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**An investigation of nutrition risk  
among hospitalised adults of advanced  
age admitted to the AT&R wards at  
North Shore and Waitakere Hospitals**

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

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Amy Popman  
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## Abstract

**Background:** In line with the global trend of an ageing population, the number and proportion of New Zealanders aged 65 years and older is increasing. Those of advanced age (85 years and older) make up the fastest-growing demographic group within the aging population. In coming years it is projected almost a quarter of older adults in New Zealand will be aged 85 years and older. Advanced age adults are at an increased risk of poor nutrition status. Optimising nutritional wellbeing in advanced age is important as nutrition risk has been associated with longer hospital admissions, loss of independence due to disability and the need for a higher level of care.

**Aim:** The aim of this study was to establish the prevalence of nutrition risk among adults of advanced age (85 years and older) recently admitted to the Admission, Treatment and Rehabilitation (AT&R) wards at North Shore and Waitakere Hospitals.

**Method:** Participants were recruited into this cross-sectional study within five days of admission to the AT&R wards at North Shore and Waitakere Hospitals. Sociodemographic and health characteristics were established using an interviewer administered questionnaire. Anthropometric measures including body mass, muscle mass, and muscle strength were also taken. Nutrition risk was assessed using a validated screening tool, the Mini Nutritional Assessment-Short Form (MNA-SF). The validated 10-item Eating Assessment Tool was used to assess dysphagia risk and the validated Montreal Cognitive Assessment was used to determine level of cognition. Data were analysed using descriptive statistics. Pearson Chi-Square and Fisher's Exact tests were used to examine differences between MNA-SF nutrition status groups. A  $p$ -value $<0.05$  was considered statistically significant.

**Results:** Of the 88 participants, 43.2% were at high risk of malnutrition and 28.4% were malnourished. The majority of malnourished participants were widowed (64.0%), received the pension as their only source of income (76.0%), were taking more than five medications (76.0%), wore dentures (64%), had below normal cognitive function (92.3%), received regular support services (72.0%), and required daily help (76.0%). Participants who were malnourished were significantly more likely to be at risk of

dysphagia (52.0%,  $p=0.015$ ),). The MNA-SF score was positively correlated with body mass index ( $r=0.484$ ,  $p<0.001$ ); grip strength in the dominant hand ( $r=0.250$ ,  $p=0.026$ ), and negatively correlated with dysphagia risk score ( $r=-0.383$ ,  $p<0.001$ ).

**Conclusion:** Nutrition risk and malnutrition is highly prevalent among hospitalised adults of advanced age. Ensuring routine nutrition screening is carried out on admission to an AT&R ward is an important first step to identify those at nutrition risk. These findings also highlight the importance of screening for dysphagia risk alongside nutrition risk among advanced age adults. Screening on admission to hospital can help to identify those in need of further assessment and can help to shape the interventions to improve nutrition status.

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# Dedication

This thesis is dedicated to my brother Andrew who taught me to never give up and inspired me to do great things.

I love you buddy.

02/05/1989 - 18/01/2012



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# Abbreviations

AMDR	Acceptable Macronutrient Distribution Range
ANOVA	Analysis of Variance
ANSI	Australian Nutrition Screening Initiative
AT&R	Admission, Treatment & Rehabilitation
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
CC	Calf Circumference
Cm	Centimetre
CT	Computed Tomography
DHB	District Health Board
DXA	Dual-Energy X-Ray Absorptiometry
EAT-10	10-Item Eating Assessment Tool
GI	Gastrointestinal
GP	General Practitioner
Kg	Kilogram
2008/09 NZANS	2008/09 New Zealand Adult Nutrition Survey
m	Metre
MMSE	Mini Mental State Examination
MNA	Mini Nutritional Assessment
MNA-SF	Mini Nutritional Assessment-Short Form



MoCA	Montreal Cognitive Assessment
MRI	Magnetic Resonance Imaging
NRV	Nutrient Reference Value
RDI	Recommended Daily Intake
SCREEN II	Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II
SD	Standard Deviation
WDHB	Waitemata District Health Board
WHO	World Health Organisation



