energy intake (corticosteroids, metformin, digoxin, tricyclic antidepressants, anticancer drugs, psychotropic drugs), interfering with vitamin (phenytoin, isoniazid, colchicine, methotrexate, neomycin, cholestyramine) or minerals status (diuretics, laxatives, glucocorticoids, antacids, non-steroidal anti-inflammatory drugs) (Gariballa, 2004; Roe, 1984).

Older adults in an Australian study who were 'not well nourished' took a mean 5.8 medications per day, which was significantly more than those who were 'well nourished' (Visvanathan et al., 2003). A higher number of medications in those who are malnourished, compared to well-nourished has also been found in hospitalised older adults (Edington et al., 2000; Naber, 1997; Pirlich et al., 2006). Polypharmacy is therefore a nutrition risk factor for older adults through medication side effects, and drug-nutrient interactions.

2.4.5.5 Dysphagia

Dysphagia describes swallowing difficulties which can arise from anatomical or physiological problems in the mouth, pharynx, larynx and oesophagus (Sura et al., 2012). This is relevant to the ageing population as the occurrence increases with age-related changes in swallowing physiology, and age-related diseases (Sura et al., 2012). Swallow physiology changes occur with age due to reductions in muscle mass and connective tissue elasticity, and therefore loss of strength and range of motion. Age-related diseases that can affect swallowing function include neurological diseases such as stroke and dementia; progressive diseases such as Parkinson's Disease; head, neck, and oesophageal cancers; and metabolic deficits (Sura et al., 2012). Xerostomia associated with ageing can also contribute to dysphagia. Additionally, dysphagia can also be caused by mechanical obstruction or inflammation. It has been estimated that 15 percent of the population is affected by dysphagia

(Sura et al., 2012). Among stroke patients up to 50 percent are affected (Mann, Hankey, & Cameron, 2000); and up to 95 percent of those with Parkinson's Disease (Tjaden, 2008). The prevalence also increases with age. A study of 4038 hospitalised patients in the United States found that over 70 percent of referrals were for those older than 60 years, of which more than half were for patients over 80 years (Leder & Suiter, 2009). Dysphagia is therefore prevalent in older adults and likely to become an increasing issue with the ageing population due to its adverse side-effects.

Dysphagia among hospitalised stroke patients has been associated with a 13-fold increased risk of mortality during hospital rehabilitation, and a longer hospital stay compared to those without dysphagia (Altman et al., 2007). Among 131,836 stroke patients in the United States, 14.7 percent of patients without dysphagia had over seven days in care, compared to 44.6 percent of patientswith dysphagia (Altman et al., 2007). Dysphagia is also associated with increased risk of aspiration and subsequent complications, as well as anxiety and depression (Eslick & Talley, 2008). Furthermore, dysphagia is a symptom and regardless of the underlying cause, the common effect is reduced nutrition.

Dysphagia has been consistently associated with reduced nutrition status (Feldblum et al., 2007). A study of 1195 community-living older adults in Japan revealed a significant association, with 66 percent of those who were malnourished, also at risk of dysphagia (Takeuchi et al., 2014). Similarly, another study of 633 older adults in Spain showed the risk of malnutrition was 12 percent in those without dysphagia, and increased significantly to 22 percent in those with dysphagia (Serra-Prat et al., 2012). Finally, in a study of 201 hospitalised acute stroke patients, those who presented with dysphagia had poorer nutrition status than those without dysphagia (Gariballa et al., 1998). With such a significant association between dysphagia and poor nutrition it is important to understand how this association exists.

Poor nutrition is a common side effect of dysphagia due to reduced food and fluid intake, and consequently, energy and nutrient deficiencies. Reduced intake may occur due to highly restrictive diets, fear of choking, eating alone, extended periods of nil-by-mouth, and slower eating (Mann, Heuberger, &

Wong, 2013). Additionally, diet texture modifications may be required to ensure safety and ease of swallow. However these textures often have low acceptability and therefore inadequate intake (Katzka & Kochman, 2004). Furthermore, dysphagia is often unrecognised as the symptoms are clinically silent, and therefore goes untreated whist negatively affecting nutrition status. The declining nutrition status with dysphagia can further contribute to reduced oropharyngeal or oesophageal functional capacity, worsening the dysphagia (Foley, Martin, Salter, & Teasell, 2009; Mann et al., 2013). Early identification of dysphagia is critical to avoid the associated adverse consequences.

Screening for dysphagia facilitates referral to dysphagia specialists for assessment and management. Hinchey et al. (2005) found settings where dysphagia was routinely screened, experienced lower incidence of pneumonia and length of hospital stay (Hinchey et al., 2005). The EAT-10 was developed to fill the need for a rapidly administered and easily scored dysphagia screening instrument (Belafsky et al., 2008). The result was a 10 question self-administered survey to subjectively assess dysphagia risk. It is easy to read, can be completed in two minutes, and has a simple scoring system. The final score is between zero and 40, with three or higher indicating possible risk of swallowing difficulties. The EAT-10 has shown internal consistency, test-retest reproducibility, and criterion-based validity in a large cohort of patients with a wide variety of causes of dysphagia (Belafsky et al., 2008). The EAT-10 is therefore a validated disease specific quality-of-life tool for dysphagia, which can be used to determine initial severity and monitor treatment response. A study using the EAT-10 to assess dysphagia prevalence in 50 older adults found that 20 percent were at risk of swallowing difficulties (Ercilla et al., 2012).

2.4.5.6 Cognitive Status

Ageing is generally associated with a decline in cognitive function, ranging from mild cognitive impairment to severe dementia. In New Zealand the prevalence of memory disability is two to four times higher in those aged over 75 years, than 45 to 64 years (Ministry of Health, 2013b). A Ministry of Health report (Lewis, 2002) stated the prevalence of dementia in New Zealand is around one percent for those aged 60 to 64 years, however this increases at an

approximate rate of one to two percent per year of age, reaching around 30 percent for those aged 85 years and older. The prevalence of people over 65 years in the population is around eight percent, therefore around 48,500 people aged 65-plus had dementia in New Zealand in 2013 (Research New Zealand, 2014).

Reduced cognitive function is a known risk factor for malnutrition (Johansson, 2009; Lee et al., 2009). A study in Sweden of over 1400 older adults found a correlation between cognition and nutrition status (Fagerstrom, Palmqvist, Carlsson, & Hellstrom, 2011). The occurrence of both malnutrition and cognitive impairment was 20 percent for those living in regular housing and 78 percent for those living in special-care housing. Those living in special-care housing with moderate to severe cognitive impairment were 16 times more likely to be malnourished. Therefore the association between reduced cognitive status and poor nutrition seems to be strengthened as cognitive impairment worsens.

Cognitive impairment can affect autonomy, independence and activities-of-daily living, including those associated with eating (Teo, 2001). Problems with eating, weight loss and nutrition risk are therefore common in older adults with cognitive impairment. This can be caused by increased and inappropriate eating, being easily distracted, indifference to food, lack of appetite, sensory changes, decreased ability to understand directions and to verbally express needs, increased energy expenditure, refusing or forgetting to eat, or reduced ability to recognise food (Lou, Dai, Huang, & Yu, 2007; Teo, 2001; Watson & Green, 2006).

Cognitive impairment may also affect nutrition status through a decreased ability to self-feed (Andrieu et al., 2001). A prospective cohort study of almost 6000 older adults found that those with cognitive impairment were three times more likely to have severe functional impairment than those with normal cognitive ability (Mehta, Yaffe, & Covinsky, 2002). Among persons with dementia, the ability to eat without assistance is an important factor for preserving normal BMI (Lou et al., 2007). Declining functional ability with worsening cognition is therefore associated with poor nutrition status. Furthermore, those who experience memory loss in the beginning of the

disease may also avoid social eating situations, known to assist nutrition status, due to feeling unsafe or vulnerable.

All of these factors can lead to inadequate oral intake and weight loss. In a French study of 331 hospitalised older adults, BMI was significantly higher in those with no cognitive impairment compared with cognitively impaired individuals (Farid et al., 2013). The resultant malnutrition leads to complications such as infections and a faster loss of independence (Guerin et al., 2005). A study in the United States of over 650 Alzheimer's Disease patients found that weight loss was associated with severity and progression of the disease (White, Pieper, & Schmader, 1998). Additionally, weight loss was a predictor of mortality in these patients, while weight gain appeared to have a protective effect.

While declining cognitive status can cause inadequate food intake and malnutrition, malnutrition itself can alter neurotransmission and cause declining mental capacity (Donini, Savina, & Cannella, 2003). Conversely, a healthy diet may be protective of cognitive status. A Spanish study of 260 health older adults found that lower fat, saturated fat, and cholesterol intake, in addition to higher carbohydrate, fibre, vitamin (particularly folate, vitamins C and E, and β-carotenes), and mineral (iron and zinc) intake may improve cognitive ability (Ortega, 1997). Furthermore, a high dietary intake of antioxidants and omega-3 fatty acids appears to lower the risk of Alzheimer's disease (Donini, De Felice, & Cannella, 2007; Morris, 2009). Declining cognition is therefore an important nutrition risk factor. However a nutrient-dense diet, low in saturated fat and cholesterol, and high in antioxidants and omega-3 fatty acids may be protective of cognitive decline in older adults.

With impaired cognition known to adversely affect nutrition status, it is important to screen older adults to identify a decline in cognitive function, and then manage nutrition status. The Mini-Mental State Examination (MMSE) (Folstein, Folstein, & McHugh, 1975) is the most widely used cognitive screening tool. However, there have been difficulties in detecting early dementia and many individuals meet the clinical criteria for cognitive impairment score 'normal' in the MMSE. The Montreal Cognitive Assessment (MoCA) was developed as a

rapid screening tool to detect mild cognitive impairment (Nasreddine et al., 2005). The sensitivity and specificity of the MoCA for detecting mild Alzheimer's Disease (n=93) were 100 percent and 87 percent, respectively. The MoCA assesses visuospacial, naming, memory, attention, language, abstraction, delayed recall and orientation. It is a simple tool that anyone can administer in approximately 10 minutes. The result is scored out of 30, with 26 or greater considered normal cognitive function.

2.4.6 Support Service Factors

Many older adults live independently; however, an increasing proportion have physical impairments that result in limited functionality, restricting their ability to perform activities-of-daily living. Support services can assist with household work, personal cares, transport, shopping, socialisation or meal delivery (Krondl, Lau, Coleman, & Stocker, 2003). This may enable older adults to maintain adequate nutrition status, well-being and remain living in their own homes.

Declining functionality with age affects the ability to procure and prepare food which may subsequently decrease food intake. Nutrition status may then deteriorate which further reduces functionality. This is seen in the relationship between older adults' declining nutrition status and their reduced mobility and self-care ability (Dale, Soderhamn, & Soderhamn, 2012; Feldblum et al., 2007; Johansson, 2009; Soderhamn, Bachrach-Lindstrom, & Ek, 2008). This was demonstrated in a Swedish study of 507 older adults; the percentage requiring assistance with shopping and cooking increased, as nutrition status decreased (Saletti et al., 2005). Similarly, in an Australian study of 250 older adults, those who were 'not well nourished' received up to 3.6 hours of formal care per month, compared to those who were 'well-nourished who received up to two hours (Visvanathan et al., 2003). A number of other studies have found that older adults living in the community, who receive help to manage activities-of-daily living, have poorer nutrition status than those who do not receive help (Shum et al., 2005; Söderhamn, Christensson, Idvall, Johansson, & Bachrach‐Lindström, 2012; Tomstad, Soderhamn, Espnes, & Soderhamn, 2012). Therefore poor nutrition status increases the risk of being unable to perform activities-of-daily living and subsequently requiring a support service.

Meals on Wheels (MOW) is an example of a community support service; this offers a hot meal and dessert up to five times per week. By supporting the nutrition status of its clients, it aims to maximise independence and reduce government-funding for nursing home care (Wilson & Dennison, 2011). In a longitudinal study of 258 participants, the use of MOW was found to increase the odds of being at risk of malnutrition (Johansson, 2009). This shows that older adults who have been unable to maintain their nutrition status are more likely to be receiving MOW, than those who are well-nourished. However, another study (n=203) found that after six months of MOW provision, 47 percent of the malnourished participants now had a well-nourished nutrition score (Kretser, Voss, Kerr, Cavadini, & Friedmann, 2003). Additionally, the use of MOW in a Canadian study of 263 older adults found that those receiving this support had a lower risk of poor nutrition (Keller, 2006). Therefore, MOW provision may positively affect the nutrition status of older adults. In the Canadian study, increasing the amount of support received was associated with declining nutrition status (Keller, 2006). This suggests deterioration in the older person's health and functionality and greater reliance on support services. Therefore older adults who are poorly nourished are more likely to be receiving support services as they can no longer maintain activities-of-daily living. However, in receiving these services, nutrition status can be improved.

2.4.7 Nutrition Risk Screening Tools

Due to the multifactorial process of developing poor nutrition status, many factors must be taken into consideration when making a diagnosis. These include anthropometric, demographic, health and support service factors. Nutrition risk screening tools use these factors to identify nutrition status. Screening tools are therefore a simple and rapid means to identify individuals at nutrition risk who may benefit from nutrition intervention, in order to prevent progression to malnutrition.

Screening can prompt early detection, which is important as it is very challenging to correct poor nutrition status in older adults, and treatment is most effective in the early stages (Guigoz, Vellas, & Garry, 1996; Skates & Anthony, 2012). Screening for nutrition risk is a key clinical outcome of National Institute

for Health and Care Excellence guidelines; these suggest all inpatients should be screened on admission and weekly thereafter, and those who are malnourished should receive nutrition support (NICE, 2006). In the hospital setting, patients are often referred to dietitians by medical, nursing or allied health professionals if they are suspected to be malnourished, however many people go unscreened and unidentified, and therefore do not receive nutrition intervention (Van Lill, 2002).

Many tools have been developed to screen nutrition status. From a review of the literature, 15 tools were identified, which were developed to screen and assess the nutrition status of hospitalised older adults. These are described in **Table 2** below, which draws on the reviews of Green and Watson (2006) and van Bokhorst-de van der Schueren, Guaitoli, Jansma, and de Vet (2014). Diagnostic items in the screening tools vary from a simple assessment of appetite and food intake, to measurement of anthropometric and laboratory parameters (White, Guenter, Jensen, Malone, & Schofield, 2012). Many of the tools have not been evaluated, and therefore sensitivity and specificity have not been demonstrated.

Table 2: *Screening Tools for Identifying Nutrition Status in Hospitalised Older Adults*

Tool, Reference, Country	**Nutrition Screening Items**	**Risk Categories**
Nutrition Risk Index (Wolinsky et al., 1990) United States	Dental status, medications, abdominal surgery, bowel habits, dietary restrictions, biting, chewing, eating and swallowing ability, smoking, anaemia, gastrointestinal symptoms, appetite, weight change.	High risk Low risk
Mini Nutritional Assessment (Guigoz et al., 1996) Switzerland	Food intake, weight loss, mobility, psychological stress, fluid, neuropsychological problems, BMI, living situation, medications, pressure sores/skin ulcers, meals daily, protein intake, fruit and vegetable intake, feeding mode, self-view of nutrition/health status, mid arm/calf circumference.	<17=malnourished 17-23.5=at risk ≥24=normal

Tool, Reference, Country	Nutrition Screening Items	Risk Categories
Mini Nutritional Assessment-Short Form (Rubenstein, Harker, Salva, Guigoz, & Vellas, 2001) United States	Recent food intake, recent weight loss, mobility, recent acute disease or psychological stress, neuropsychological problems, BMI.	0-7=malnourished 8-11=at risk 12-14=normal
Nutritional Form For the Eldery (Soderhamn & Soderhamn, 2001) Sweden	Weight loss, dietary intake changes, appetite, food and fluid intake, food access, company at meals, activity, tooth/mouth/swallowing problems, gastrointestinal problems, help with eating, medications, health status.	Maximum score=30 (higher score indicates a higher degree of undernutrition or risk of undernutrition).
Simple Screening Tool 1 and 2 (Laporte, Villalon, & Payette, 2001) Canada	Tool 1: BMI, percentage weight loss Tool 2: BMI, albumin	High risk Low risk
Minimal Eating Observation and Nutrition Form (Westergren, Norberg, Vallen, & Hagell, 2011) Sweden	Weight loss, BMI, eating problems, mouth/swallowing problems, energy, appetite, clinical signs of undernutrition.	0-2=low risk 3-4=moderate risk ≥5=high risk
Rapid Screen (Visvanathan, Penhall, & Chapman, 2004) Australia	BMI, weight loss.	0=nourished ≥1=undernourished
Nutrition Screening Initiative (Posner, Jette, Smith, & Miller, 1993) United States	Diet changes, <2 meals/day, little fruit/vegetables/milk, ≥3alcoholic drinks/day, eating alone, ≥3 drugs or vitamins per day, age, weight change,tooth/mouth/swallowing problems, financial issues, unable to shop/cook/feed self.	0-2=normal 3-5=moderate risk ≥6=high risk
Subjective Global Assessment (Makhija & Baker, 2008) Canada	Weight change, dietary change, gastrointestinal symptoms, functional capacity, disease, physical assessment.	A=well-nourished B=moderately or suspected malnutrition C=severely malnourished
Malnutrition Screening Tool (Ferguson, Capra, Bauer, & Banks, 1999) Australia	Recent weight loss, recent poor intake.	≥2=at risk of malnutrition

Tool, Reference, Country	Nutrition Screening Items	Risk Categories
Malnutrition Universal Screening Tool (Malnutrition Advisory Group, 2003) United Kingdom	BMI, weight loss, acute disease effect score.	>2=high risk 1=medium risk 0=low risk
Malnutrition Advisory Group Screening Tool (Bauer & Capra, 2003) United Kingdom	BMI, weight loss.	High risk Medium risk Low risk
Nutrition Risk Screening 2002 (Kondrup, Rasmussen, Hamberg, & Stanga, 2003) Denmark	Recent weight loss, recent poor intake, BMI, severity of disease, ≥70 years.	>3=start nutrition support
British Nutrition Screening Tool (Weekes, Elia, & Emery, 2004) United Kingdom	Weight loss, food intake decrease.	0=normal 2-3=at risk 4-5=malnourished
Short Nutritional Assessment Questionnaire (Kruizenga, Seidell, de Vet, Wierdsma, & van Bokhorst-de van der Schueren, 2005) The Netherlands	Weight loss, decreased appetite, use of supplement drinks/tube feeding.	<2=well nourished 2=moderately malnourished ≥3=severely malnourished

2.4.8 Mini Nutritional Assessment

There is no international consensus on the single best nutrition risk screening tool for hospitalised older adults. However, a systematic review of 10 screening tools concluded that the full Mini Nutritional Assessment (MNA) appears to be the most appropriate nutrition screening tool for adults over 65 years old (Phillips et al., 2010). The MNA is a single and rapid assessment which was developed to assess the nutrition status of older adults in clinics, nursing homes or hospitals in order to facilitate an early nutrition intervention (Guigoz, 2006). The MNA is the most validated malnutrition screening tool in older adults. It was developed and validated with three consecutive studies; a development study (n=150) (Guigoz, 1994) and a validation study (n=120) (Guigoz, 2006) in France, and an additional validation study (n=347) (Vellas et al., 2006) in New

Mexico. The MNA was designed to have a reliable scale, clear thresholds, compatibility with a general assessor, minimal opportunity for bias, acceptability of patients, and low cost to administer. The sensitivity, specificity and predictive value are all high at 96, 98, and 97 percent, respectively (Vellas et al., 1999). The MNA also correlates with clinical assessment as well as objective measures of nutrition status such as albumin, BMI, tricep skin fold thickness, energy intake, and vitamin status (Vellas et al., 2006). Additionally, low MNA scores have been predictive of negative clinical outcomes, morbidity and mortality in hospital patients (Bauer, Kaiser, Anthony, Guigoz, & Sieber, 2008; Donini, Savina, Rosano, et al., 2003; Guigoz & Vellas, 1997).