# Chapter 1 Introduction

## 1.1 Background

Population ageing has emerged as a trend around the world, with an increasing proportion of people aged 65 years and older (World Health Organisation, 2015a). Population ageing reflects decreasing mortality and declining fertility rates. In line with the global trend, the population of older adults (65 years and over) in New Zealand has steadily increased from 12.1% in 2001 to 14.3% in 2013 (Statistics New Zealand, 2015). Those of advanced age (85 years and older) make up the fastest-growing demographic group within the aging population. In coming years, it is projected almost a quarter of older adults in New Zealand will be aged 85 years and older (Statistics New Zealand, 2015).

Advancing age is associated with an increase in the prevalence of chronic disease and disability, placing older adults at high risk of requiring extensive care (Ben-Shalomo & Kuh, 2002; Ministry of Health, 2013). Consequently, older adults have a much greater need for health and disability services than any other population group. Population ageing is projected to further drive the demand for health and disability support, and thus overall health expenditure. The New Zealand Government has recognised the value of maintaining good health and wellbeing throughout the life course. In order to meet the needs of the rapidly increasing older adult population, policy initiatives such as the Health of Older People Strategy and the Positive Ageing Strategy have been implemented (Ministry of Health, 2002; Ministry of Social Development, 2001). 'Ageing in place' is emphasised in both of these strategies, a concept which focuses on older adults maintaining their independence for as long as possible and living in their own homes.

Maintaining a high level of nutritional wellbeing is fundamental to successful ageing. Physiologically, nutrition helps to promote health and functionality among older adults, as well as play a key role in chronic disease prevention. Good nutrition also has a positive impact on social, cultural, and psychological quality of life (Kuczmarski, Weddle, & The American Dietetic Association, 2005). However, nutritional wellbeing

among advanced age adults is often difficult to achieve as ageing brings about a myriad of changes which increases their nutritional vulnerability. Commonly, older adults face increases in fat mass and a slow, progressive decline in muscle mass (Cruz-Jentoft et al., 2010) which contributes to changes in body composition and a reduction in muscle strength. Older adults often have a higher prevalence of impaired or disrupted swallowing function, known as dysphagia, which is thought to be linked with the impact of age related decline in muscle mass and strength on swallowing function (Feng et al., 2012). Dysphagia may also be a key contributor to a poor nutritional status in older adults (Takeuchi et al., 2014). Oral intake may be limited as a result of dysphagia; in which case overall energy intake is invariably reduced (Mann, Heuberger, & Wong, 2013). Furthermore, dysphagia can negatively impact on an individual's quality of life, as swallowing problems may become stressful and interfere with the ability and desire to eat within a social environment (Ekberg, Hamdy, Woisard, Wuttge-Hannig, & Ortega, 2002).

Social changes accompany advancing age. Widowhood becomes more prevalent and in turn this population transitions from living with others to living alone (Statistics New Zealand, 2015). Loneliness is often experienced as a result of this, impacting on eating behaviours as appetite is reduced and the motivation to prepare and eat meals is lost (Kwon, Suzuki, Kumagai, Shinkai, & Yukawa, 2006; Lee et al., 2005; Shahar, Schultz, Shahar, & Wing, 2001). A New Zealand study has highlighted the significant impact these social changes can have on nutrition status, as nutrition risk, a state which precedes malnutrition, is 3.5 times higher among older adults living alone than those who live with others (McElnay et al., 2012).