The MNA involves four parts (Guigoz et al., 1996):

1. Anthropometric assessment: weight, height, arm and calf circumferences, and weight loss.
2. General assessment: six questions regarding lifestyle, medication, and mobility.
3. Dietary assessment: eight questions about number of meals, food and fluid intake, and autonomy of feeding.
4. Subjective assessment: self-perception of health and nutrition.

Due to the focus on physical, mental and dietary aspects as well as factors associated with the target population (dementia, living situation), it is more likely to identify risk of developing malnutrition, compared with other tools (Anthony, 2008). The MNA is a highly efficient and effective tool which identifies patients as either being of normal nutrition status (24 to 30 points), at risk of malnutrition (17 to 23.5 points), or malnourished (less than 17 points) (Ranhoff, Gjoen, & Mowe, 2005).

From the MNA, the MNA-Short Form (MNA-SF) was developed in order to be more practical, but retain the accuracy of the original tool. Items from the original MNA were selected for the MNA-SF based on the highest correlation with the final MNA score, greatest diagnostic accuracy, minimal investigation time, and lowest amount of ‘don’t know’ answers (Rubenstein et al., 2001). The result was the MNA-SF which contained six items: BMI, weight loss, psychological stress or acute disease, mobility, neuropsychological problems,

and appetite loss or eating difficulty. The MNA-SF was designed as a nutrition screening tool for rapid identification of those who require further assessment. It classified people as 'not at risk of undernutrition' (12 to 14 points) and therefore not requiring any further assessment, or 'at risk of malnutrition' (zero to 11 points), therefore necessitating completion of the full MNA to further define nutrition status (Rubenstein et al., 2001).

The correlation between the MNA and MNA-SF was high, at Pearson's *r*=0.969 (Rubenstein et al., 2001). The MNA-SF was validated on a combined dataset from Spain and New Mexico, with 97.9 percent sensitivity and 100 percent specificity (Rubenstein et al., 2001). The MNA-SF was then revalidated in 2009 (Kaiser et al., 2009) which reaffirmed the high correlation with the full MNA, and also established three cut-off points for nutrition status: 'normal nutrition status' (12 to 14 points), 'at risk of malnutrition' (eight to 11 points) or 'malnourished' (seven or less points). Kaiser et al. (2009) concluded that the revised MNA-SF allows the tool to be a stand-alone nutrition assessment screening tool for older adults. The MNA-SF was therefore selected as the nutrition risk screening tool for the present study.

2.4.9 Prevalence of Nutrition Risk in Hospitalised Older Adults

The exact prevalence of nutrition risk in hospitalised older adults worldwide is unknown due to lack of an internationally accepted definition of malnutrition and a gold standard screening tool, different study methods, diagnostic criterion, and lack of routine nutrition screening (Guigoz, 2006; Skates & Anthony, 2012). Despite this, 36 studies using the MNA in over 8500 hospitalised older adults within 17 countries, found the average prevalence of malnutrition was 23 percent, and the risk of malnutrition was 46 percent (Guigoz, 2006). Therefore almost three quarters of hospitalised older adults had a compromised nutrition status. A study of over 800 patients in sub-acute care mainly for orthopaedic or neurological rehabilitation, found over 90 percent were either at risk of malnutrition, or malnourished on admission (Thomas et al., 2002).

This current review of the literature identified 22 studies which used the MNA in hospitalised older adults (Appendix A). From these, the malnutrition prevalence ranged from 2.6 to 68.2 percent, and the percentage of those at risk of

malnutrition ranged from 29.6 to 81.5 percent. Evidence suggests the prevalence of nutrition risk has remained the same for over 20 years, suggesting that it is a largely unaddressed problem (Kubrak, 2007).

Although the prevalence of nutrition risk internationally is widely studied, there is limited data on the prevalence of malnutrition, or the preceding nutrition risk in New Zealand hospitalised older adults. A study was undertaken in 1996 at Christchurch hospital among hip fracture patients aged 65 years and above (mean age 81.5 years) which investigated risk of malnutrition using biochemical and anthropometric methods. Over 16 weeks 66 (77.6%) of the 85 patients admitted agreed to participate and 42 percent were found to be malnourished (Hanger, 1999). In 2002, the nutrition status of 71 older adults (average age 81 years) admitted to Middlemore Hospital AT&R wards was investigated using the MNA. One quarter (24%) were found to be malnourished and a further 44 percent were at risk of malnutrition (Van Lill, 2002). Therefore based on this study, nearly 70 percent of older adults may have an impaired nutrition status while in hospital. Furthermore, this study also found only 25 percent of these participants had been referred to a dietitian for nutrition intervention, suggesting many malnourished patients may be going unrecognised and therefore untreated. Ethnic disparities may exist in the prevalence of nutrition risk in New Zealand. A population prevalence study of 473 adults aged over 65 years (average age 74 years) found that community-living Maori were 5.2 times more likely than non-Maori to be at nutrition risk (McElnay et al., 2012).

From the two studies by Hanger (1999) and Van Lill (2002), it is clear that poor nutrition status is prevalent in hospitalised older adults in New Zealand. However, these are only two small studies from over 10 years ago. Further investigation is required to examine current nutrition risk status of hospitalised older adults in New Zealand, as well as factors associated with nutrition risk. The present study will expand on these two New Zealand studies by identifying the prevalence of nutrition risk in North Shore and Waitakere Hospitals, and by identifying the factors that are associated with poor nutrition (including dysphagia and cognitive status). The following chapter provides a detailed description of the methods utilised in the execution of this study.

Chapter 3 - Methods

3.1 Study Design

This study was a cross-sectional, observational study to identify the nutrition risk of hospitalised older adults in the AT&R wards at North Shore and Waitakere Hospitals. This joint Waitemata District Health Board (WDHB) and Massey University research project aimed to identify the prevalence of nutrition risk and the associated demographic, health and support service factors. Face-to-face interviews were conducted using a questionnaire developed for the study, which incorporated a number of previously validated screening tools.

3.2 Setting

The study setting was the AT&R wards at North Shore (ward 14 and 15) and Waitakere (Muriwai ward) Hospitals, WDHB, Auckland, New Zealand. These wards are a mixture of geriatric medicine, and rehabilitation for frail older adults. Typically patients have multi-factorial illness and impaired functionality including poor mobility, incontinence, falls, fractures, declining cognitive function, delirium, dementia, and strokes (Ministry of Health, 2002a). The wards have an interdisciplinary team to address these complex and diverse needs, with the aim of restoring patients functional ability, and independence as much as possible (Ministry of Health, 2002a). There are 68 geriatric AT&R beds at North Shore Hospital and 47 at Waitakere Hospital. Approximately 80 percent of referrals to AT&R come from inpatient medical and surgical specialists (Ministry of Health, 2004b).

3.3 Ethics

3.3.1 Ethics Approval

Ethics approval was obtained from the Health and Disability Ethics Committees (14/NTA/70) (Appendix B). WDHB Ethics Committee review was also performed and approved (Appendix C). Additionally, the study protocol was reviewed and accepted by the Maori Research Committee for the WDHB (Appendix D). Approval for the study was gained from Nutrition Services at

North Shore and Waitakere Hospitals, and from the Charge Nurse Manager of each hospital ward that was used for participant recruitment.

3.3.2 Informed Consent

Participants were given time to read the Patient Information Sheet (Appendix E), ask questions and decide whether or not they would participate. Details in this form included: researcher contact details, study aims, participant selection, research procedures, risks and benefits, participation, inclusion and exclusion criteria, confidentiality, access to study results, and encouragement to ask any questions. Participants were advised that the interview would only take approximately 30 minutes, that they had the right to decide whether or not to participate, and could opt-out at any time. Further, that if they decided not to participate, or wished to discontinue at any stage, that this would not adversely affect their on-going patient care. This allowed informed consent and voluntary participation. Written consent was gained via signature on the Consent to Participate form (Appendix F). Permission was also gained to view medical records in order to obtain further details regarding health issues and regular medications.

3.3.3 Adverse Events

Participants were informed it was extremely unlikely that they would experience any side effects from participation in this study. A possible adverse effect could have been psychological stress for the participant created by questioning them about their nutrition status; however it was explained that they may directly benefit from having nutrition problems identified. Where participants were identified as being ‘at risk of malnutrition,’ they were given brief education (High Energy High Protein, and Poor Appetite), asked to be monitored closely by nursing staff with daily food diaries and regular weights, and to be referred to the ward dietitian if necessary. Those who were categorised as ‘malnourished’ were immediately referred to the ward dietitian for assessment and management. Similarly, those identified as being ‘at risk of swallowing difficulties’ were referred to the ward Speech and Language therapist for assessment and management.

3.3.4 Confidentiality

The questionnaires and signed consent forms were stored in a filing cabinet on the day of data collection, and any data entered onto the computer was secured by a password known only by the researcher. Participants were assured that all efforts would be made to ensure personal information was kept private and that if information from the study was published, participants name or other personal information would not be used.

3.4 Participants and Recruitment

Between April and July 2014 (12 weeks) patients admitted to the AT&R wards of North Shore and Waitakere Hospitals were consecutively recruited (non-randomised), within five days of admission. Patients were initially screened (see below for inclusion and exclusion criteria) for suitability to take part in the study. This was important to allow identification of patients for whom the burden of taking part would not be too great, and who could be expected to reliably answer questions. At North Shore Hospital, this screening was conducted by the same ward Geriatrician, who then informed the researcher (MSc Nutrition and Dietetic student) of patients which met the inclusion and exclusion criteria. To identify eligible patients at Waitakere Hospital, screening was performed by the researcher, using a list of new admissions from the Muriwai Ward Clerk.

Inclusion criteria:

1. Sixty-five years of age or older (or 55 years if Maori or Polynesian).
2. Ability to understand and give informed consent.
3. Ability to complete self-assessment questionnaire.
4. Willing to undergo anthropometric measures.
5. Admitted to a ward or residential care facility no more than five days previously.

Exclusion criteria:

1. Age less than 65 years old (or 55 years for Maori and Polynesian).
2. Inability to give reasonable informed consent.
3. Any tumour in the voicebox.
4. Anyone with psychiatric illness affecting nutrition eg. Anorexia nervosa.
5. Anyone with a Zenker diverticulum.

6. Anyone with malabsorption syndromes or metabolic syndromes affecting digestion.
7. Anyone with a fistula between the throat and the skin.
8. Anyone in palliative care.

If eligible, a time was organised within five days of admission to explain the purpose of the study and gain written consent if the participant was happy to proceed.

3.5 Data Collection

The study protocol was emailed to the relevant dietitians, nurses and doctors at North Shore and Waitakere Hospitals. Interviews took place on the hospital ward, with investigators travelling to the site to meet the participant. The same researcher performed every interview to reduce inter-individual variability. The study used both qualitative questionnaires and quantitative anthropometric measurements to evaluate nutrition status. Once informed consent was received a face-to-face interview was conducted. The first part of the questionnaire (Appendix G) involved collection of personal, demographic, health, and support service information. This was gathered from the patient's clinical notes and the medical data base, Concerto, as well as from the patient's themselves.

The second part of the questionnaire involved face-to-face administration of two screening tools. Each participant completed the Mini Nutritional Assessment-Short Form, MNA-SF (Appendix H) (Rubenstein et al., 2001), and the Eating Assessment Tool, EAT-10 (Appendix I) (Belafsky et al., 2008). The average time for completing data collection was 45 minutes. For each participant, participation in the study as well as scores for nutrition risk (MNA-SF) and dysphagia risk (EAT-10) screens were recorded in the clinical notes, and requirements for appropriate follow up were indicated if necessary. Prior to the patient being discharged from hospital, a simple screen for cognitive status was performed by the researcher or the Geriatrician involved with the study, using the MoCA (Appendix J) (Nasreddine et al., 2005).

3.5.1 Questionnaire

The study questionnaire was developed using previously validated screening tools to determine nutrition (MNA-short form) and dysphagia risk (EAT-10) and cognitive status (MoCA), in conjunction with personal, demographic, health and support service questions to identify factors affecting nutrition status. The study questionnaire contained 47 items. After the questionnaire was developed it was reviewed by nutrition and research professionals, and revisions were made based on recommendations.

3.5.1.1 Piloting the Questionnaire

A convenience sample of the target group, made up of older adults known to the researcher, was used as the pilot study group (n=10). The aim was to gain feedback on the instructions, content and layout, wording, and understanding of the questionnaire items. The researcher guided the participants through each question and participants were given the opportunity to ask any questions and provide feedback. The time taken for completion of the questionnaire was recorded for all participants. The questionnaire then was modified to improve comprehension and flow, and to reduce participant burden.

3.5.1.2 Participant Characteristics

The first and second sections of the questionnaire were the personal and demographic characteristics. The personal information included full name, National Health Index number, date-of-birth, age, gender, weight and height. All of this information was gathered from the participants' clinical notes.

3.5.1.3 Height and Weight

The majority of participants had a weight measured since admission (within the previous five days) and this was recorded in their clinical notes. The participants' height was recorded from either their clinical notes or Concerto. Weight and height was then used to calculate BMI. Where a height and weight were not recorded, participants had a CC (calf circumference) measurement taken in keeping with the MNA-SF protocol. A CC measurement has shown to be just as good a parameter to determine nutrition risk as BMI, in relation to the MNA-SF (Aparecida Leandro-Merhi, Luiz Braga de Aquino, & Gonzaga Teixeira de Camargo, 2012). The CC was measured as per the following

Standard Operating Procedure (Nestle Nutrition Institute, 1994, revised 2009): CC was measured with the participant lying in supine position with the left knee bent at a 90° angle and clothing moved out of the way. A loop of the tape measure (Lufkin Executive Thinline measuring tape) was put around the left calf until the largest diameter was located. The tape was then pulled so it was just snug around the calf, but not so tight that tissue was compressed. The number on the tape measure was read and accurately recorded to the nearest 0.1cm. Three measurements were taken which agreed within 0.5cm.

3.5.1.4 Demographic Characteristics

In the second section of the questionnaire, participants were asked to identify their ethnicity, marital status, current living situation, whether income was pension only and their highest level of education. Ethnicity was based on the 2008/2009 National Nutrition Survey (University of Otago and Ministry of Health, 2011): New Zealand European, New Zealand Maori, Pacific Islander and Other (participants were asked to specify). Marital status identified whether the participants were married, widowed, divorced or separated, or never married. Living arrangement was identified as either living alone, living with spouse only, or living with others. Income in addition to the pension was used to separate those from receiving pension only. The highest level of education was identified as either primary, secondary or tertiary.

3.5.1.5 Health

'Health' was the third section of the questionnaire. The first three health questions were answered using the 'Admission to AT&R' document in the participants' clinical notes. These questions were whether the participant had any key comorbidities, other health problems, and whether they were taking any prescribed medications. If the answer was yes to any of these questions, the health conditions or medications were recorded.

The final three health questions were answered by the participant themselves. These identified whether the participants were taking any over-the-counter medications, regular nutrition supplements, and whether their dental status was dentate, edentulous, or wearing a dental appliance.

3.5.1.6 Support Services

The forth section of the questionnaire was two questions to which participants stated whether or not they were receiving regular subsidised support services, and whether or not they usually needed help with activities-of-daily living. Any details participants could recall of supports received, were noted.

3.5.1.7 Mini Nutritional Assessment-Short Form

The validated MNA-SF was used to determine nutrition status. The MNA-SF is efficient and effective with high diagnostic accuracy relative to clinical nutrition status. It was developed from the full MNA which has been validated in large samples of older adults worldwide (Guigoz, 2006; Rubenstein et al., 2001). This screening tool had six questions, which the participant was asked and then given the answer options:

1: Whether the participant's food intake had changed over the past three months (severe decrease, moderate decrease, or no decrease in food intake).
2: Whether the participant had experienced any weight loss in the past three months (greater than 3kg, they do not know, weight loss between 1kg and 3kg, or no weight loss).
3: Regarding the participant's mobility (bed or chair bound, able to get out of bed/chair but does not go out, or goes out).
4: Whether the participant had suffered any psychological stress or acute disease in the past three months (yes, or no).
5: Regarding neuropsychological problems (severe dementia or depression, mild dementia, or no psychological problems).
6: Height and weight were used to calculate BMI (less than 19, 19 to less than 21, 21 to less than 23, or greater than 23). Alternatively, CC was used and recorded as either less than 31cm, or 31cm and above.

The MNA-SF item scores were then added to give a total score. The participants were grouped as either 'normal nutrition' status (12 to 14 points), being 'at risk of malnutrition' (eight to 11 points), or 'malnourished' (zero to seven points) (Kaiser et al., 2009). Participants were also grouped as 'at risk of undernutrition' (<12 points) or 'not at risk of undernutrition' (≥12 points) to compare those with and those without any nutrition impairment. The MNA-SF

took approximately 10 minutes to complete.

3.5.1.8 Eating Assessment Tool-10

The Eating Assessment Tool was used to determine if the participants were at risk of swallowing difficulties (Belafsky et al., 2008). The EAT-10 is a validated, disease-specific quality-of-life tool for dysphagia, which can be used to determine initial severity and monitor treatment response. It has 10 statements which participants were asked to rate on a scale of zero to four, zero being no problem, to four being a severe problem:

1: My swallowing problem has caused me to lose weight.
2: My swallowing problem interferes with my ability to go out for meals.
3: Swallowing liquids takes extra effort.
4: Swallowing solids takes extra effort.
5: Swallowing pills takes extra effort.
6: Swallowing is painful.
7: The pleasure of eating is affected by my swallowing.
8: When I swallow food sticks in my throat.
9: I cough when I eat.
10: Swallowing is stressful.