Malnutrition is defined as a state of nutritional imbalance which causes an adverse effect on body composition and functional status, and impaired health-related quality-of-life and clinical outcome (British Association for Parenteral and Enteral Nutrition, 2012). Malnutrition can lead to complications which impact on muscle and respiratory function (Norman, Pichard, Lochs, & Pirlich, 2008; Shahin et al., 2010). Malnutrition can be a vicious cycle for older adults as it is often interlinked with reduced immune function, weakening their defence against other conditions such as pneumonia and diarrhoea (Katona & Katona-Apte, 2008). In turn, nutrient requirements increase,

nutrient losses increase and older adults can be faced with a poor appetite (White et al., 2012). As a consequence of this, these individuals may face longer hospital admissions, higher mortality rates, and are more likely to need long term residential care (Agarwal et al., 2013; Charlton et al., 2012; Middleton, Nazarenko, Nivison-Smith, & Smerdely, 2001).

Despite these adverse outcomes, the nutrition of hospitalised older adults in New Zealand remains to be an understudied area. From the two studies that have been carried out in this population, malnutrition prevalence was found to range from 24-42%, while nutrition risk prevalence was estimated to be 44% (Hanger, Smart, Mettlees, & Frampton, 1999; Van Lill, 2002). Given the limited New Zealand research, and the wide variability in international nutrition risk prevalence among hospitalised older adults (1-74% malnutrition, 8-64% nutrition risk) (Guigoz, 2006), further research into this area is needed.

Nutrition risk screening has been widely recognised in the literature as a quick and simple method to identify older adults at risk of malnutrition. While no gold standard method of screening currently exists, a systematic review noted that with the inclusion of anthropometric, functional, and nutritional indices, nutrition risk prevalence can be accurately identified (Donini, Felice, & Cannella, 2007). Shortened from the Mini Nutritional Assessment (MNA), the validated MNA-Short Form (MNA-SF) establishes prevalence of nutrition risk using six key items: food intake, weight loss, mobility, psychological stress/acute disease, neuropsychological issues and body mass index (BMI) (Rubenstein, Harker, Salvà, Guigoz, & Vellas, 2001).

The setting for the present study was the Waitemata District Health Board (WDHB). Following Canterbury DHB, WDHB has the second largest older adult population in New Zealand. Of the 64,484 older adults residing in the WDHB catchment area, 12% are of advanced age (Statistics New Zealand, 2014). WDHB has specialised wards, known as the Assessment, Treatment, and Rehabilitation (AT&R wards), which have been established to help the older adult population return to the community after hospital admissions. WDHB has a research partnership with Massey University and

this study provided an opportunity to investigate the prevalence of nutrition risk among a vulnerable population admitted to hospital.

## **1.2 Purpose of the Study**

With the older adult population projected to grow in coming years, New Zealand faces a challenge to keep the ageing population independent in the community. Poor nutrition status contributes to this challenge, however to date the majority of research on the nutrition risk status of New Zealand older adults has focused on those living in the community. Little research has been conducted in New Zealand hospitals and in particular among adults of advanced age. This is a vulnerable population given various social, psychological and physical factors which put this demographic at increased nutrition risk.

Identifying the prevalence of nutrition risk, and associated risk factors, among advanced age adults as they are admitted to the AT&R ward gives an insight into their nutrition status prior to hospitalisation. This is important as it can help to inform strategies to improve the care and clinical outcome of this population.

## **1.3 Aim and Objectives**

### **1.3.1 Aim**

The aim of this study was to establish the prevalence of nutrition risk among adults of advanced age (85 years and older) recently admitted to the Admission, Treatment, and Rehabilitation (AT&R) wards at North Shore and Waitakere Hospitals.

### **1.3.2 Objectives**

1. To determine nutrition risk prevalence among adults of advanced age recently admitted to the WDHB AT&R wards using the Mini Nutritional Assessment-Short Form (MNA-SF).
2. To determine dysphagia risk prevalence among adults of advanced age recently admitted to the WDHB AT&R wards using the 10-item Eating Assessment Tool (EAT-10).

3. To measure body mass and estimate muscle mass of adults of advanced age recently admitted to the WDHB AT&R wards using bioelectrical impedance analysis (BIA) scales.
4. To assess muscle strength of adults of advanced age recently admitted to the WDHB AT&R wards using a grip strength dynamometer.
5. To identify sociodemographic and health factors associated with high nutrition risk.