The EAT-10 question scores were then added up, with a possible score of zero to 40 points. The result was either 'not at risk of swallowing difficulties' (less than three points), or 'at risk of swallowing difficulties' (three or more points). The questionnaire took around five minutes to complete.

3.5.1.9 Montreal Cognitive Assessment

The Montreal Cognitive Assessment is a rapid screening tool used to detect mild cognitive impairment (Nasreddine et al., 2005). The MoCA assesses visuospacial, naming, memory, attention, language, abstraction, delayed recall and orientation. The MoCA was performed closer to discharge as it was deemed inaccurate to perform this on admission, as results may be falsely lowered by delirium, confusion, stress, or other factors. The highest possible score is 30, with 26 or greater considered 'normal cognition,' and lower than 26 considered 'below normal cognition'.

3.5.1.10 Respondents Reliability and Understanding

The final two questions of the study questionnaire were for the researcher to rate the reliability of the participants' responses and understanding of the questions, from one to five (where five gives the highest reliability and understanding). If one or two were selected by the researcher, comments were provided to assist with the accuracy of data coding.

3.6 Statistical Analysis and Data Handling

The questionnaire items were coded and entered into Excel spreadsheets on a personal computer accessible by password known only by the researcher. Data was imported into SPSS for statistical analysis. Data analysis was performed using IBM SPSS software version 21.0 (IBM Corporation, 2012). Descriptive statistics were used to describe participant characteristics, anthropometry, health, support services, nutrition status, dysphagia and cognition of the study participants. Kolmogorov-Smirnov test was used to determine normality ($p>0.05$). Continuous variables that were normally distributed were expressed as mean±standard deviation, and continuous variables that were not normally distributed were expressed as median [25th, 75th percentiles]. Categorical variables were expressed as count, and percentage of total in brackets.

3.6.1 Nutrition Status

Nutrition status of the study participants was classified as 'malnourished,' 'at risk of malnutrition' and 'normal nutrition' status as per the MNA-SF (Kaiser et al., 2009). Participants were also grouped as 'at risk of undernutrition' (<12 points) or 'not at risk of undernutrition' (≥12 points). The comparisons between the nutrition status groups (and between genders) were performed by the non-parametric Mann Whitney U test for medians, and Chi-Square test and Fisher's Exact test (2-tailed) for counts. The Fisher's Exact test was used when the Chi-Square test was invalid: when more than zero percent of the cells had expected counts less than five. The level of significance was set at $p<0.05$.

3.6.2 BMI

The participants' BMI's were grouped according to the New Zealand Food and Nutrition Guidelines for Older Adults (Ministry of Health, 2013b): Underweight, <18.50kg/m^2; normal, 18.50–24.99 kg/m^2; and overweight/obese, ≥25.00 kg/m^2.

3.6.3 Health Conditions

The key comorbidities of each participant were collected from their medical notes on admission to AT&R. These were then grouped into the health condition groups that caused the most health loss in 2006, for adults aged over 65 years (Ministry of Health, 2013c): cancer, vascular and blood disorders, musculoskeletal, respiratory, diabetes and endocrine, and neurological. A gastrointestinal group was added due to the significance of these conditions on nutrition status and also a high number of participants experiencing gastrointestinal conditions. The 'other' group was for all additional conditions that did not fit into the other seven condition groups. The key comorbidities were compared between nutrition status groups as either less than four, or four or more. This cut-off was taken from the 2002/2003 New Zealand Health Survey, as reported in the Older People's Health Chart Book 2006 (Ministry of Health, 2006b) in order to provide a comparison.

3.6.4 Medications

The participants' regular medications were grouped as either taking less than five medications or taking more than five medications. This was because polypharmacy, a known nutrition risk factor, is defined as taking five or more medications (Martin et al., 2002; Shum et al., 2005).

Chapter 4 - Results

4.1 Questionnaire Pilot

The pilot showed that respondents felt comfortable answering all questions and there were no concerns regarding questions of a personal or sensitive nature. The majority of the questions read smoothly and were easily understood by respondents. The average length of time to complete the questionnaire was around 30 to 45 minutes, with differences in interview time depending on whether the weight and height needed to be measured, and the engagement, concentration, and level of understanding of the respondent. This time did not include the time that would be needed to gain consent from each participant.

4.2 Participant Characteristics

Fifty seven participants who were admitted to the AT&R wards at North Shore and Waitakere Hospitals between April and July 2014 were recruited for this research study. All of the patients screened, were eligible to participate and agreed to take part in the study. The average length of stay during the months of data collection was recorded by the AT&R wards to be 20 days. The characteristics of the study participants are detailed in **Table 3**.

Table 3: *Participant Characteristics*[1]

	Total **n (%)**	Men	Women
Total	57 (100.0)	23 (40.4)	34 (59.6)
Age (years) Median	83.0 [78.0, 87.0]	81.0 [74.0, 85.0]	84.5 [81.0-88.0]
Age Range (years)	66.0-95.0	66.0-90.0	69.0-95.0
Age Categories			
65-74 years	11 (19.3)	7 (30.4)	4 (11.8)
75-84 years	22 (38.6)	9 (39.1)	13 (38.2)
85+ years	24 (42.1)	7 (30.4)	17 (50.0)
Ethnicity			
New Zealand European	43 (75.4)	15 (65.2)	28 (82.4)
New Zealand Maori	2 (3.5)	1 (6.7)	1 (2.9)
Pacific Islander	1 (1.8)	1 (6.7)	0 (0.0)
Other	11 (19.3)	6 (26.1)	5 (14.7)
Marital Status			
Married/partnered	22 (38.6)	12 (52.2)	10 (29.4)
Widowed	25 (43.9)	5 (21.7)	20 (58.8)
Divorced/separated	4 (7.0)	2 (8.7)	2 (5.9)
Never married	6 (10.5)	4 (17.4)	2 (5.9)

Living Situation			
Living alone	27 (47.4)	8 (34.8)	19 (55.9)
Living with spouse only	19 (33.3)	10 (43.5)	9 (26.5)
Living with others	11 (19.3)	5 (21.7)	6 (17.6)
Income			
Pension only income	34 (59.6)	12 (52.2)	22 (64.7)
Pension plus other income	23 (40.4)	11 (47.8)	12 (35.3)
Education			
Primary	28 (49.1)	11 (47.8)	17 (50.0)
Secondary	19 (33.3)	8 (34.8)	11 (32.4)
Tertiary	10 (17.5)	4 (17.4)	6 (17.6)

[1]Results expressed as count (percentage), or median [25th, 75th percentiles].

The participants were aged between 66.0 and 95.0 years, however, more than 80% of participants were aged 75 years or older. New Zealand European was the most common ethnicity (75.4%), with only two New Zealand Maori participants, one Pacific Island participant, and 11 participants classified as 'Other' (people from England, India, South Africa, and The Netherlands). Ninety percent of participants had been married at some time. Of these 51% were either widowed or divorced, and almost half of the participants were living alone. Of those that were widowed or divorced/separated, the percentage living alone increased to 69.0%. For most of the participants (59.6%), their pension was their only source of income. Primary level was the most frequently reported highest level of education (49.1%).

Nearly 60% of the participants were women. When women and men were compared in terms of participant characteristics, women were slightly older than men with a median age of 84.5 years compared to 81.0 years for men. Women therefore had a lower prevalence in the 65 to 74 year old group compared to men, at 11.8% and 30.4% respectively. Likewise, women had a higher prevalence in the over 85 year old group than men at 50% and 30.4% respectively. More women than men were widowed, at 58.8% compared to 21.7% of men. Furthermore, women had a higher prevalence of living alone compared to men, at 55.9% and 34.8% respectively. Men had a slightly higher prevalence in the pension plus other income group, and there were no great differences in the prevalence of men and women in the different education groups.

4.3 Anthropometry

Ninety-six percent (96%) of study participants had height and weight measurements recorded. For the remaining two participants, where a measurement was not possible due to practical difficulties following a recent stroke, CC measurements were taken as per the MNA-SF protocol. As indicated in **Table 4**, the median weight of the 55 participants was 69.5kg. Men were significantly heavier (p=0.001) and taller (p<0.0001) than women. The median weights were 77.8kg and 59.0kg respectively, and heights 175.0cm and 162.0cm respectively. The median BMI of the 55 participants was 24.7kg/m^2. The prevalence for the total population of BMI underweight (<18.50kg/m^2), normal (18.50 to 24.99 kg/m^2), and overweight/obese (≥25.0 kg/m^2), was 11.0%, 45.4% and 43.6% respectively. Men and women did not differ significantly in terms of median BMI, or prevalence in these three BMI categories. The two CC measurements were 31.2cm and 32cm. These were both in the higher of the two CC groups as per MNA-SF protocol (≥31cm compared to <31cm).

Table 4: *Anthropometry of the Study Participants*[1]

	Total	Men	Women	*p*-value
Total	55 (95.6)	23 (41.8)	32 (58.2)	
Weight (kg)	69.5 [56.8, 82.8]	77.8 [72.1, 85.9]	59.0 [51.3, 70.3]	0.001[2*]
Height (cm)	163.0 [158.0, 174.0]	175.0 [170.0, 180.0]	162.0 [157.0, 163.0]	<0.0001[2*]
BMI (kg/m²)	24.7 [21.3, 28.8]	25.7 [24.2, 28.8]	22.7 [20.0, 28.9]	
	n (%)			
Underweight <18.50	6 (11.0)	1 (4.3)	5 (15.6)	
Normal 18.50–24.99	25 (45.4)	9 (39.1)	16 (50.0)	
Overweight/obese ≥25.00	24 (43.6)	13 (56.5)	11 (34.4)	

*Significant difference between genders, p<0.05
[1]Results expressed as median [25th, 75th percentiles], or count (percentage) for categorical data.
[2]Comparisons between genders were performed by the Mann-Whitney U test

4.4 Health

4.4.1 Health Conditions

All 57 of the study participants were experiencing health issues to some degree; these ranged from one to 15 key comorbidities per participant (Appendix L). The median [25th, 75th percentiles] number of key comorbidities was 6 [4, 8] per

participant, with 87.7% (n=50) of the study participants having four or more key comorbidities.

When these key comorbidities were grouped into health conditions, the most common group was vascular and blood disorders, with 91.2% of participants having one or more of these conditions (**Table 5**). The 'Other' group was the second most common, at almost three quarters of participants having a condition in this group. This category was made up of the following health issues: glaucoma, cataracts, visual impairment, total knee and hip joint replacements, acute or chronic kidney disease, adenomyomatosis of the gallbladder, chronic hepatitis, chronic ulcers, psoriasis, anxiety, depression, adjustment disorder, bipolar, vertigo, vitamin D deficiency, Von Willebrands Disease, phrenic nerve palsy, and chronic lymphoedema. Musculoskeletal conditions were the third most common health condition group, with just over half of participants having one or more musculoskeletal conditions. Gastrointestinal and neurological conditions were the fourth and fifth most common groups, experienced by 42.1% and 33.3% of the study participants, respectively. Both respiratory conditions, and diabetes and endocrine conditions were experienced by almost one quarter of the study participants. The least common of the eight health condition groups was cancer, at 15.8%.

There were no statistically significant differences in the prevalence of each of the eight health condition groups between men and women. However, 64.7% of women and 39.1% of men had musculoskeletal conditions, and this higher prevalence in women than men almost reached statistical significance (p=.057, Pearson Chi-Square).

Table 5: *Health Conditions Experienced by the Study Participants*[1]

	Total **n (%)**	Men	Women
Total	57 (100.0)	23 (40.4)	34 (59.6)
Cancer	9 (15.8)	4 (17.4)	5 (14.7)
Vascular and blood disorders	52 (91.2)	22 (95.7)	30 (88.2)
Musculoskeletal	31 (54.4)	9 (39.1)	22 (64.7)
Respiratory	14 (24.6)	4 (17.4)	10 (29.4)
Diabetes and endocrine	14 (24.6)	4 (17.4)	10 (29.4)
Neurological	19 (33.3)	10 (43.5)	9 (26.5)
Gastrointestinal	24 (42.1)	8 (34.8)	16 (47.1)
Other	43 (75.4)	16 (69.6)	27 (79.4)
≥4 key comorbidities	50 (87.7)	19 (82.6)	31 (91.2)

[1]Results expressed as count (percentage)

Thirteen (22.8%) participants had experienced total knee and/or hip joint replacements, with slightly more than half being men. For hip replacements, it was more common to have had just one replaced (75.0%), whereas for knee replacements it was more common to have had both replaced (66.7%).

4.4.2 Regular Prescribed Medications

Nearly all of the participants (93.0%) were taking five or more (polypharmacy) prescribed medications regularly (**Table 6**). Only two of the 57 participants were not taking any prescribed medications. There were no significant differences between men and women in those taking five or more regular prescribed medications. The median [25th, 75th percentiles] number of prescribed medications taken regularly by the study participants was 10 [7, 13] medications per day, and the range was zero to 30 different medications per day. Of the 184 different medications taken by the study participants, the top 10 most common regular prescribed medications were: Paracetamol (n=38), Aspirin (n=24), Laxsol (n=23), Lactulose (n=22), Metoprolol (n=20), Omeprazole (n=20), Atorvastatin (n=18), Frusemide (n=14), Cilazapril (n=13), and Citalopram (n=11). The top three medications, Paracetamol, Aspirin and Laxsol were taken by 66.7%, 42.1%, and 40.4% of the study participants respectively.

Table 6: *Regular Prescribed Medications Taken by the Study Participants*[1]

	Total **n (%)**	Men	Women
Total	57 (100.0)	23 (40.4)	34 (59.6)
5 or more medications	53 (93.0)	21 (91.3)	32 (94.1)
Less than 5 medications	4 (7.0)	2 (8.7)	2 (5.9)

[1]Results expressed as count (percentage)

4.4.3 Prescribed Nutrition Supplements

Twenty six participants (45.6%) were taking nutrition supplements as part of their prescribed medications. Cholecalciferol was the most common, prescribed for 15.8% of participants. Other prescribed nutrition supplements were: other vitamin D supplements (calcitriol), iron supplements (ferrous sulphate, ferrous fumerate, ferrous sulphate + ascorbic acid), vitamins and minerals (potassium chloride, sodium chloride, thiamine, multivitamin, folic acid, glucosamine, magnesium amino acid chelate, sodium phosphate, Vitamin B12 injections), and special foods (Fortisip, Calogen, and Ensure). The range of prescribed nutrition supplements per participant was one to five different supplements per day, however the majority (57.1%) were only taking one per day.

4.4.4 Over-the-counter Medications

Only four participants (7%) recorded taking over-the-counter medications. These participants were taking either one or two of the following: Laxofast, Panadol, and Gaviscon.

4.4.5 Over-the-counter Nutrition Supplements

Sixteen participants (28%) recorded taking nutrition supplements other than those which were prescribed. These were Salmon oil, Omega-3 fish oil, Cod liver oil, Multivitamin, Centrum, B Vitamins, Vitamin C, Vitamin D, Vitamin E, Ferrgrad-Fe + vitamin C, Magnesium, Coenzyme Q10, Deer velvet, Thompsons Ultra Cranberry, Flora restore, Phloe, Nepro, Renilon, and Complan. Participants who were taking over-the-counter nutrition supplements regularly, were taking between one to six different supplements per day. The majority (56.3%) of participants were taking just one supplement per day, and the most common (n=5) supplements were magnesium and multivitamins.

4.4.6 Dental Status

Table 7 shows that 73.7% of the participants reported wearing some form of dental appliance, and 26.3% were dentate. None of the 57 participants were edentulous. There was no significant differences between men and women in regards to dental status.

Table 7: *Dental Status of the Study Participants*[1]

	Total **n (%)**	Men	Women
Total	57 (100.0)	23 (40.4)	34 (59.6)
Dentate	15 (26.3)	6 (26.1)	9 (26.5)
Dental Appliance	42 (73.7)	17 (73.9)	25 (73.5)

[1]Results expressed as count (percentage)

4.4.7 Dysphagia

The participants' risk of swallowing difficulties was assessed by the EAT-10 tool. This categorises participants 'at risk' of dysphagia if they score three or more points out of a total of 40. As seen in **Table 8**, the majority of participants (84.2%) were not 'at risk' of swallowing difficulties, with only nine participants scoring three points or higher. The range of EAT-10 scores was zero to 25 points. Over half (50.9%) of the participants scored zero, and another third (33.3%) scored either one or two points in the EAT-10.

Table 8: *Dysphagia Risk*[1] *of the Study Participants Using the EAT-10*[2]

	Total **n (%)**	Men	Women
Total	57 (100.0)	23 (40.4)	34 (59.6)
Not 'at risk' of swallowing difficulties	48 (84.2)	19 (82.6)	29 (85.3)
'At risk' of swallowing difficulties	9 (15.8)	4 (17.4)	5 (14.7)

[1]Recognised cut-offs for dysphagia risk as per the EAT-10 (Belafsky et al., 2008)
[2]Results expressed as count (percentage)

4.4.8 Cognition

The participants' cognitive status was assessed by the MoCA tool. This rates participants' as having 'normal cognitive status' if they score 26 or higher. Only 44 of the 57 (77.2%) of the participants had a MoCA assessment. The 13 that did not were for the following reasons: participant refused (n=1), participant discharged before researcher was able to get back to assess them (n=10), and participant deceased (n=2). As seen in **Table 9**, the majority of participants

(88.6%) had 'below normal cognitive status,' with only five participants scoring 26 points or higher. The mean ± SD MoCA score was 18.45 ± 6.71, and the range was one to 28 points. There was no statistically significant difference between genders in cognitive status.

Table 9: *Cognitive Status[1] of the Study Participants Using the MoCA[2]*

	Total **n (%)**	Men	Women
Total	44 (100.0)	15 (34.1)	29 (65.9)
'Normal cognitive function' (26-30)	5 (11.4)	0 (0)	5 (14.7)
'Below normal cognitive function' (<26)	39 (88.6)	15 (100)	24 (70.6)

[1]Recognised cut-offs for cognitive status as per the MoCA (Nasreddine et al., 2005)
[2]Results expressed as count (percentage)

4.5 Support Services

Slightly more than half of the participants (52.6%) were not receiving regular support services, however 63.2% of participants reported requiring help with activities-of-daily living (**Table 10**). There were no significant differences between men and women in terms of receiving regular support service, or requiring daily help.

For those who did receive regular support services, this help ranged from one hour per fortnight to 1.5 hours per day. Assistance was either provided for home help such as vacuuming, cleaning or cooking, or personal cares such as showering and dressing. For those who required help with activities-of-daily living, this was most often provided by the participants' children, particularly by daughters.

Table 10: *Support Services Used by the Study Participants[1]*

	Total **n (%)**	Men	Women
Total	57 (100.0)	23 (40.4)	34 (59.6)
Receiving support service	27 (47.4)	8 (34.8)	19 (55.9)
Needing daily help	36 (63.2)	14 (60.9)	22 (64.7)

[1]Results expressed as count (percentage)

4.6 Nutrition Status

Nutrition status was evaluated by the MNA-SF with a rating of zero to seven considered 'malnourished', eight to 11 being 'at risk of malnutrition,' and 12 to 14 being 'normal nutrition' status. The median [25th, 75th percentile] MNA-SF score was 10.0 [7.5, 11.0]. As displayed in **Table 11**, over half (57.9%) of participants were in the 'at risk of malnutrition' category, with a further 22.8% classified as 'malnourished'. Therefore, only 19.3% of participants had 'normal nutrition' status. There were no statistically significant differences between the nutrition status groups by gender, however 69.2% of those who were 'malnourished' were women.

Table 11: *MNA-SF[1] Score of the Study Participants[2]*

	Total **n (%)**	Men	Women
Total	57 (100.0)	23 (40.4)	34 (59.6)
'Normal nutrition' status (12-14)	11 (19.3)	5 (21.7)	6 (17.6)
'At risk' of malnutrition (8-11)	33 (57.9)	14 (60.9)	19 (55.9)
'Malnourished' (0-7)	13 (22.8)	4 (17.4)	9 (26.5)

[1]Recognised cut-offs for nutrition status as per the MNA-SF (Kaiser et al., 2009)
[2]Results expressed as count (percentage)

Table 12 displays the six items (A to F) that make up the MNA-SF by nutrition status group, with BMI replaced with CC when weight and height measurements were not available.

Table 12: *MNA-SF Questionnaire Item Scores*[1]

	Total **n (%)**	Malnourished	At risk	Normal
Total	57 (100.0)	13 (22.8)	33 (57.9)	11 (19.3)
A: Food intake				
Severe decrease	1 (1.8)	1 (7.7)	0 (0.0)	0 (0.0)
Moderate decrease	19 (33.3)	8 (61.5)	9 (27.3)	2 (18.2)
No decrease	37 (64.9)	4 (30.8)	24 (72.7)	9 (81.8)
B: Weight loss				
Weight loss greater than 3kg	10 (17.5)	7 (53.8)	3 (9.1)	0 (0.0)
Does not know	1 (1.8)	0 (0.0)	1 (3.0)	0 (0.0)
Weight loss between 1 to 3kg	17 (29.8)	4 (30.8)	12 (36.4)	1 (9.1)
No weight loss	29 (50.9)	2 (15.4)	17 (51.5)	10 (90.9)
C: Mobility				
Bed or chair bound	1 (1.8)	1 (7.7)	0 (0.0)	0 (0.0)
Able to get out of bed/chair but does not go out	47 (82.5)	12 (92.3)	28 (84.8)	7 (63.6)
Goes out	9 (15.8)	0 (0.0)	5 (15.2)	4 (36.4)
D: Psychological stress or acute disease				
Yes	45 (78.9)	13 (100.0)	30 (90.9)	2 (18.2)
No	12 (21.1)	0 (0.0)	3 (9.1)	9 (81.8)
E: Neuropsychological problem				
Severe dementia or depression	1 (1.8)	0 (0.0)	1 (3.0)	0 (0.0)
Mild dementia	10 (17.5)	3 (23.1)	6 (18.2)	1 (9.1)
No psychological problems	46 (80.7)	10 (76.9)	26 (78.8)	10 (90.9)
F1: BMI[2,3]				
BMI less than 19	7 (12.3)	6 (46.2)	1 (3.0)	0 (0.0)
BMI 19 to less than 21	3 (5.3)	1 (7.7)	1 (3.0)	1 (9.1)
BMI 21 to less than 23	10 (17.5)	3 (23.1)	7 (21.2)	0 (0.0)
BMI 23 or greater	35 (61.4)	3 (23.1)	22 (66.7)	10 (90.9)
F2: Calf circumference[2,3]				
CC less than 31cm	0 (0)	0 (0.0)	0 (0.0)	0 (0.0)
CC 31cm or greater	2 (3.5)	0 (0.0)	2 (6.1)	0 (0.0)

[1]Results expressed as count (percentage)
[2]BMI and CC cut-offs as per MNA-SF (Rubenstein et al., 2001)
[3]Missing values

4.6.1 Food Intake

Over half (64.9%) of participants reported having 'no decrease in food intake' in the past three months, one third of participants reported a 'moderate decrease' and only one participant reported a 'severe decrease' in food intake. Those in the 'normal nutrition' group had a higher prevalence (81.8%) of 'no decrease in food intake,' compared to those in the malnourished group (30.8%). Likewise, the 'malnourished' group had a higher prevalence (61.5%) of 'moderate decrease in food intake,' compared to the 'normal nutrition' group (18.2%).

4.6.2 Weight Loss

Half of the participants reported 'no weight loss,' and one third reported having 'lost between 1kg and 3kg'. A further 10 (17.5%) participants had 'lost greater than 3kg'. The prevalence of 'no weight loss' increased with improving nutrition status: the 'malnourished' group had 15.4%, the 'at risk' group had 51.5%, and the 'normal nutrition' group had 90.9% reporting 'no weight loss.' Conversely, the prevalence of 'weight loss greater than 3kg' decreased with improving nutrition status from 53.8% of those in the 'malnourished' group, to 9.1% of the 'at risk' group, and none of the 'normal nutrition' status group. Of those who had 'weight loss greater than 3kg,' 70% were 'malnourished' participants.

4.6.3 Mobility

The mobility of the majority (82.5%) of participants was classified as being 'able to get out of bed, but does not go out.' The prevalence of participants with mobility classed as 'goes out' increased from none in the 'malnourished' group, to 15.2% of the 'at risk' group, and 36.4% of the 'normal nutrition' group. Only one participant in the study was 'bed or chair bound.'

4.6.4 Psychological Stress or Acute Disease

The majority of participants (78.9%) had 'suffered psychological stress or acute disease' in the past three months. This was made up of 100% of the 'malnourished' participants, 90.9% of those 'at risk' and 18.2% of the 'normal nutrition' group.

4.6.5 Neuropsychological Problems

Most (80.7%) of the participants did not have neuropsychological problems. However the prevalence of mild dementia increased from 9.1% in the 'normal nutrition' group, to 18.2% in the 'at risk' group, and was the highest in the 'malnourished' group (23.1%). Whereas the prevalence of 'no psychological problems' was highest in the 'normal nutrition' status group (90.9%).

4.6.6 BMI and Calf Circumference

A BMI was recorded for 55 of the participants, of which 61.4% had a BMI in the highest category (greater than 23kg/m^2). The nutrition status group with the highest prevalence in this BMI group was the 'normal nutrition' group (90.9%). Only 12.3% of the study participants were in the lowest BMI category, of less

than 19kg/m^2. The nutrition status group with the highest prevalence in this BMI group was the 'malnourished group' (46.2%). The CC was used in place of BMI for the two participants who did not have a height or weight taken. Both of these participants had a CC over 31cm.

4.7 Nutrition Risk Factors

Table 13 displays the prevalence of the nutrition risk factors in each of the three nutrition status categories as defined by the MNA-SF (Kaiser et al., 2009): 'malnourished' (0-7 points), 'at risk of malnutrition' (8-11 points), and 'normal nutrition' status (12-14 points).

Table 13: *MNA-SF Nutrition Risk Status and Participant Sociodemographic, Health and Support Service Risk Factors*[1]

	Malnourished[2] **n (%)**	At risk[2]	Normal[2]
Total n=57	13 (22.8)	33 (57.9)	11 (19.3)
Marital Status			
Married/partnered	7 (53.8)	11 (33.3)	4 (36.4)
Widowed	4 (30.8)	17 (51.5)	4 (36.4)
Divorced/separated	0 (0)	2 (6.1)	2 (18.2)
Never married	2 (15.4)	3 (9.1)	1 (9.1)
Living Situation			
Living alone	3 (23.1)	18 (54.5)	6 (54.5)
Living with spouse only	7 (53.8)	9 (27.3)	3 (27.3)
Living with others	3 (23.1)	6 (18.2)	2 (18.2)
Income			
Pension only income	9 (69.2)	21 (63.6)	4 (36.4)
Pension plus other income	4 (30.8)	12 (36.4)	7 (63.6)
Education			
Primary	7 (53.8)	17 (51.5)	4 (36.4)
Secondary	6 (46.2)	10 (30.3)	3 (27.3)
Tertiary	0 (0)	6 (18.2)	4 (36.4)
BMI (kg/m^2)[3]			
Underweight <18.50*	5 (38.5)	1 (3.2)	0 (0)
Normal 18.50–24.99	7 (53.8)	14 (45.2)	4 (36.4)
Overweight/obese ≥25.00*	1 (7.7)	16 (51.6)	7 (63.6)
Health Conditions			
≥4 Key Comorbidities	12 (92.3)	28 (84.8)	10 (90.9)
<4 Key Comorbidities	1 (7.7)	5 (15.2)	1 (9.1)
Regular Prescribed Medications			
<5 medications	1 (7.7)	2 (6.1)	1 (9.1)
≥5 medications	12 (92.3)	31 (93.9)	10 (90.9)
Over-the-counter Nutrition Supplements			
Taking Regular Nutrition Supplements	3 (23.1)	8 (24.2)	5 (45.5)
Not Taking Regular Nutrition Supplements	10 (76.9)	25 (75.8)	6 (54.5)

Dental Status			
Dentate	4 (30.8)	8 (24.2)	3 (27.3)
Dental Appliance	9 (69.2)	25 (75.8)	8 (72.7)
Dysphagia			
Not 'at risk' of swallowing difficulties	10 (76.9)	29 (87.9)	9 (81.8)
'At risk' of swallowing difficulties	3 (23.1)	4 (12.1)	2 (18.2)
Cognition[3]			
'Normal cognitive function'	2 (22.2)	1 (3.0)	2 (20.0)
'Below normal cognitive function'	7 (77.8)	24 (96.0)	8 (80.0)
Support Service			
Receiving support service*	3 (23.1)	18 (54.5	6 (54.5)
Not receiving support service	10 (76.9)	15 (45.5)	5 (45.5)
Need daily help	7 (53.8)	21 (63.6)	8 (72.7)
Not needing daily help	6 (46.2)	12 (36.4)	3 (27.3)

*Significant difference between nutrition status groups, $p<0.05$
[1] Results expressed as count (percentage)
[2]Comparisons between nutrition status groups were performed by the Pearson Chi-Square test and Fisher's Exact test (2-tailed)
[3]Missing values

4.7.1 Sociodemographic Nutrition Risk Factors

4.7.1.1 Marital Status

There was little difference across the nutrition status groups in the numbers who had never married, however, among those who had been married, the malnourished group had a higher prevalence who were still married/partnered (53.8%). The 'at risk' group was the most likely to be widowed (51.5%), and there was little difference across groups in the numbers who were divorced/separated.

4.7.1.2 Living Situation

Living with spouse or living with others was more common in the 'malnourished' group (76.9%), compared to 45.5% of those 'at risk' and 45.5% of those with 'normal' nutrition status.

4.7.1.3 Income

The frequency of those receiving 'pension only income' (as opposed to 'pension plus other income') decreased with increasing nutrition status: the 'malnourished' group were most likely to receive 'pension only income' (69.2%) compared to 63.6% and 36.4% of the 'at risk' and 'normal nutrition' groups, respectively.

4.7.1.4 Education

Primary and secondary as the highest level of education, were most frequently reported in the 'malnourished' group, at 53.8% and 46.2% respectively. Primary and secondary as the highest level of education decreased to 51.5% and 30.3% in the 'at risk' group, respectively. Therefore 'normal nutrition' status least frequently reported primary and secondary as highest level of education at 36.4% and 27.3% respectively. Conversely, tertiary as the highest level of education was highest amongst those with 'normal' nutrition status (36.4%).

Between the 'malnourished', 'at risk of malnutrition' and 'normal nutrition' status groups, there was no statistically significant differences in sociodemographic risk factors (Chi-Square and Fisher's Exact tests). When being married/partnered was compared with all other marital status' and likewise for living alone, pension on income, and primary level education, there were still no significant differences between the nutrition status groups.

4.7.2 Health Risk Factors

4.7.2.1 BMI

The prevalence of participants with an underweight BMI was significantly different between the 'at risk of malnutrition' group and the 'malnourished' group, when analysed by the Fisher's Exact test (p=0.006). The 'malnourished' group had a significantly higher prevalence of underweight BMI participants (38.5%) compared to the 'at risk' group (3.2%). Additionally, between the 'normal nutrition' status group and the 'malnourished' group, there was a significant difference in the prevalence of underweight BMI. 38.5% of those who were 'malnourished' had an underweight BMI, compared to 0% of those in the 'normal nutrition' status group (p=0.041) (Fisher's Exact test). There was no significant difference between the 'normal nutrition' status group and the 'at risk of malnutrition' group among the three BMI groups.

The percentage of normal BMI was highest in the 'malnourished' group at 53.8%, and this decreased to 45.2% of the 'at risk' group and 36.4% of the 'normal nutrition' status group.

The prevalence of overweight/obesity increased from 7.7% in the 'malnourished' group, to 51.6% of the 'at risk' group, and was highest in the 'normal nutrition' status group (63.6%). The prevalence of having an overweight BMI between the 'at risk of malnutrition' group and the 'malnourished' group was significantly different (p=0.007) (Fisher's Exact test). Significantly more participants in the 'at risk of malnutrition' group (51.6%) than 'malnourished' group (7.7%) had an overweight BMI. Additionally there were significantly more people in the 'normal nutrition' status group who were in the BMI overweight category (63.6%) compared to the 'malnourished' group (7.7%) (p=0.008) (Fisher's Exact test).

4.7.2.2 Health Conditions

The prevalence of participants experiencing four or more key comorbidities was common across all three nutrition status groups, and ranged from 84.8% in the 'at risk of malnutrition group' to 92.3% in the 'malnourished' group.

4.7.2.3 Regular Prescribed Medications

Participants taking five or more prescribed medications regularly, was similar across the three nutrition status groups: 92.3%, 93.9% and 90.9% of those in the 'malnourished', 'at risk' and 'normal nutrition' groups, respectively.

4.7.2.4 Regular Over-the-counter Nutrition Supplements

The prevalence of those taking over-the-counter nutrition supplements regularly was highest in the normal nutrition status group (45.5%), with the other two groups having similar levels of intake; 23.1% in the 'malnourished' group and 24.2% in the 'at risk' group.

4.7.2.5 Dental Status

There were only small differences across the nutrition status groups in terms of dental status. The 'malnourished' group had a slightly higher prevalence of older adults with dentate dental status (30.8%), followed by the 'normal nutrition' group (27.3%), with the 'at risk' group having the lowest prevalence (24.2%). Therefore, having a dental appliance was slightly more prevalent in the 'at risk' group (75.8%), followed by the 'normal nutrition' group (72.7%), and then the 'malnourished' group (69.2%). None of the 57 participants in the study were edentulous.

4.7.2.6 Dysphagia Risk

Being ‘at risk’ of swallowing difficulties was more commonly reported in the ‘malnourished’ group (23.1%), however there was not a lot of difference between all three groups.

4.7.2.7 Cognitive Status

In all of the nutrition status groups the majority of participants had below normal cognitive function.

4.7.3 Support Service Nutrition Risk Factors

Receiving regular support services was more common in the ‘at risk’ and ‘normal nutrition’ groups (54.5% of each group), than the ‘malnourished’ group (23.1%). Therefore, not receiving support was most common in the ‘malnourished’ group (76.9%). The frequency of those reporting ‘needing help with daily tasks’ increased as nutrition status improved: the percentage in the ‘malnourished group’ was 53.8%, the ‘at risk’ group was 63.6%, and the ‘normal nutrition’ group was 72.7%.

Between the ‘at risk’ and the ‘malnourished’ group, the difference in prevalence of those receiving regular subsidised support almost reached significance using the Chi-Square test (p=0.054). However, there were no significant differences among the ‘malnourished’ and ‘normal nutrition’ group, or the ‘at risk of malnutrition’ and ‘normal nutrition’ group in terms of receiving regular subsidised support. Additionally, there were no significant differences among the three nutrition status groups and the need for help with daily tasks (Chi-Square and Fisher’s Exact test).

4.7.4 Participant Risk Factors by those At Nutrition Risk and those Not at Nutrition Risk

When the MNA-SF scores were categorised using the cut-offs of ‘at nutrition risk’ (<12 points) and ‘not at nutrition risk’ (≥12 points) (Rubenstein et al., 2001), there were 46 (80.7%) and 11 (19.3%) participants respectively in each group (**Table 14**). Although only one significant difference was found between the two groups (Chi-Square and Fisher’s Exact tests), a number of risk factors showed trends of having a higher prevalence in participants at nutrition risk.