#### **1.4 Thesis Structure**

This thesis is presented in six chapters. Chapter one introduces the study and provides a context for the importance of identifying nutrition risk among hospitalised adults of advanced age. A review of relevant literature is presented in chapter two, with key themes around nutrition risk status identified, analysed and interpreted. The third chapter presents and justifies the methodology chosen for the study. Chapter four reports the results of the study, and is followed by chapter five which critically discusses the findings of this study with existing research. The final chapter provides a summary of the study and reflects on the strengths and limitations of the research. Recommendations for future research are also presented in this final chapter.

#### **1.5 Researchers' Contributions**

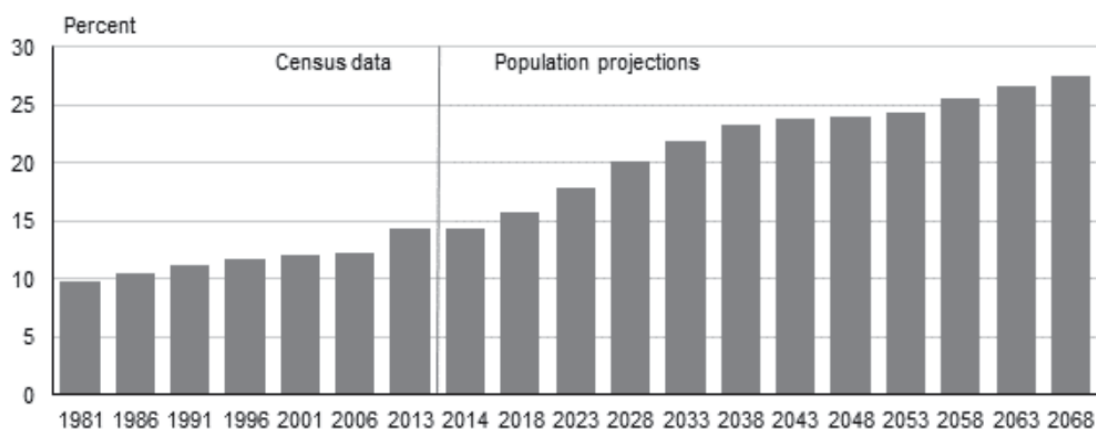
**Table 1.1** *Researchers' Contributions*

Contributors	Contribution to Research
Amy Popman	Student researcher, recruited participants and collected data, analysed data and performed statistical analysis, interpreted results, prepared thesis manuscript.
Dr Carol Wham	Academic supervisor, research design, assisted in interpretation of results, revised and approved the thesis manuscript.
Dr Marilize Richter	Academic co-supervisor, assisted with statistical analysis and interpretation of results, revised the thesis manuscript.
Dr Jacqueline Allen	Professional supervisor, research design, applied for ethics, aided in the recruitment of participants.
Darshan Patel	Assisted with participant recruitment and data collection.
Stacey King	Assisted with participant recruitment and data collection.

# Chapter 2 Literature Review

## 2.1 Ageing in New Zealand

In line with the global trend of an ageing population, the number and proportion of New Zealanders aged 65 years and older is increasing. As of 2013, New Zealanders aged 65 years and older made up 14.3% of the population (Statistics New Zealand, 2015). Projections by Statistics New Zealand (2015) highlight the population growth of older adults, with this demographic predicted to grow to more than 22.0% by 2033, and to more than a quarter of the population by 2058 (**Figure 2.1**). Accelerated birth rates post World War II (1946-1965) are contributing to the increased population, as the “baby boomers” are now entering the older adult demographic. These demographic changes also reflect the impact caused by recent decreases in both fertility and mortality rates (Statistics New Zealand, 2015).