Table 14: *At Risk and Not at Risk MNA-SF Nutrition Status and Participant Sociodemographic, Health and Support Service Factors*[1]

	At Nutrition Risk **n (%)**	Not At Nutrition Risk
Total n=57	46 (80.7)	11 (19.3)
Age		
65-74 years	9 (19.6)	2 (18.2)
75-84 years	18 (39.1)	4 (36.4)
85+ years	19 (41.3)	5 (45.5)
Gender		
Men	18 (39.1)	5 (45.5)
Women	28 (60.9)	6 (54.5)
Marital Status		
Married/partnered	18 (39.1)	4 (36.4)
Widowed	21 (45.7)	4 (36.4)
Divorced/separated	2 (4.3)	2 (18.2)
Never married	5 (10.9)	1 (9.1)
Living Situation		
Living alone	21 (45.7)	6 (54.5)
Living with spouse only	16 (34.8)	3 (27.3)
Living with others	9 (19.6)	2 (18.2)
Income		
Pension only income	30 (65.2)	4 (36.4)
Pension plus other income	16 (34.8)	7 (63.6)
Education		
Primary	24 (52.2)	4 (36.4)
Secondary	16 (34.8)	3 (27.3)
Tertiary	6 (13.0)	4 (36.4)
Food Intake		
Moderate decrease	17 (37.0)	2 (18.2)
No decrease	28 (60.9)	9 (81.8)
Weight loss >1kg	26 (56.5)	1 (9.1)*
BMI (kg/m^2)		
Underweight <18.50	6 (13.0)	0 (0)
Normal 18.50–24.99	21 (45.7)	4 (36.4)
Overweight/obese ≥25.00	17 (37.0)	7 (63.6)
Psychological stress or acute disease in the past 3 months	43 (93.5)	2 (18.2)
Health Conditions		
≥4 Key Comorbidities	40 (87.0)	10 (90.9)
<4 Key Comorbidities	6 (13.0)	1 (9.1)
Regular Prescribed Medications		
<5 medications	3 (6.5)	1 (9.1)
≥5 medications	43 (93.5)	10 (90.9)
Nutrition Supplements		
Taking Regular Nutrition Supplements	11 (23.9)	5 (45.5)
Not Taking Regular Nutrition Supplements	35 (76.1)	6 (54.5)
Dental Status		

Dentate	12 (26.1)	3 (27.3)
Dental Appliance	34 (73.9)	8 (72.7)
Mobility		
Unable to get out of bed	1 (2.1)	0 (0.0)
Able to get out of bed/chair but does not go out	40 (87.0)	7 (63.6)
Goes out	5 (10.9)	4 (36.4)
Dysphagia		
Not 'at risk' of swallowing difficulties	39 (84.8)	9 (81.8)
'At risk' of swallowing difficulties	7 (15.2)	2 (18.2)
Cognition		
'Normal cognitive function'	3 (8.8)	2 (20.0)
'Below normal cognitive function'	31 (91.2)	8 (80.0)
Neuropsychological problem		
Mild or severe dementia/depression	10 (21.7)	1 (9.1)
No psychological problems	36 (78.3)	10 (90.9)
Support Service		
Receiving support service	21 (45.7)	6 (54.5)
Not receiving support service	25 (54.3)	5 (45.5)
Need daily help	28 (60.9)	8 (72.7)
Not needing daily help	18 (39.1)	3 (27.3)

* Significant difference between groups, $p<0.05$ (Pearson's Chi-Square)
[1] Results expressed as count (percentage)
[2] Missing values

4.7.4.1 MNA-SF Nutrition Risk Factors More Prevalent in Participants At Nutrition Risk

A 'moderate decline in food intake' was more prevalent in participants at nutrition risk (37.0%), compared to those not at risk (18.2%). There was a significant difference (p=0.01) in the prevalence of participants who had weight loss of over 1kg in the previous three months in the nutrition risk group (56.5%), compared those not at risk (9.1%). Reduced mobility ('able to get out of bed/chair but does not go out') was more common in those at nutrition risk, compared to those not at risk, at 87.0% and 63.6% respectively. Participants at nutrition risk reported much higher levels of psychological stress or acute disease in the past three months (93.5% compared to 18.2% among those not at risk). 'Mild dementia' was also more common in the nutrition risk group. Furthermore, six participants (13%) at nutrition risk were in the underweight BMI category, compared to none in the not at nutrition risk group.

4.7.4.2 Other Nutrition Risk Factors More Prevalent in Participants At Nutrition Risk

In relation to sociodemographic risk factors, being widowed was more prevalent

in the nutrition risk group at 45.7% compared to 36.4% of participants not at risk. Participants in the at risk group were more likely to be receiving ‘pension only income,’ compared to those who were not at risk, at 65.2% and 36.4% respectively. Further, 52.2% of those at nutrition risk had only primary level education, compared to 36.4% in the not at risk group.

There was half the usage of nutrition supplements in the nutrition risk group compared to those not at risk. Finally, the prevalence receiving regular support services was 45.7% of those at nutrition risk and 54.5% of those not at risk.

Chapter 5 - Discussion

The purpose of this study was to determine the prevalence of nutrition risk in hospitalised older adults, and identify the factors associated with nutrition risk. This study was carried out on the AT&R wards at North Shore and Waitakere Hospitals in Auckland. To our knowledge this is the only study in New Zealand which has investigated nutrition risk, as well as nutrition risk factors, in this population.

5.1 Prevalence of Nutrition Risk

The present study found that nutrition risk was evident in 81 percent of this sample (23% were 'malnourished,' and a further 58% were 'at risk of malnutrition'). Therefore, on admission to the AT&R wards, only 19 percent of participants had 'normal' nutrition status.

Another New Zealand study of nutrition risk prevalence in AT&R wards (Middlemore Hospital), identified 68 percent (n=48) of older adults were at nutrition risk (Van Lill, 2002). Similarly, an international review of 8500 hospitalised older adults in 36 studies, found that approximately 69 percent were at nutrition risk (Guigoz, 2006). Therefore the present study has a high prevalence of nutrition risk (81%) compared to many other studies of hospitalised older adults. This may be due to the poor health status or older age of the current population.

A study in Australia which assessed the nutrition status of older adults in rehabilitation (n=133), found a much lower prevalence of nutrition risk than the current study (Neumann, 2005), where half (53%) of participants were at nutrition risk. However, the population may not have been representative of older adults in rehabilitation, as they were considered a 'healthy' group. The higher levels of nutrition risk in the present study may be due to the study participants being a relatively unwell population. For example, in the current study 88 percent of participants experienced four or more key comorbidities, compared to only 18 percent of older adults in the 2002/2003 New Zealand Health Survey (Ministry of Health, 2006b). Poor health status may increase

nutrition risk through factors such as increased nutrition requirements; poor appetite and nutrient absorption; and decreased functionality limiting the ability to prepare and consume food (American Dietetic Association, 2005; Norman, Pichard, Lochs, & Pirlich, 2008).

The higher median age (83 years) of participants in the present study may also have contributed to increased nutrition risk prevalence, as younger age has previously been associated with better nutrition status. For example, two studies with younger populations in the United Kingdom (mean age of 78 years) (Stratton et al., 2004), and Mexico (mean age of 71 years) (Reyes, Zuniga, & Cruz, 2006), found nutrition risk prevalences of 65 percent and 70 percent respectively. In the present study the prevalence of nutrition risk increased by age group; 20 percent in the 65 to 74 year old group, 39 percent among those aged 75 to 84 years, and 41 percent of participants aged over 85 years.

The high prevalence of nutrition risk in the current study may predispose the participants to increased complications, longer length of hospital stay, and decreased quality-of-life. Among 709 participants in a study in Brazil, malnourished patients had a higher incidence of complications (RR 1.60) (such as respiratory failure, cardiac arrest, and wound dehiscence) and mortality (RR 2.63), than participants who were well-nourished (Correia & Waitzberg, 2003). The increase in complications can lead to a slower recovery and increased length of stay in hospital. Among 1886 hospital patients in Germany, malnutrition was associated with a 43 percent increase in length of hospital stay ($p<0.001$) (Pirlich et al., 2006). Another hospital study of 850 patients in England also found a longer length of hospital stay in those with poorer nutrition status, as well as an increased risk of infections (Edington et al., 2000). Additionally, in a United States study of 837 adults in rehabilitation, participants who were malnourished were significantly more likely to be readmitted to an acute care hospital, compared to those who were well-nourished (Thomas et al., 2002). The adverse effects on those who are poorly nourished may have consequences persisting long after discharge. An Australian study (n=133) found participants who were at nutrition risk had poorer function and quality-of-life 90 days after admission, and almost twice the likelihood of being admitted to

higher level care post discharge (Neumann, 2005). This evidence suggests poor nutrition status on admission to AT&R is associated with poor health outcomes during admission, which may continue to adversely affect patients post discharge. It is therefore imperative to identify those at nutrition risk and provide dietetic intervention.

5.2 Participant Nutrition Risk Factors

This study highlights important risk factors that may predispose older adults to increased nutrition risk (**Table 15**). Firstly, the MNA-SF identifies six key risk factors based on items from the full MNA that had the highest correlation with the final MNA score, highest diagnostic accuracy, minimal investigation time, and lowest amount of 'don't know' answers. Secondly, other risk factors were identified from sociodemographic, health and support service characteristics of the study participants.

Table 15: *Participant Key Risk Factors*

MNA-SF Risk Factors	At Nutrition Risk (%)	Not At Nutrition Risk (%)
A-Moderate Decrease in Food Intake	37	18
B-Unintentional Weight Loss (>1kg)	57	9
C-Reduced Mobility ('does not go out')	87	64
D-Psychological Stress or Acute Disease	94	18
E-Neuropsychological Problems	22	9
F-Underweight BMI	13	0
Other Risk Factors		
Widowhood	46	36
Low Income	65	36
Low Level of Education	52	36
Low Use of Nutrition Supplements	24	46
Low Use of Support Services	46	55

5.2.1 Mini Nutritional Assessment-Short Form Risk Factors

5.2.1.1 Decrease in Food Intake

In the present study, a recent 'moderate decrease in food intake' was found in 37 percent of participants at nutrition risk, compared to 18 percent of those not at risk. This finding was similar to studies of adults aged over 75 years in Israel (Kagansky, 2005) and Finland (Soini, Routasalo, & Lagstrom, 2004), which

found a decrease in food intake was significantly associated with nutrition risk. Similarly, a study in Sweden of 258 older adults found participants at nutrition risk had a significantly higher prevalence of a reduced food intake (37%), compared to those not at risk (6%) (Johansson, 2009). This association could be attributed to the reduced food intake leading to a decline in energy intake, nutrient deficiencies and weight loss (Elmstahl et al., 1997; Roberts, Wolfson, & Payette, 2007).

Reduced food intake is common in older adults (Ministry of Health, 2013b), and can be caused by factors associated with ageing such as reduced appetite, decreased sense of taste and smell, swallowing and chewing problems, or difficulty with self-feeding (Collins, 2003; Hickson, 2006). A nutrient-dense diet is needed to support adequate provision of essential nutrients when energy intake is low. Further research could identify community interventions to avoid reduced food intake before older adults require hospitalisation.

Participants in the present study may have also experienced reduced food intake due to factors associated with their first few days of hospital admission. These include a low intake following an acute health episode (such as a stroke); unappetising or unfamiliar hospital food; lack of flexibility in hospital catering; and interruption or withholding of meals for procedures (Gary & Fleury, 2002; Pennington, 1998). Furthermore, hospitalisation may result in unpleasant sights and smells reducing appetite, or a lack of assistance with feeding for those who have reduced functionality. This supports the results of a United States study of 417 older adults, which found hospitalised men consumed 653kcal less than men at home (p<0.05) (Mowe et al., 1994). It is therefore important that these patients with reduced food intake receive dietetic supported to meet their nutrition requirements while in hospital.

5.2.1.2 Unintentional Weight Loss

Fifty seven percent of participants at nutrition risk had ‘weight loss greater than 1kg’ in the previous three months, compared to only nine percent of participants not at risk. This finding agrees with previous studies which have found weight loss is associated with a poorer nutrition status. In a New Zealand study of 152 community-living older adults, 79 percent of participants in the high-nutrition risk

group had experienced unintentional weight change, compared to only three percent of those not at nutrition risk (Watson, 2010). Additionally, studies of older adults in Sweden (Johansson, 2009) and Egypt (Amer, Mousa, Abdel Rahman, & Saber, 2009) found a significantly higher prevalence of weight loss in participants at nutrition risk compared to those not at risk.

Weight loss is a component in the majority of nutrition risk screening tools, and has been described as an independent risk parameter for malnutrition (Hengstermann, Nieczaj, Steinhagen-Thiessen, & Schulz, 2008). Specifically, a weight loss of greater than five percent over a period of three months has been associated with an increased risk for malnutrition (Hickson, 2006), and in frail older adults even a weight loss of three percent may be significant (Payette et al., 1999; Tully & Snowdon, 1995).

Weight loss in older adults is associated with a disproportionate loss of lean body tissue. Severe muscle loss is termed sarcopenia and is associated with functional impairments, falls, and disability (Chapman, MacIntosh, Morley, & Horowitz, 2002; Rolland et al., 2008). In a prospective cohort study of 426 older adults (mean age of 76 years), weight loss was associated with a two-fold increase in the risk for disability (Launer, Harris, Rumpel, & Madans, 1994). Additionally, a study over eight years in Auckland hospital found that over 10 percent weight loss significantly reduced skeletal and respiratory function, increased fatigue, and impaired wound healing, and increased the number of complications during admission (infection, pneumonia, mortality, increased length of stay) (Hill, 1992). This suggests that weighing patients on admission to hospital must be a routine practise in order to identify weight loss, and avoid or alleviate the associated consequences.

5.2.1.3 Reduced Mobility

A higher proportion of participants at nutrition risk had restricted mobility (‘able to get out of bed/chair, but does not go out’) (87%), compared to participants not at risk (64%). This findings was similar to a study of 808 older adults in a German hospital, which found enhanced mobility in participants who had a better nutrition status; 36 percent of the well-nourished group were ‘able to get out of bed/chair but does not go out,’ compared to only 14 percent in the

malnourished group (Hengstermann et al., 2008). Other studies among older adults have also indicated that poor nutrition increased the risk of reduced mobility. In Israel, participants who were malnourished had a higher prevalence of impaired mobility, compared to those at risk of malnutrition (Feldblum et al., 2007). Similarly, a study in Sweden of 258 adults (71 to 80 years), found a significantly higher prevalence of requiring special transport services in participants at nutrition risk (37%), compared to those not at risk (13%) (Johansson, 2009).

This association may be attributed to the loss of lean muscle tissue associated with poor nutrition status, which reduces muscle strength and function, and aerobic capacity (Evans, 1995). This can restrict functionality and mobility and hence being able to 'go out.' The prevalence of participants in the current study with mobility classified as 'goes out,' was 36 percent in those not at nutrition risk, compared to only 11 percent of participants at nutrition risk. Restricted mobility may affect nutritional intake as it may limit the frequency of purchasing food, or the types of food that frail older adults can manage to procure (Wylie, Copeman, & Kirk, 1999). Ensuring hospitalised older adults with impaired mobility are provided adequate assistance for discharge, may therefore be an important factor in preventing further decline of nutrition status when they return to the community.

5.2.1.4 Psychological Stress or Acute Disease

The present study found 'psychological stress or acute disease in the previous three months' was experienced by 94 percent of participants at nutrition risk, compared to only 18 percent of those not at risk. This supports the results of a United States study amongst 142 adults (mean age of 76.4 years) which found acute illness and stress was well correlated (r=.781) with poor nutrition status (Rubenstein et al., 2001).

This trend may be due to the inflammatory response caused by acute illness which may alter energy metabolism and cause protein catabolism (Felblinger, 2003). In addition to this, older adults generally have a declining anabolic response to protein intake (Bauer et al., 2013), and acute illness may be less likely to consume adequate food due to factors such as low appetite, pain,

nausea or periods of nil-by-mouth (Collins, 2003; Hengstermann et al., 2008; Thomas et al., 2002). Therefore during periods of hospitalisation, older adults may be particularly vulnerable to poor protein status. This was found in a Dutch study of 610 hospitalised older adults, where only 28 percent met protein intake targets (Leistra et al., 2011). Furthermore, a French study of 49 hospitalised older adults found that the 'sickest patients' were the least likely to meet recommended protein intake, and were most likely to be poorly nourished (Perier et al., 2004).

By the time patients are admitted to rehabilitation wards, they have generally become medically stable following their acute illness. Therefore while nutrition status can be improved in this setting, it would be more valuable for patients to have intensive nutrition intervention during their initial illness on the acute hospital wards. Further research could investigate the nutrition screening protocols on these wards to evaluate whether malnourished patients are being identified and treated before they reach rehabilitation wards.

Older adults are generally prescribed more medications during periods of acute disease. In previous research, an increased number of medications has been associated with poorer nutrition status (McCormack, 1997). Two studies of hospitalised older adults in England (n=850) (Edington et al., 2000) and the Netherlands (n=155) (Naber, 1997) found participants who were malnourished were prescribed significantly more medications per day, than those who were not malnourished. Furthermore, studies in Germany (n=1886) (Pirlich et al., 2006), and Egypt (n=100) (Amer et al., 2009) found that polypharmacy was an independent risk factor for malnutrition. Contrary to what was anticipated, the present study found no association between nutrition status and polypharmacy (five or more medications per day). However, polypharmacy levels were high in both participants at nutrition risk, and those not at risk, at 94 percent and 91 percent respectively. This could be due to the study population being a relatively unwell group with multiple key-comorbidities, and therefore polypharmacy was high regardless of nutrition status.

The association found between polypharmacy and poor nutrition status found in previous studies may be due to the side effects of medications such as

xerostomia and altered taste, or medication-nutrient interactions such as interference with vitamin status (Gariballa, 2004; Ministry of Health, 2013b).

5.2.1.5 Low Level of Cognitive Function

'Mild dementia' was more common in the nutrition risk group compared to participants not at risk, at 20 and nine percent respectively. This association between nutrition status and cognitive function is supported by previous studies. A study of 258 older adults in Sweden found that those who were at risk of malnutrition had a higher prevalence of memory impairment than those who were well-nourished (Johansson, 2009). Similarly, a study in Israel of 259 older adults found lower cognitive function was a significant risk factor for malnutrition (Feldblum et al., 2007). Other studies have found that this association strengthens as cognitive status deteriorates; in Sweden among 1400 older adults, nutrition declined further as cognitive impairment worsened (Fagerstrom et al., 2011). Declining cognitive status is common in ageing, and is likely an important predictor of nutrition risk due to the associated side effects of poor cognition.

Nutrition risk may increase with cognitive impairment due to associated factors such as refusing or forgetting to eat, difficulty understanding directions or verbalising needs, becoming easily distracted, reduced appetite, sensory changes, dysphagia, or increased energy expenditure (Lou et al., 2007; Teo, 2001; Watson & Green, 2006). All of these factors can contribute to inadequate food intake, and subsequent nutrient deficiencies, weight loss and a declining BMI. This is supported by a French study of 331 older adults, which found BMI was significantly lower in those with cognitive impairment, compared to those with normal cognition (Farid et al., 2013).

With impaired cognition known to adversely affect nutrition status, it is important to screen older adults to identify a decline in cognitive function, and then manage nutrition status accordingly. This is especially important due to the ageing population likely to increase this problem, as dementia prevalence is estimated to increase from one percent in adults aged 60 to 64 years to 30 percent in those aged over 85 years (Lewis, 2002).

5.2.1.6 Underweight BMI

BMI is often used as a marker of nutrition status (Green & Watson, 2006; Kuczmarski., 1994). As anticipated, the present study found a higher prevalence of participants with an underweight BMI among the nutrition risk group (13%), compared to those not at risk (0%). This is supported by a similar study in a German hospital of 808 older adults where 49 percent of those at nutrition risk had an underweight BMI, compared to three percent of those not at nutrition risk (Hengstermann et al., 2008). This is consistent with similar studies of hospitalised older adults in Iceland (Thorsdottir, 2005), and Israel (Feldblum et al., 2007) which found participants at nutrition risk had significantly lower BMI's than those not at nutrition risk. A low BMI was also found to correlate well with total MNA score in a United States study of 142 older adults (mean age of 76 years) (Rubenstein et al., 2001).

Despite the strong association between low BMI and poor nutrition status, BMI may not be a reliable marker of nutrition status in some circumstances. For example, BMI may over estimate nutrition risk in older adults with a naturally small frame, or under estimate nutrition risk in hospitalised patients with oedema or ascites (Harris & Haboubi, 2005). Additionally, patients who have recently had poor oral intake may be at nutrition risk despite their BMI's remaining high (Vellas et al., 1999). BMI as a one-off measure also does not identify recent unintentional weight loss which is a significant nutrition risk factor. It is therefore important that if BMI is calculated to determine nutrition risk, it is used in conjunction with other markers of poor nutrition status, such as reduced food intake and recent weight loss.

A further finding of the current study was a higher prevalence of overweight BMI among participants not at nutrition risk (64%), compared to those at risk (37%). Future research could evaluate the potential protective effect of an overweight BMI against nutrition risk among older adults.

5.2.2 Other Factors Associated with Nutrition Risk

5.2.2.1 Widowhood

The current study found a higher prevalence of being widowed (46%) among

participants at nutrition risk, compared to those not at risk (36%). This finding is consistent with previous studies; for example, a New Zealand study which investigated nutrition risk factors in 108 community-living older adults, found 66 percent of participants at high-nutrition risk were widowed, compared to only 37 percent of those in the low-nutrition risk group (Wham, 2011). This is supported by two other studies of over 370 older adults in Israel which found malnutrition (Feldblum et al., 2007) and weight loss (Shahar, 2001) were more common in those who were widowed.

The association between widowhood and poorer nutrition status may be due to loneliness and bereavement, resulting in a low appetite. In a study of 16 older adults, 11 participants were widowed and of those, seven reported that their food intake had reduced since the loss of their spouse due to loneliness, no longer enjoying food, a lower appetite, or forgetting to eat proper meals (Wylie et al., 1999). Poor nutrition status in widowers may also be due to a decreased motivation to procure and prepare meals. This was supported by further studies of older adults in the United States which found that being widowed was associated with a lack of interest in meal planning, shopping and food preparation (Rosenbloom, 1993), and increased likelihood of skipping meals or having smaller meals with reduced variety (Gustafsson & Sidenvall, 2002; Quandt, McDonald, Arcury, Bell, & Vitolins, 2000). These factors can lead to low energy and nutrient intake, and subsequently poor nutrition status.

5.2.2.2 Low Income

In the present study receiving pension only income (as opposed to pension plus other income) was more prevalent in the nutrition risk group (65%), compared to those not at risk (36%). This finding is supported by studies among older adults in England (Elia & Stratton, 2005), and the United States (Locher et al., 2005) which found poorer socioeconomic status was associated with a higher prevalence of nutrition risk. Another study of 100 older adults (mean age of 72 years) in Egypt found that experiencing ‘economic hardship’ was significantly more common in participants at nutrition risk (22%), compared to those not at risk (4%) (p=0.037) (Amer et al., 2009). As anticipated, a study of 2675 older adults in the NHANES (1999 to 2002) found being ‘fully food secure’ increased

from 77 percent in the low-income group, to 99 percent in the high-income group (Bowman., 2007).

The association between low income and poorer nutrition status may be attributed to an inability to afford enough food or nutrient-dense food. The NHANES (1999 to 2002) study (Bowman., 2007) found daily energy intake increased with income level, suggesting a greater food intake at higher income levels, which may promote a better nutrition status. Dietary variety increases along with food intake among those receiving higher income. This is supported by studies in the United States (n=3477) (Davis, Randall, Forthofer, Lee, & Margen, 1985) and Israel (n=322) (Shahar, 2005) which found those with higher socioeconomic status had a greater energy and nutrient intake, and dietary quality. Another study of 805 older adults in the United States suggested that this association between low income and poor nutrition status may be due to financial stress causing a poor appetite and therefore reduced dietary intake (McIntosh, Shifflett, & Picou, 1989).

5.2.2.3 Low Level of Education

The current study found participants whose highest level of education was primary experienced greater prevalence of nutrition risk, compared to those not at risk (52% and 36% respectively). This finding is consistent with a study of 49 adults aged 66 to 93 years in the United States, where lower education was found to predict lower BMI, a marker for poor nutrition status. (Ritchie et al., 1997). Additionally in a study of 256 hospitalised older adults, having less than 12 years of education was a significant risk factor for malnutrition (Feldblum et al., 2007).

A lower level of education may also be associated with a poorer nutrition, simply because it acts as a marker of lower socioeconomic status (Bowman., 2007; Shahar, 2005). This trend was observed in the current study where 61 percent of participants with primary level of education were receiving pension-only income.

The association between education and nutrition may also be due to those with a higher level of education having a greater understanding of the importance of

good nutrition, and the knowledge of how to apply that to daily food choices and cooking. A study of 68 community-living older adults in the United States found those who were well-educated placed more importance on being knowledgeable about nutritional health, and demonstrated behaviours such as cutting down on fats, grilling or baking instead of frying, increasing vegetable intake and taking daily multivitamins (Callen & Wells, 2003). These participants were also noted to regularly read about nutrition, and attend nutrition-related classes in their communities. Conversely, a lack of education about nutrition and practical cooking skills may limit food choices and the ability to improve dietary behaviours (Caraher et al., 1999). The hospital rehabilitation setting provides a good opportunity for patients to be educated about enhancing their nutrition status and the options available to them in the community (such as MOW, shopping tours, Age Concern courses). Future studies could evaluate the effectiveness of group education classes held by dietitians on the rehabilitation wards.

5.2.2.4 Low Use of Nutrition Supplements

The current study found the prevalence of taking nutrition supplements (for example vitamins, minerals, and special foods such as Fortisip and Ensure) was higher among participants not at nutrition risk (46%), compared to those who were at nutrition risk (24%). This association may have been through the nutrition supplements assisting with energy and nutrient requirements, weight maintenance, and subsequently nutrition status. This is supported by a study of 20 older adults in England that found participants who were consuming a nutritionally complete drink were more likely to meet nutrient requirements, and experienced significant improvements in anthropometric measures (Hankey, Summerbell, & Wynne, 1993). Similarly, nutrition supplementation was seen to increase energy and nutrient intake with no reduction in voluntary food intake in a study of 88 older adults in France (Lauque et al., 2000). This subsequently resulted in increased weight and improvements in the nutrition risk screening scores of these participants. Furthermore, in a study of 501 hospitalised older adults, participants who received nutrition supplementation had a lower prevalence of malnutrition after 26 weeks (Larsson et al., 1990). Therefore nutrition supplements are useful for improving nutrition status while in hospital,

but may also prevent deterioration in nutrition status among older adults in the community. It would therefore be useful for older adults in rehabilitation, who may struggle to maintain their nutrition status on discharge, to be made aware of nutrition supplements available over-the-counter.

5.2.2.5 Low Use of Support Services

The present study found that participants who were not at nutrition risk were more likely to receive regular support services (55%), compared to those at nutrition risk (46%). In contrast with the present study, previous studies have found participants at nutrition risk receive higher levels of support than those not at risk. Studies in Sweden (n=258) (Johansson, 2009), Australia (n=250) (Visvanathan et al., 2003), and Norway (n=158) (Tomstad et al., 2012) found participants with poorer nutrition status were more likely to be receiving MOW, more hours of formal care, home help and family assistance. This may be explained by previous studies of older adults in Germany (Hengstermann et al., 2008) and Sweden (Johansson, 2009) which found participants at nutrition risk had a significantly reduced ability to perform activities-of-daily living (including mobility, and feeding), when compared to participants not at risk. Furthermore, a study of 100 older adults in Egypt found those who were at nutrition risk exhibited a higher prevalence of requiring assistance with self-care (29%), compared to those who were not at risk (13%) (Amer et al., 2009). Therefore older adults with poor nutrition may have impaired functionality, which limits their ability to perform daily activities, including shopping and cooking, and increases their need for support services.

However in the present study, receiving support services may have been more common in those not at risk, due to an improvement in nutrition status following commencement of support services. This is because support services can enhance nutrition status through assistance with meal delivery, shopping, cooking, transport, and also provide socialisation and help with household work and personal cares (Frongillo, Isaacman, Horan, Wethington, & Pillemer, 2010; Krondl et al., 2003). This is supported by a United States study: of 81 adults aged over 60 years, those who received home-delivered meals had significantly greater improvement in nutrition compared to the control group (Suda, Marske,

Flaherty, Zdrodowski, & Morley, 2000). Furthermore, of 203 older adults in the United States who received six months of support service, 47 percent improved from a 'malnourished' to a 'well-nourished' nutrition score (Kretser et al., 2003). Assessing the needs of patients on the rehabilitation wards may therefore be an important practise; putting personal cares and home help in place may reduce the risk of developing poor nutrition on discharge.

5.3 Dysphagia Screening (EAT-10)

In the present study, the EAT-10 was used to screen for dysphagia risk. The EAT-10 is made up of 10 questions which are scored from zero to four points, and this contributes to a final score which assesses dysphagia risk. In the present study the prevalence of participants 'at risk of dysphagia' was low, at only 16 percent. Among these participants the three swallowing problems which scored the most points were 'swallowing solids takes extra effort,' 'swallowing pills takes extra effort,' and 'I cough when I eat.'

Dysphagia has been associated with a poorer nutrition status due to factors such as reduced food intake due to fear of choking; low acceptability of texture modified diets; slower eating; and extended periods of nil-by-mouth (Mann et al., 2013). Previous research has demonstrated this association between dysphagia risk and nutrition status. Dysphagia was found to be more prevalent in participants who were at nutrition risk in studies in Israel (Feldblum et al., 2007) and Spain (Serra-Prat et al., 2012). Furthermore, a recent large study in Japan (n=874) of adults aged over 65 years found a significant association (p=0.02) between dysphagia and malnutrition among this sample of community-living older adults (Takeuchi et al., 2014). However, this Japanese study had a high overall prevalence of dysphagia risk (59%), compared to only 16 percent in the present study.

Unlike what was anticipated, the present study did not find an association between dysphagia risk and nutrition; 15 percent of participants at nutrition risk were found to be at risk of dysphagia, and 18 percent of participants not at nutrition risk. Therefore dysphagia risk did not appear to contribute to poorer nutrition status among the present study participants.

5.4 Cognition Screening (MoCA)

As part of the study protocol cognitive screening was undertaken using the MoCA. The MoCA results indicated a very high proportion of cognitive impairment among the present study participants (89%), compared to the MNA-SF which identified only 19 percent of participants had 'neuropsychological problems' (provided in medical notes as part of clinical assessment). The MoCA was a more in-depth cognitive screening tool, assessing the following eight areas: visuospatial/executive, naming, memory, attention, language, abstraction, delayed recall, and orientation. In order to be classified as 'normal cognitive function' participants had to score 26 or more points out of 30. Only 11 percent of participants were classified as having 'normal cognitive function' in the present study. In general the participants appeared to have a good comprehension of the study questionnaire and were able to respond appropriately. Additionally, participants appeared to enjoy engagement in the study and discussion with the researcher. Therefore the MoCA did not appear to be a reliable indicator of cognitive function as there was no great evidence of major cognitive impairment in the majority of participants. Given the simple screen in the MNA-SF indicating only one fifth of participants had neuropsychological problems, it appears the MoCA may have overestimated the prevalence of cognitive impairment in the present study population. Future research using the MoCA in hospitalised older adults may help to clarify the reliability of its results.

This finding of the current study is in contrast to a Canadian study of 277 older adults that found the MoCA had high specificity and sensitivity to detect mild cognitive impairment (87% and 90% respectively) (Nasreddine et al., 2005). This Canadian study also showed a high correlation between the MoCA and the MMSE (r=0.87, p<0.001) (Nasreddine et al., 2005), which is the most widely used cognitive screening tool (Mitchell, 2009).

Participants in the current study who were at nutrition risk had a higher prevalence of 'below normal cognitive function' (91%), compared with those who were not at nutrition risk (80%). This association was similar to another study which also used the MoCA and the MNA to screen for cognition and

nutrition status respectively; among 120 participants (mean age of 71 years), nutrition risk was significantly higher in those with lower cognitive function (p=0.002) (Khater & Abouelezz, 2011). A similar study in Egypt of 100 older adults also found that participants at nutrition risk had significantly lower cognitive function (p=0.01) (Amer et al., 2009). Furthermore, in a study of 623 hospitalised older adults, the frequency of malnutrition in participants with mild cognitive impairment was significantly higher than those with no cognitive impairment (p<0.0001) (Orsitto et al., 2009). Therefore previous research, as well as the current study, clearly indicates cognitive impairment is an important predictor of poor nutrition status. Routine screening of cognition in rehabilitation wards may help to identify older adults who currently have normal nutrition status, but may be at risk of nutrition status deteriorating in the future. These patients could then be provided prophylactic education and support from a dietitian.

5.5 Strengths and Limitations of the Present Study

The first strength of this study included the use of a validated nutrition risk screening tool (MNA-SF), which was designed for hospitalised older adults and has been found to have high sensitivity, specificity and predictive value (Vellas et al., 1999). The overall malnutrition rate was similar to another nutrition screening study in older adults in rehabilitation wards in New Zealand (Van Lill, 2002), and an international review of 8500 hospitalised older adults (Guigoz, 2006). This suggests good reliability of the results. Additionally, the MNA is widely used internationally and therefore, study results could be directly compared with other research studies. The MNA was simple and quick to administer, and also useful in determining nutrition risk factors. Additionally, the researcher was trained on how to administer this tool and was the only person to conduct interviews, therefore reducing inter-individual variation.

Another strength of this study was the high response rate, with 100 percent of participants who were screened to be eligible, agreeing to participate. This shows that participants were comfortable with the requirements of the study, which made for a smooth recruitment process. Additionally, all patients who were screened were eligible to participate. This shows that the eligibility criteria

did not restrict inclusion.

There were a number of study limitations, which restrict the extent to which the findings can be generalised beyond the study conditions. A limitation of the present study was the restricted data collection time period, therefore resulting in the small sample size. Additionally, the convenience nature of the sampling resulted in non-randomised sampling. Further, selection bias may have occurred, as all participants were volunteers, and were identified by a Gerontologist as being suitable to participate. The fact that serial recruitment was possible, without refusals or exclusions, limits this bias somewhat. However, these factors may have resulted in a sample that is not representative of the actual population of older adults in AT&R wards, and so the results should be interpreted cautiously.

The cross-sectional study design is also a limitation, as it does not allow for comment on causality in factors related to nutrition risk. Rather, the findings that were observed can only be interpreted as potential associations. However, this was only intended to be a preliminary study and does provide useful information, as no similar previous studies have been conducted in New Zealand. Nonetheless, a larger sample size may have added statistical significance to some of the findings.

Another limitation is the lack of data collected from all of the people in the AT&R wards during the period of data collection (the number of patients in the AT&R wards from whom the 57 participants were selected). This information may have helped to indicate how representative the sample was of those admitted to AT&R wards during this time. However, time and logistics did not allow for all admissions to be screened, and the inclusion criteria sought to screen the participants on admission to the AT&R wards, rather than after a longer length of stay. Rehabilitation programmes may have affected nutrition outcomes and therefore early screening was the goal. Additionally, no information was collected on where the participants were admitted from. This information is important to indicate how long some patients had already been on acute hospital wards, as longer hospital stay is likely to increase nutrition risk prevalence.

A further limitation is that this sample comes from a region (WDHB) of New Zealand with a slightly higher socioeconomic level than the New Zealand average (Auckland Regional Public Health Service, 2008). Thus, the results may not be directly transferable to other regions of the country, as socioeconomic status has been shown to impact nutrition status (Elia & Stratton, 2005).

The final limitation identified was that the Montreal Cognitive Assessment may have over represented poor cognitive function. However, cognitive function was identified as part of the MNA-SF and appeared to provide a more indicative assessment of impaired cognition.

Chapter 6 - Recommendations and Conclusions

This study suggests that many older adults (81%) are at nutrition risk on admission to AT&R wards. Therefore it is important that patients are screened on admission since nutrition risk has far-reaching consequences. It is prudent for early identification of nutrition risk, and prompt referral to a dietitian for nutrition intervention, as nutrition status is known to deteriorate during hospital stay. Screening may be a cost-saving method to achieve and maintain optimal nutrition and health status in hospitalised older adults.

The MNA-SF was found to be a simple and quick tool to screen for nutrition risk among these older adults. It is important that a screening tool is routinely and consistently used to facilitate identification of nutrition risk, enable comparability across different settings, and provide more reliable estimates of nutrition risk prevalence.

The present study indicates a moderate decrease in food intake, unintentional weight loss, reduced mobility, psychological stress and acute disease, neuropsychological problems, and an underweight BMI are important risk factors for poorer nutrition status. Other factors related to high nutrition risk included widowhood, low income, low level of education, low use of nutrition supplements, and low use of support services. Dysphagia risk did not appear to contribute to poorer nutrition status.

Future studies should identify nutrition risk prevalence in a larger sample of hospitalised older adults to provide a more robust estimate of nutrition risk prevalence. Such studies should also review the nutrition screening and dietitian referral process in hospital settings. This would provide information on the prevalence of patients at nutrition risk continuing unrecognised, and enable targeted interventions and policy guidelines to improve screening rates and subsequently lower nutrition risk prevalence. Previous studies have found that implementing routine screening has significantly increased the number of dietitian referrals (H. Kruizenga et al., 2005; O'Flynn, Peake, Hickson, Foster, & Frost, 2005; Oakley & Hill, 2000). This may require an increase in the dietetic

staff to manage a potential increase in referrals, allowing patients to receive appropriate treatment. As nutrition risk is an important problem among older adults, and will continue to be so with the projected increase in the older population, there is a need for more dietitians to effectively address nutrition risk in hospitalised older adults. As poor nutrition status in older adults is a multifactorial problem, it requires an interdisciplinary team approach to address all of the factors that may impact nutrition risk status.

An improved nutrition status can enhance patient outcomes and circumvent weight loss, preventing a vicious cycle of loss of muscle mass and strength, which may lead to frailty and reduced quality-of-life (Keller, 2004). Poor nutrition status during hospitalisation is a known risk factor for patient transfer to higher level care post discharge (Neumann, 2005). Therefore, it is important to improve nutrition status at early admission of hospitalisation. This can assist in both the reduction of health costs and the supporting of older people to rehabilitate more readily back into the community, facilitating continued independent living.