**Figure 2.1** *New Zealand Population Aged 65 Years and Older, 1981-2068 (Statistics New Zealand, 2015)*

Advancing medical research has contributed to increases in life expectancies (Salomon et al., 2012), thus older adults are becoming older. In the early 1950s, the median age of New Zealanders aged 65 years and older was 71.4 years. By 2006, this had increased by almost three years, to an average age of 74.2 years (Statistics New Zealand, 2007). By 2051, Statistics New Zealand (2007) predict the median age of this demographic to exceed 77 years. Those aged 85 years and older make up the fastest-growing demographic group within the ageing population (Statistics



New Zealand, 2007). In 2013, the population of older adults stood at 607,032, of which 12.1% were aged 85 years or older (Statistics New Zealand, 2015). By 2064, this is predicted to nearly double, and a quarter of older adults in New Zealand will be aged 85 years or older (Statistics New Zealand, 2015).

The New Zealand older adult population is predominantly European, as, in 2013, this was the primary ethnic group of nearly 90% of the demographic (Statistics New Zealand, 2015). Conversely, Māori are a significantly younger population. In 2013, 32,181 older adults (65 years and over) identified themselves as Māori, making up only 5.6% of the population aged 65 years and older (Statistics New Zealand, 2015). Higher birth rates of Māori than non-Māori have contributed to the younger population being more ethnically diverse than the older demographic. Furthermore, the life expectancy of Māori is significantly lower than the general population (73 years for Māori men and 77.1 years for Māori women vs. 80.3 years for non-Māori men and 83.9 years for non-Māori women) (Ministry of Health, 2015a). Despite this, the population of Māori kaumātua (Māori elders) has increased by from 4.1% in 2006 to 5.6% in 2013, reflecting the narrowing gap in life expectancy between ethnic groups (Statistics New Zealand, 2013).

### **2.1.1 Ageing in the Waitemata District Health Board Catchment**

New Zealand is made up of 20 District Health Boards (DHBs), each having a responsibility to fund and provide health services to their area (Ministry of Health, 2014). Auckland has three DHBs: Waitemata, Auckland, and Counties Manukau. Waitemata District Health Board (WDHB) is the largest in Auckland, and covers North Shore City, Waitakere City, and the Rodney district. The WDHB population makes up 12% of the country's population (Statistics New Zealand, 2014).

While the WDHB population is younger than New Zealand as a whole, following Canterbury DHB it has the second highest population of older adults. Census estimates from 2013 show there are 68,484 people aged 65 years and older living in the WDHB, of which 8,235 were aged 85 years and older (Statistics New Zealand, 2014). Projections indicate the growth rate in WDHB population is higher than the national average, with the 65 and older age group predicted to have the largest increase

(Statistics New Zealand, 2007). The 108.2% increase projected in this demographic group will mean that the number of residents aged 65 years and older will have doubled to more than 114,000 by 2026 (Statistics New Zealand, 2007).

The proportion of people identifying themselves as Māori in the WDHB is lower than that of New Zealand as a whole. In 2013, the WDHB Māori population stood at 46,302, making up 7.7% of the total Māori population living in New Zealand (Statistics New Zealand, 2014). The WDHB catchment also serves 13.4% of the Pacific population, equating to 39,702 Pacific residents in the WDHB region (Statistics New Zealand, 2014). The WDHB Māori and Pacific population are significantly younger than the general population, with the respective population of advanced age Māori kaumātua and Pacific aged 85 years and older in this region only standing at 1.1% and 1.3%, respectively (Statistics New Zealand, 2014). Population growth among Māori and Pacific groups has begun to accelerate owing to the lower median age and higher fertility rates among these populations. Since 2006 there has been a 45% increase in the WDHB population of advanced age Māori kaumātua, and a 65% increase in the population of Pacific aged 85 years and older (Statistics New Zealand, 2014).