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Appendices

Appendix A: *International Studies of Nutrition Risk in Hospitalised Older Adults Using the MNA.*

Authors	(n)	Age * (years)	At risk n (%)	Malnourished n (%)
(Azad, Murphy, Amos, & Toppan, 1999) Canada	152	79 ± 14	66 (43)	4 (3)
(Bauduer, Scribans, Dubernet, & Capdupuy, 2003) France	120	(60-97)		16 (13)
(Bauer et al., 2005) Germany	121	80 ± 8	30 (38)	26 (33)
(Compan, Di Castri, Plaze, & Arnaud-Battandier, 1999) France	196	83 ± 7	108 (55)	63 (32)
(Feldblum et al., 2007) Israel	259	75 ± 6	211 (81)	48 (19)
(Formiga, Chivite, Mascaro, Ramon, & Pujol, 2005) Spain	73	82 ± 7	39 (53)	
(Gazzotti, Albert, Pepinster, & Petermans, 2000) Belgium	175	80 ± 9	85 (49)	52 (22)
(Gomez Ramos & Gonzalez Valverde, 2005) Spain	200	81 ± 7	76 (38)	100 (50)
(Hengstermann et al., 2008) Germany	808	77 ± 9	525 (65)	162 (20)
(Izaola, 2005) Spain	145	57 ±18	43 (30)	99 (68)
(Kagansky, 2005) Israel	414	85 ± 6	137 (33)	204 (49)
(Kaiser, 2010) Germany	1328	82 ± 8	598 (45)	544 (41)
(Kuzuya et al., 2005) Japan	226	79 ± 1	131 (58)	45 (20)
(Murphy, Brooks, New, & Lumbers, 2000) United Kingdom	49	80 ± 9	23 (47)	8 (16)
(Neumann, 2005) Australia	133	81 ± 6	63 (47)	8 (6)
(Persson, Brismar, Katzarski, Nordenstrom, & Cederholm, 2002) Sweden	83	83 ± 7	46 (56)	22 (26)
(Ranhoff et al., 2005) Norway	69	82 ± 6	51 (74)	

(Reyes et al., 2006) Mexico	97	71 ± 8	49 (51)	18 (19)
(Shum et al., 2005) Hong Kong	120	80 ± 7	53 (44)	20 (17)
(Stratton et al., 2004) United Kingdom	86	78 ± 7	56 (65)	
(Thomas et al., 2002) United States	104	76 ± 13	65 (63)	30 (29)
(Visvanathan, Penhall, et al., 2004) Australia	65	80 ± 8	30 (46)	19 (29)

*Age: mean±SD or range (lowest-highest)

Appendix B: *Health and Disability Ethics Committees Review*

Health and Disability Ethics Committees

Health and Disability Ethics Committees
Ministry of Health
C/- MEDSAFE, Level 6, Deloitte House
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PO Box 5013
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6011

0800 4 ETHICS
hdecs@moh.govt.nz

30 June 2014

Dr Jacqueline Allen
PO Box 99743
Newmarket
Auckland
Auckland 1149

Dear Dr Allen

Re:	Ethics ref:	14/NTA/70
	Study title:	Multidimensional Nutritional Analysis of Waitemata DHB Elderly Population

I am pleased to advise that this application has been *approved* by the Northern A Health and Disability Ethics Committee. This decision was made through the HDEC-Expedited Review pathway.

Conditions of HDEC approval

HDEC approval for this study is subject to the following conditions being met prior to the commencement of the study in New Zealand. It is your responsibility, and that of the study's sponsor, to ensure that these conditions are met. No further review by the Northern A Health and Disability Ethics Committee is required.

Standard conditions:

1. Before the study commences at *any* locality in New Zealand, all relevant regulatory approvals must be obtained.
2. Before the study commences at *a given* locality in New Zealand, it must be authorised by that locality in Online Forms. Locality authorisation confirms that the locality is suitable for the safe and effective conduct of the study, and that local research governance issues have been addressed.

After HDEC review

Please refer to the *Standard Operating Procedures for Health and Disability Ethics Committees* (available on www.ethics.health.govt.nz) for HDEC requirements relating to amendments and other post-approval processes.

Your **next progress report** is due by 27 June 2015.

Please don't hesitate to contact the HDEC secretariat for further information. We wish you all the best for your study.

Yours sincerely,

BJ Fergus

Dr Brian Fergus
Chairperson
Northern A Health and Disability Ethics Committee

Documents submitted

Document	*Version*	*Date*
CV for CI: CV Dr Allen	1.0	17 February 2014
PIS/CF: Patient Information Sheet	1.0	17 February 2014
Survey/questionnaire: MNA Tool	1.0	17 February 2014
Survey/questionnaire: Eating Assessment Tool-10	1.0	25 February 2014
Survey/questionnaire: Montreal Cognitive Assessment	1.0	25 February 2014
Covering Letter: Covering letter	1.1	19 April 2014
CVs for other Investigators: CV Wham	1.0	19 April 2014
Evidence of scientific review: Peer Review	1.0	19 April 2014
CVs for other Investigators: CV Johnston	1.0	19 April 2014
CVs for other Investigators: CV Watkins	1.0	19 April 2014
CVs for other Investigators: CV Dennison	1.0	19 April 2014
CVs for other Investigators: CV Dagley	1.0	19 April 2014
CVs for other Investigators: CV Fraser	1.0	19 April 2014
CVs for other Investigators: CV Buhs-Catterall	1.0	19 April 2014
CVs for other Investigators: CV Johnston C	1.0	19 April 2014
CVs for other Investigators: CV Bish	1.0	19 April 2014
Invitation letter	1.0	19 April 2014
PIS/CF: Consent Form (inclusion and exclusion criteria included)	1.0	19 April 2014
Protocol: Study Protocol	1.0	19 April 2014
PIS/CF for persons interested in welfare of non-consenting participant: Consent for vulnerable people	1.0	19 April 2014
Application		10 May 2014
Covering Letter: HDEC response letter June 2014.docx		04 June 2014
Survey/questionnaire: MNA study ID.pdf		04 June 2014
Survey/questionnaire: MOCA study ID.pdf		04 June 2014
PIS/CF: Patient Information Sheet Nutrition-1.4. May 2014.docx	1.4	04 June 2014
PIS/CF: Study Consent I&E BW JA revision .doc		04 June 2014
PIS/CF: Study Consent I&E for vulnerable participants .doc		04 June 2014
Response to Request for Further Information		05 June 2014
Covering Letter: HDEC response letter 2 June 2014 - .docx		02 June 2014
PIS/CF: Patient Information Sheet Nutrition-1.5. June 2014.docx	1.5	04 June 2014
PIS/CF: Study Consent I&E JA revision version 1.5 June 14.doc	1.5	04 June 2014

Statement of compliance and list of members

Statement of compliance

The Northern A Health and Disability Ethics Committee:

- is constituted in accordance with its Terms of Reference
- operates in accordance with the *Standard Operating Procedures for Health and Disability Ethics Committees*, and with the principles of international good clinical practice (GCP)
- is approved by the Health Research Council of New Zealand's Ethics Committee for the purposes of section 25(1)(c) of the Health Research Council Act 1990
- is registered (number 00008714) with the US Department of Health and Human Services' Office for Human Research Protection (OHRP).

List of members

Name	*Category*	*Appointed*	*Term Expires*
Dr Brian Fergus	Lay (consumer/community perspectives)	01/07/2012	01/07/2015
Dr Karen Bartholomew	Non-lay (intervention studies)	01/07/2013	01/07/2016
Ms Susan Buckland	Lay (consumer/community perspectives)	01/07/2012	01/07/2015
Ms Shamim Chagani	Non-lay (health/disability service provision)	01/07/2012	01/07/2014
Dr Christine Crooks	Non-lay (intervention studies)	01/07/2013	01/07/2015
Mr Kerry Hiini	Lay (consumer/community perspectives)	01/07/2012	01/07/2014
Ms Michele Stanton	Lay (the law)	01/07/2012	01/07/2014

Appendix C: *Waitemata District Health Board Ethics Committee Review*

Health and Disability Ethics Committees

Authorisation report

Study ref:	**14/NTA/70**
Study title:	Multidimensional Nutritional Analysis in an Elderly Urban Population
Status:	Application decision given - Decision: decision of "approved" 27/06/2014 05:31:00

This authorisation report was generated by DHB Waitemata District Health Board on 01 Jul 2014 at 11:47 AM

Authorisation Type	Authorisor	Date and time	Lead Investigator(s) at locality
Co-ordinating Investigator	Jacqueline Allen	19 Apr 2014, 03:05 PM	Jacqueline Allen
Primary Contact Person	Jacqueline Allen	19 Apr 2014, 03:15 PM	Jacqueline Allen
Sponsor	cath cronin WDHB	30 Apr 2014, 09:55 AM	
Locality	Waitemata DHB	01 Jul 2014, 11:42 AM	Jacqui Allen

Electronic Authorisations History

Date	Authorisation Type	Action
01 Jul 2014, 11:42 AM	Locality	Authorisation given by DHB Waitemata District Health Board
15 May 2014, 12:00 PM	Locality	Request for authorisation accepted by DHB Waitemata District Health Board
30 Apr 2014, 09:55 AM	Sponsor	Authorisation given by Ms Cath Cronin
30 Apr 2014, 09:50 AM	Sponsor	Request for authorisation accepted by Ms Cath Cronin
29 Apr 2014, 09:23 PM	Sponsor	Request for authorisation sent by Dr Jacqueline Allen to Ms Cath Cronin
29 Apr 2014, 09:22 PM	Sponsor	Request for authorisation recalled by Dr Jacqueline Allen
19 Apr 2014, 03:18 PM	Sponsor	Request for authorisation sent by Dr Jacqueline Allen to DHB Waitemata District Health Board
19 Apr 2014, 03:16 PM	Locality	Request for authorisation sent by Dr Jacqueline Allen to DHB Waitemata District Health Board
19 Apr 2014, 03:15 PM	Primary Contact Person	Authorisation given by Dr Jacqueline Allen
19 Apr 2014, 03:05 PM	Co-ordinating Investigator	Authorisation given by Dr Jacqueline Allen

Appendix D: *Maori Research Committee Review*

26 March 2014

Dr Jacqui Allen FRACS
Senior Lecturer
University of Auckland
New Zealand

Re: Multidimensional Nutritional Assessment in an Elderly Urban Population

Tēnā koe Jacqui

As a reminder the Maori Research Review critiques research proposals for responsiveness to Maori. Ethical, scientific and clinical rigour is reviewed by the respective bodies at each District Health Board.

Thank you for providing the study protocol. Overall I think it was thoughtful and well written. The study seeks to explore nutritional status in an elderly urban population at a single point in time and compare elderly subjects living in three different contexts. The study is being powered to allow for subgroup analysis, including ethnicity subgroups. Powering for ethnic analysis will ensure Māori experiences are reflected in the study findings and interventions. To ensure this happens 750 participants will be recruited.

Consent will be discussed in person and written information given. Face to face consenting increases the likelihood of Māori participation. Subjects will be given time to read information, ask questions and decide on whether to participate. Giving Māori time to respond will enable them to discuss the matter with their whānau. Appropriate interpreting services will be available if needed. Provision of interpreter services will also increase Māori participation as some Māori feel more comfortable using their own language, particularly kaumātua.

In the rationale the investigator notes:

> The New Zealand adult nutrition survey (2008) identified 0.5-2.5% of older people (71 years+) as clinically underweight[13]

Was there any information related to Māori kaumātua in the survey?

As you probably know one way in which research can address tikanga Māori in research practice is to ensure Māori are part of the research team. Are there any Māori researchers on this study?

Please provide the Māori Research Committee what a copy of the final report.

If you have not done so already please add the following to the information and or consent form.

- If you require Māori cultural support talk to your whānau in the first instance. Alternatively you may contact the administrator for He Kamaka Waiora (Māori Health Team) by telephoning 09 486 8324 ext 2324
- If you have any questions or complaints about the study you may contact the Auckland and Waitematā District Health Boards Maori Research Committee or Maori Research Advisor by telephoning 09 4868920 ext 3204

On behalf of the Maori Research Committee at the Waitematā and Auckland District Health Boards the application has been approved.

Heio ano

H. A Wihongi

Dr Helen Wihongi
Maori Research Advisor
He Kamaka Waiora (Maori Health)
Waitematā and Auckland DHB's,
Private Bag 93 503,
Takapuna, Auckland
Ph + 64 9 4868920 ext 3204
Cell 021 0203 1167
Email helen.wihongi@waitematadhb.govt.nz

Tereki Stewart
Chairperson
Māori Research Committee
Waitematā and Auckland DHB's
PO Box 108040
Symond Street
Ph +64 09 366 1993
email tstewart@tihiora.co.nz

Appendix E: *Patient Information Sheet*

PATIENT INFORMATION SHEET

Research Title:

Multidimensional Nutritional Assessment in an Elderly Urban Population

Primary / Principal Researcher:

Dr Jacqui Allen, FRACS
Otolaryngologist, Waitemata District Health Board
University of Auckland
021 897 444

Co-Investigators:

Dr Carol Wham, PhD
Dr Carol Wham, PhD, NZ Registered Dietitian
Senior Lecturer
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Auckland Campus
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Dr Cheryl Johnson, MBChB
Geriatrician
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Rebecca Watkin
Masters Student
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Julia Buhs-Catterall
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MOB: 021 689-131
DDI: +64 9 414-6732

Tanya Bish
Quality and Professional Development Nurse Leader for ARRC I, WDHB
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Private Bag 93503
Takapuna
Ph: 4868920 ext 3746 M: 0212464125 F: 441 8957

Introduction and aims of the project:

You are invited to participate in a research project that will evaluate the nutritional status of persons over 65 years of age in the Waitemata District Health Board regions. You have the right not to participate in the study, or subsequently withdraw from this study at any time. Any decision not to participate will not affect your current, continuing or future health care at this or any other health care facility.

People who are older adults may encounter unique nutritional challenges. Living circumstances may affect what and how we eat. Nutrition also affects overall health and susceptibility to illness. Understanding differences in nutrition associated with home situations will help inform health policy and community interventions.

The aim of this project is to evaluate nutritional status in older adults living in three different situations – independently in their own home, in the hospital rehabilitation ward and in a residential care facility. This will be performed by interviews and body measurements.

Participant selection:

You have been identified as a potential participant for this study because you are in the correct age group. Upon your consent, you will be selected for this study. The study will include a total of 750 participants. We acknowledge that you may wish to discuss this project with your Whanau before consenting.

The research procedure:

If you agree to participate in the study, the following will occur:

1. Once you have signed the consent form to participate in the study, you will be enrolled in the study.
2. We will then schedule a time for a researcher to meet with you to complete further interviews and to perform body measurements including your weight, height, forearm length and arm circumference. This interview will take approximately 30-60 minutes and be performed at a place convenient for you.
3. You may withdraw from the study at any time.

Risks and Benefits:

It is possible that the interviews and measures may detect a nutritional problem. If this happens you will be offered appropriate intervention and management by the Hospital team.

Side effects may occur although this is extremely unlikely. We do not know all side effects that may happen.

Participation:

If you do agree to take part in this study, you are free to withdraw at any time, without having to give a reason. This will in no way affect any future care or treatment. Your participation in the study will be stopped should any harmful effects appear or if you feel it is not in your best interest to continue.

Inclusion and Exclusion Criteria:

The following criteria will be used to determine who should be invited to participate in this study. Inclusion criteria are those things that should be present in order to be invited to participate. Exclusion criteria are those things that should be absent in order to be invited to participate. If all inclusion criteria are met and no exclusion criteria are present then you will be invited to participate in the study.

Inclusion Criteria:

1) Age greater than 65 yr (European ethnicity), age greater than 55 yr (Maori and Pacific Island ethnicity)
2) Able to complete self-assessment questionnaire
3) Willing to undergo anthropomorphic measures
4) Admitted to ward or residential care within no longer than five working days

Exclusion Criteria:

1) Age less than 65 or 55 yrs (depending on ethnicity).
2) Presence of a tracheotomy tube or airway obstruction necessitating a tracheotomy tube.
3) Patients with orocutaneous or pharyngocutaneous fistulae at the time of evaluation.

4) Patients with known metabolic or nutritional malabsorption disorders.
5) Patients with psychiatric illness affecting nutrition eg. Anorexia nervosa.
6) Patients with a life expectancy < 2 years.

These criteria may be discussed with the investigator

Confidentiality:

Research findings will be presented at international research meetings and submitted for publication in peer-reviewed journals. Additionally, research findings will be made available to the local medical community through research presentations and regional forums. However, no material that could personally identify you will be used in any reports on this study. Consent forms will be kept in a locked filing cabinet in the Department of Otolaryngology at the hospital or will be stored on password-protected computers. Research data will be stored for a period of 10 years after data collection is complete (as required by New Zealand law), at which time they will be destroyed. With your permission, de-identified data from this study may be used in future related studies, which have been given ethical approval from the Ethics Committee.

Results:

If requested, you will be offered copies of the publications that arise from this research. However, you should be aware that a significant delay may occur between completion of data collection and completion of the final report. Alternatively, or in addition, you can choose to have the results of the study discussed with you personally by the lead investigator.

Questions:

You may have a friend or whanau support to help you understand the risks and/or benefits of this study and any other explanation you may require.

Please contact Dr Allen if you require any further information about the study.

If you need an interpreter, this can be provided.

To ensure ongoing cultural safety Nga Kai Tataki - Maori Research Review Committee Waitemata DHB encourage those who identify themselves as Maori

and who are participating in health research or clinical trials to seek cultural support and advice from either Mo Wai Te Ora – Maori Health Services or their own Kaumatua or Whaea. For assistance please contact the Services Clinical Leader for Mo Wai Te Ora – Maori Health on 09 486 1491 ext: 2324 or the Maori Research Advisor on 09 486 1491 ext: 2553.

If you have any queries or concerns about your rights as a participant in this study, you may wish to contact a Health and Disability Advocate: 09 525 2700 or 0800 555 050. Email (NZ wide): advocacy@hdc.org.nz.

Appendix F: *Consent to Participate Form*

INFORMED CONSENT FORM

WAITEMATA DHB

CONSENT TO PARTICIPATE IN A RESEARCH STUDY

Investigator's Name: Dr Jacqui Allen, FRACS

Department: Department of Otolaryngology/Head and Neck Surgery

Study Title: Multidimensional Nutritional Assessment in an Elderly Urban Population

Introduction:

This is a research study. Research studies only include subjects who choose to participate. As a study participant you have the right to know about the procedures that will be used in this research study so that you can make the decision whether or not to participate. The information presented here is to make you better informed so that you may give or withhold your consent to participate in this research study. Please take your time to make your decision and discuss it with your family and friends.