### **2.1.2 Health Care Service and Cost Implications**

The older adult demographic is the greatest consumer of the New Zealand health care system. Older adults have an increased prevalence of chronic disease and associated frailty, resulting in a plethora of services being utilised by this population (Te Pou, 2011). Consequently, as the population ages, the overall demand for health and disability services will increase. Older adults have been identified to have the most confidence and trust in their general practitioner (GP) (Ministry of Health, 2015b), thus when faced with a health problem, this population frequently first turn to the primary health sector. This is reflected in findings from the 2014/15 New Zealand Health Survey, which reported over 91% of older adults had seen their GP in the previous year, with those aged 75 years and older the most prevalent users of GP services (Ministry of Health, 2015b).

Health is viewed as a taonga (treasure) among Māori populations (Barrett & Connolly-Stone, 1998). Despite this, kaumātua are passive in utilising services offered by the

public health care system. Negative past experiences with health care services have been reported by kaumātua, who were once subjected to racial discrimination (Harris et al., 2006a; Hirini et al., 1999). These past experiences give explanation as to why the use of health care services in this demographic remains lower than non-Māori older adult populations. These differences have also been attributed to the hesitancy of kaumātua to access health care as it can be seen to lessen their position in the Māori community as rangatira (leaders) (Barrett & Connolly-Stone, 1998). Regardless of this, with the population of older Māori projected to increase, it is predicted that the utilisation of health care services will become more common (Ministry of Health, 2015a).

Older adults have higher hospitalisation rates than younger populations and account for a third of all publicly funded procedures (Ministry of Health, 2015b), thus the treatment and support of this demographic imposes a considerable cost, much greater than any other age group (Ministry of Health, 2002). Te Pou o Te Whakaaro Nui, a New Zealand national centre of health research, published a report in 2011 highlighting the impact ageing has on health expenditure, with older adults aged 65 years and older reported to incur 80% of medical costs (Te Pou, 2011), despite only making up 14.3% of the population. Health expenditure continues to increase with advancing age, with per capita expenditure for those aged 85 years and older nearly eight times the all-age average (Ministry of Health, 2002). Consequently, as the population ages, the cost to support the proportionally greater number of older adults will increase overall health system costs, inevitably subjecting the government to face additional pressure on their health care expenditure.

### **2.1.3 Health of Older People Strategy**

The New Zealand Government has recognised the value of maintaining good health and wellbeing throughout the life course. In order to meet the needs of the rapidly increasing older adult population, the Health of Older People Strategy was developed (Ministry of Health, 2002). This policy was initiated by the Health Minister in 2001 with the purpose of providing direction to future health care systems aimed at older adults. The strategy is organised around eight objectives, each set out to encourage older

adults to take part in the decisions made surrounding their health. The Ministry of Health has made it a responsibility of each DHB to encompass the strategy and work towards the objectives outlined in **Table 2.1**.

**Table 2.1:** *Objectives of the Health of Older People Strategy (Ministry of Health, 2002)*

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Objective 1	Older adults, their families and whanau are able to make well-informed choices about options for healthy living, health care and/or disability support needs.
Objective 2	Policy and service planning will support quality health and disability support programmes integrated around the needs of older adults.
Objective 3	Funding and service delivery will promote timely access to quality integrated health and disability support services for older adults, family, whanau and carers.
Objective 4	The health and disability support needs of older Māori and their whanau will be met by appropriate, integrated health care and disability support services.
Objective 5	Population-based health initiatives and programmes will promote health and wellbeing in older age.
Objective 6	Older adults will have timely access to primary and community health services that proactively improve and maintain their health and functioning.
Objective 7	Admission to general hospital services will be integrated with any community-based care and support that an older adult requires.
Objective 8	Older adults with high and complex health and disability support needs will have access to flexible, timely and co-ordinated services and living options that take account of family and whanau carer needs.

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## 2.2 Health of Older Adults

An ageing population brings about challenges in maintaining the health of these individuals so that as they live longer they can maintain their independence and quality of life (Ministry of Health, 2002). Rowe and Kahn (1997) paved the way for research into successful ageing by acknowledging it is multidimensional and involves three key aspects: the good fortune to avoid disease and disability, the ability to achieve and maintain a high level of physical and cognitive function, and the continued interaction in social activities.