You are being asked to take part in this study because you are older than 65 years (or older than 55 years if you are Maori or Pacifica). We wish to evaluate nutritional status in older adults living in the Waitemata District Health Board region.

In order to participate in this study, it will be necessary to give your written consent.

Why is this study being done?

The purpose of this study is to evaluate nutritional status in persons over 65 years old (or over 55 yrs if you are Maori or Pacific Islander) who live in different domestic situations. These are adults living independently in their own homes, those in the hospital rehabilitation ward and those living in a residential care facility. The evaluation will be performed by questionnaires and body measurements at a single visit. Different nutritional profiles will help us understand whether nutrition contributes to a person's living situation.

How many people will take part in the study?

750 people will take part in this study.

Before you begin the study

You will need to meet certain eligibility criteria for participation. You must be over 65 years old, or 55 years if you are Maori or Polynesian. No testing is required before participating in the study.

Inclusion and exclusion criteria

Inclusion criteria are things that should be present before or at the time that you are invited to participate in the study. Exclusion criteria are things that should be absent before or at the time that you are invited to participate in the study. These criteria may be discussed with the investigator.

Inclusion criteria

1. Sixty-five years of age or older (or 55yrs if Maori or Polynesian)
2. Ability to understand and give consent for the study
3. Ability to complete self-assessment questionnaire
4. Willing to undergo anthropomorphic measures (these measure body dimensions such as weight, height and arm circumference)
5. Admitted to a ward or residential care facility no more than five days previously

Exclusion criteria

1. Age less than 65 years old (or 55 yrs for Maori and Polynesian)
2. Inability to give reasonable informed consent
3. Any tumour in the voicebox
4. Anyone with psychiatric illness affecting nutrition eg. Anorexia nervosa
5. Anyone with a Zenker diverticulum – this is a pocket in the throat that collects food and causes swallow problems
6. Anyone with malabsorption syndromes or metabolic syndromes affecting digestion
7. Anyone with a leak between the throat and the skin (a fistula)
8. Anyone in palliative care

What will happen if I take part in this research study?

If you decide to participate in this study, you will be asked to do the following: Complete a survey about your swallowing, the 10-item Eating Assessment Tool (EAT-10). This takes approximately five minutes. A single visit will be scheduled with you, at your convenience, to complete several further surveys and take body measurements including your weight, height, arm circumference and forearm length. The total time expected for the visit is 60-90 minutes. A researcher will perform all measurements. We will also request permission to review your medical charts to see what medication you are taking and what illnesses you may have. At this time, the study will be complete.

The following procedures are part of regular care and may be done even if you do not join the study:

None of this investigation is part of routine patient care. If you decide not to participate your care will not in any way be affected.

How long will I be in the study?

You will be asked to participate in the study for a single visit lasting about 30-60 minutes.

Can I stop being in the study?

You can decide to stop at any time. Tell the study doctor if you are thinking about stopping or decide to stop. You may complete any aspect of the study and you may stop participating at any time.

What side effects or risks can I expect from being in the study?

It is extremely unlikely that you would experience side effects from participation in this study. All body measurements are non-invasive. Everyone taking part in the study will be watched carefully for any side effects. However, the study doctor does not know all the side effects that may happen. You should talk to your study doctor about any side effects that you have while taking part in the study.

Are there benefits to taking part in the study?

The benefits to science and humankind that might result from this study are to learn more nutrition in older adults and how living arrangements might affect that. You may directly benefit from having nutritional problems indentified. The improvement may be mild or significant. You may not benefit from taking part in this study.

What other choices do I have if I do not take part in the study?

Your alternative is not to take part in this study. Talk with your doctor about your choices before you decide if you will take part in this study. If you choose not to take part in this study, your future care will not in any way be affected.

Will my medical information be kept private?

We will do our best to make sure that the personal information in your medical record will be kept private. However, we cannot guarantee total privacy. Your personal information may be given out if required by law.

If information from the study is published or presented at scientific meetings, your name and other personal information will not be used. All personal identifying information will be removed and the research data will be coded and stored in a locked file that is accessible only by the primary and co-investigators. The Ethics Committee has the authority to review your research and medical records.

All information will be stored for 10 years in accordance with New Zealand law then destroyed.

What happens if I am injured because I took part in this study?

If you are injured as a direct result of research procedures, you will receive reasonably necessary medical treatment at no cost. Waitemata DHB does not provide any other form of compensation for injury. In the case of injury resulting from this study, you do not lose any of your legal rights to seek payment by signing this form.

What are the costs of taking part in this study?

The researcher will come to you to perform the interview at your convenience.

There will be no costs incurred for actual patient care if required.

Will I be compensated for being in this study?

You will not be compensated for participation in this study.

What are my rights if I take part in this study?

Taking part in this study is your choice. You may choose either to take part or not to take part in the study. If you decide to take part in this study, you may leave the study at any time. No matter what decision you make, there will be no penalty to you and you will not lose any of your regular benefits. Leaving the study will not affect your medical care. You can still get your medical care from our institution.

We will tell you about new information or changes in the study that may affect your health or willingness to continue in the study.

If you require Māori cultural support, talk to your whānau in the first instance. Alternatively you may contact the administrator for He Kamaka Waiora (Māori Health Team) by telephoning 09 486 8324 ext 2324.

If you have any questions or complaints about the study you may contact the Auckland and Waitematā District Health Boards Maori Research Committee or Maori Research Advisor by telephoning 09 4868920 ext 3204.

Does the researcher have a financial interest in this research study?

The principle investigator (Dr Allen) has no financial interest in the study. The co-investigators have no financial interest in this study.

Who can answer my questions about the study?

If you have questions, please ask us. You can talk to the investigator about any questions or concerns you have about this study.

Dr. Jacqui Allen or 24 hour emergency at 021-897-444

My signature below will indicate that I have decided to participate in this study as a research subject. I have read and understand the information above. I understand that I will be given a signed and dated copy of this consent form.

_____	_____
Signature of Subject of Legal Representative	Print Name
_____	_____
Date	Time
_____	_____
Signature of Investigator	Print Name
_____	_____
Date	Time

Appendix G: *Study Questionnaire*

Older Adults Nutrition Risk and Dysphagia Screening

Student Dietitian Interviewer:……
Interview Date: / /

Personal

1. ID number:……
2. Last name:……
3. First name: ……
4. NHI number:……
5. DOB: ……...../...../.....
6. Age:……..… (years) ……....(months)
7. Gender:…….. (M=1, F=2)
8. Weight: …….kg
9. Height:……...cm
10. Demispan……..…cm
11. Calf circumference: ……....cm
12. BMI: …….....

Demographic

13. Which of these best describes your ethnicity?

1 = New Zealand European
2 = New Zealand Maori
3 = Pacific Islander
4 = Other, please specify_____

Comments:

_____

_____

14. What is your current marital status?

Married/partnered	Widowed	Divorced/separated	Never married
1	2	3	4

Comments:

_____

_____

15. Who lives in your house/unit/apartment with you most of the time?

Living alone	Living with spouse only	Living with others
1	2	3

Comments:

_____

_____

16. Do you receive any income in addition to your pension?

Pension only income	Pension plus other income
1	2

Comments:

_____

_____

17. What is your highest level of education?

Primary	Secondary	Tertiary
1	2	3

Comments:

_____

_____

Health

18. Have you been told by your doctor that you have any health issues?

Yes	No
1	2

Key co-morbidities: (ICD 10 code)	Comments:

19. Do you have any other health problems?

Yes	No
1	2

Other health problems	Comments:

20. What medications, prescribed by the doctor, are you regularly taking?
Number of medications:

Medication	Comment (i.e. dose etc)
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	
14.	

21. What over-the-counter medications are you regularly taking?
Number of medications:

Medication	Comment
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	
11.	
12.	
13.	

22. What, if any, nutrition supplements eg.Complan or vitamin and mineral supplements are you regularly taking?

Number of supplements:

Nutrition Supplement	Comment
1.	
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

23. What is your dental status?

Dentate	Edentulous	Dental Appliance
1	2	3

Comments:

Support Services

24. Do you receive any regular subsidised support service?

Yes	No
1	2

Comments (i.e. Hours, frequency etc):

25. Do you usually need help with daily tasks like shopping, cleaning, cooking?

Yes	No
1	2

Comments:

Mini Nutrition Assessment (Nestle Nutrition Institution)

26. Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?

severe decrease in food intake	moderate decrease in food intake	no decrease in food intake	
0	1	2	

27. Weight loss during the last 3 months

weight loss greater than 3 kg	does not know	weight loss between 1 and 3 kg	no weight loss	
0	1	2	3	

28. Mobility

Bed or chair bound	Able to get out of bed/chair but does not go out	Goes out	
0	1	2	

29. Has suffered psychological stress or acute disease in the past 3 months?

Yes	No	
O	2	

30. Neuropsychological problems

severe dementia or depression	mild dementia	no psychological problems	
0	1	2	

If BMI is not available, replace BMI with calf circumference

31. Body Mass Index (BMI) (weight in kg) / (height in m2)

BMI less than 19	BMI 19 to less than 21	BMI 21 to less than 23	BMI 23 or greater	
0	1	2	3	

32. Calf circumference (CC) in cm

CC less than 31	CC 31 or greater	
0	3	

Comments:

_____

_____

33. Final MNA Score

Final MNA Score: _____	Normal nutritional status (12-14 points)	At risk of malnutrition (8-11 points)	Malnourished (0-7 points)
	1	2	3

EAT-10: A Swallowing Screening Tool (Nestle Nutrition Institution)
To what extent do you experience the following problems? Rate from 1-4

34. My swallowing problem has caused me to lose weight

0 No problem	1	2	3	4 Severe problem	

35. My swallowing problem interferes with my ability to go out for meals

0 No problem	1	2	3	4 Severe problem	

36. Swallowing liquids takes extra effort

0 No problem	1	2	3	4 Severe problem	

37. Swallowing solids takes extra effort

0 No problem	1	2	3	4 Severe problem	

38. Swallowing pills takes extra effort

0 No problem	1	2	3	4 Severe problem	

39. Swallowing is painful

0 No problem	1	2	3	4 Severe problem	

40. The pleasure of eating is affected by my swallowing

0 No problem	1	2	3	4 Severe problem	

41. When I swallow food sticks in my throat

0 No problem	1	2	3	4 Severe problem	

42. I cough when I eat

0 No problem	1	2	3	4 Severe problem	

43. Swallowing is stressful

0 No problem	1	2	3	4 Severe problem	

Comments:

_____

_____

44. Final EAT-10 Score

Final EAT-10 Score: _____	Not at risk (less than 3 points)	At risk (3 points or higher)
	1	2

Montreal Cognitive Assessment

45. Final MoCA score____/30 (above 26 is considered normal).

Interviewer to answer the following

How well do you rate:

	Very poor	Poor	Neither good nor poor	Good	Very good
46. The reliability of the respondent's responses?	1	2	3	4	5
47. The participant's understanding of the questions	1	2	3	4	5

Comments (required if answer is 1 or 2):

_____

_____

Appendix H: *Mini Nutritional Assessment-Short Form*

Mini Nutritional Assessment

MNA®

Nestlé Nutrition Institute

Last name: First name:

Sex: Age: Weight, kg: Height, cm: Date:

Complete the screen by filling in the boxes with the appropriate numbers. Total the numbers for the final screening score.

Screening

A Has food intake declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties?
0 = severe decrease in food intake
1 = moderate decrease in food intake
2 = no decrease in food intake

B Weight loss during the last 3 months
0 = weight loss greater than 3 kg (6.6 lbs)
1 = does not know
2 = weight loss between 1 and 3 kg (2.2 and 6.6 lbs)
3 = no weight loss

C Mobility
0 = bed or chair bound
1 = able to get out of bed / chair but does not go out
2 = goes out

D Has suffered psychological stress or acute disease in the past 3 months?
0 = yes 2 = no

E Neuropsychological problems
0 = severe dementia or depression
1 = mild dementia
2 = no psychological problems

F1 Body Mass Index (BMI) (weight in kg) / (height in m^2)
0 = BMI less than 19
1 = BMI 19 to less than 21
2 = BMI 21 to less than 23
3 = BMI 23 or greater

IF BMI IS NOT AVAILABLE, REPLACE QUESTION F1 WITH QUESTION F2.
DO NOT ANSWER QUESTION F2 IF QUESTION F1 IS ALREADY COMPLETED.

F2 Calf circumference (CC) in cm
0 = CC less than 31
3 = CC 31 or greater

Screening score
(max. 14 points)

12-14 points: Normal nutritional status
8-11 points: At risk of malnutrition
0-7 points: Malnourished

Save Print Reset

Ref. Vellas B, Villars H, Abellan G, et al. *Overview of the MNA® - Its History and Challenges.* J Nutr Health Aging 2006;10:456-465.
Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B. *Screening for Undernutrition in Geriatric Practice: Developing the Short-Form Mini Nutritional Assessment (MNA-SF).* J. Geront 2001;56A: M366-377.
Guigoz Y. *The Mini-Nutritional Assessment (MNA®) Review of the Literature - What does it tell us?* J Nutr Health Aging 2006; 10:466-487.
Kaiser MJ, Bauer JM, Ramsch C, et al. *Validation of the Mini Nutritional Assessment Short-Form (MNA®-SF): A practical tool for identification of nutritional status.* J Nutr Health Aging 2009; 13:782-788.

Appendix I: *Eating Assessment Tool (EAT-10)*

EAT-10:
A Swallowing Screening Tool

Nestlé NutritionInstitute

LAST NAME | FIRST NAME | SEX | AGE | DATE

OBJECTIVE:

EAT-10 helps to measure swallowing difficulties.
It may be important for you to talk with your physician about treatment options for symptoms.

A. INSTRUCTIONS:

Answer each question by writing the number of points in the boxes.
To what extent do you experience the following problems?

1 My swallowing problem has caused me to lose weight.
0 = no problem
1
2
3
4 = severe problem

2 My swallowing problem interferes with my ability to go out for meals.
0 = no problem
1
2
3
4 = severe problem

3 Swallowing liquids takes extra effort.
0 = no problem
1
2
3
4 = severe problem

4 Swallowing solids takes extra effort.
0 = no problem
1
2
3
4 = severe problem

5 Swallowing pills takes extra effort.
0 = no problem
1
2
3
4 = severe problem

6 Swallowing is painful.
0 = no problem
1
2
3
4 = severe problem

7 The pleasure of eating is affected by my swallowing.
0 = no problem
1
2
3
4 = severe problem

8 When I swallow food sticks in my throat.
0 = no problem
1
2
3
4 = severe problem

9 I cough when I eat.
0 = no problem
1
2
3
4 = severe problem

10 Swallowing is stressful.
0 = no problem
1
2
3
4 = severe problem

B. SCORING:

Add up the number of points and write your total score in the boxes.
Total Score (max. 40 points)

C. WHAT TO DO NEXT:

If the EAT-10 score is 3 or higher, you may have problems swallowing efficiently and safely. We recommend discussing the EAT-10 results with a physician.

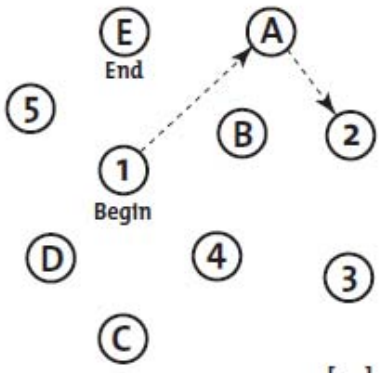
Reference: The validity and reliability of EAT-10 has been determined.
Belafsky PC, Mouadeb DA, Rees CJ, Pryor JC, Postma GN, Allen J, Leonard RJ. Validity and Reliability of the Eating Assessment Tool (EAT-10). Annals of Otology Rhinology & Laryngology 2008;117(12):919-924.

Appendix J: *Montreal Cognitive Assessment*

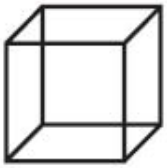
MONTREAL COGNITIVE ASSESSMENT (MOCA)

NAME :
Education : Date of birth :
Sex : DATE :

VISUOSPATIAL / EXECUTIVE



Copy cube



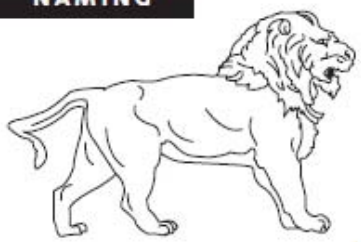
[ ] [ ]

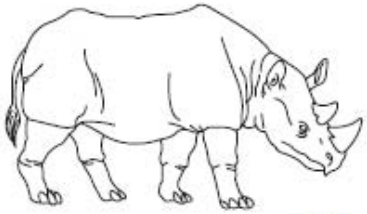
Draw CLOCK (Ten past eleven) (3 points)

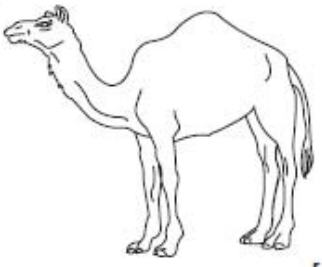
[ ] Contour [ ] Numbers [ ] Hands

POINTS ___/5

NAMING







[ ] [ ] [ ]

___/3

MEMORY Read list of words, subject must repeat them. Do 2 trials. Do a recall after 5 minutes.

	FACE	VELVET	CHURCH	DAISY	RED
1st trial					
2nd trial					

No points

ATTENTION Read list of digits (1 digit/ sec.).

Subject has to repeat them in the forward order [ ] 2 1 8 5 4

Subject has to repeat them in the backward order [ ] 7 4 2

___/2

Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors

[ ] F B A C M N A A J K L B A F A K D E A A A J A M O F A A B

___/1

Serial 7 subtraction starting at 100 [ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65

4 or 5 correct subtractions: **3 pts**, 2 or 3 correct: **2 pts**, 1 correct: **1 pt**, 0 correct: **0 pt**

___/3

LANGUAGE Repeat : I only know that John is the one to help today. [ ]

The cat always hid under the couch when dogs were in the room. [ ]

___/2

Fluency / Name maximum number of words in one minute that begin with the letter F [ ] _____ (N ≥ 11 words)

___/1

ABSTRACTION Similarity between e.g. banana - orange = fruit [ ] train – bicycle [ ] watch - ruler

___/2

DELAYED RECALL

	Has to recall words WITH NO CUE	FACE [ ]	VELVET [ ]	CHURCH [ ]	DAISY [ ]	RED [ ]	Points for UNCUED recall only
Optional	Category cue						
	Multiple choice cue						

___/5

ORIENTATION [ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City

___/6

www.mocatest.org

Normal ≥ 26 / 30

TOTAL ___/30

Add 1 point if ≤ 12 yr edu

Administered by: _____