### 2.2.1 Chronic Disease

Chronic disease is defined by the World Health Organisation (WHO) as a persistent and possibly progressive health condition (World Health Organisation, 2014). Chronic

disease has been recognised as a major health challenge in New Zealand, and is known to be the leading cause of health loss (loss of healthy life due to premature morbidity or mortality) (Ministry of Health, 2013). Older adults are disproportionately affected by chronic disease. Despite less than a fifth of the population being of older age (14.3%), health loss among this demographic is 37% (Ministry of Health, 2013). The risk of many chronic diseases is determined by risk factors exposed to individuals throughout their life course, thus with increasing age comes an increased risk of being diagnosed with a chronic disease (Ben-Shlomo & Kuh, 2002).

In 2006, cancer accounted for 29% of the health loss experienced by adults aged 65-74 years. This was closely followed by vascular disorders, namely coronary heart disease, while musculoskeletal conditions was the third leading cause of health loss. Vascular disorders are more prevalent among older adults (75 years and over) than cancers. Health loss is also significantly contributed to by neurological conditions such as dementia (Ministry of Health, 2013). Māori are impacted by chronic disease at an earlier age and are reported to sustain a 1.8 times higher health loss than non-Māori (Ministry of Health, 2013). Multiple risk factors have been identified for the disproportionately higher prevalence of chronic conditions in Māori populations, such as the impact of higher smoking rates, delay or lack of appropriate treatment for health conditions, and social deprivation (Ministry of Health, 2013).

The prevalence of comorbidity (multiple unrelated chronic conditions) becomes progressively more common with age (Ministry of Health, 2006a). Comorbidity is prevalent among 7% of women and 6% of men aged 50-64 years; significantly higher rates are seen in adults aged 65 years and older with 20.6% of women and 14.8% of men affected by multiple comorbidities (Ministry of Health, 2006a). Comorbidity increases the demand on the healthcare system due to the complex health care needs associated with multiple chronic conditions (Barnett et al., 2012). As a result, older adults face possible declines in quality of life and an increased risk of disability and mortality (Salive, 2013).

There is a direct relationship between chronic disease and poor nutrition. Appetite and the absorption, metabolism and excretion of nutrients are affected by chronic

disease (Brownie, 2006). In turn, this challenges the independence of older adults as it can contribute to both physical and functional limitations such as a decline in mobility and increased need of help with activities of daily living (Guccione et al., 1994). This relationship is bidirectional as diet and lifestyle over a lifetime can increase the risk of developing chronic diseases (World Health Organisation, 2003). This can be reduced through the modification of risk factors, even after the age of 65. A longitudinal study has demonstrated that balanced nutrition, quitting smoking, and increasing physical activity levels can contribute to better health and quality of life in older adults (Knoops et al., 2004).

## **2.2.2 Body Composition Changes with Age**

### **2.2.2.1 Sarcopenia**

Skeletal muscle mass progressively declines with increasing age, to such degree that functionality can be impacted. These characteristics of ageing are broadly termed sarcopenia; until recently there was no widely accepted definition, and no set parameters which diagnosed the syndrome. In 2010, the European Working Group on Sarcopenia in Older People set the definition as “a syndrome characterised by progressive and generalised loss of skeletal muscle mass plus low muscle strength or low physical performance” (Cruz-Jentoft et al., 2010). Using muscle mass or muscle strength alone as a single criterion for sarcopenia is too narrow for diagnosis due to the non-linear relationship between muscle mass and muscle strength. Instead, older adults who present with low muscle mass but have no decline in muscle strength or physical performance are diagnosed as pre-sarcopenic (Cruz-Jentoft et al., 2010).

The age-related progressive loss of skeletal muscle mass begins to occur as early as 25 years of age (Janssen, Heymsfield, Wang, & Ross, 2000; Lexell, 1995). When adults reach 50 years of age, an average muscle mass loss of 10% is likely to have occurred (Janssen et al., 2000; Lexell, 1995). Thereafter, the age-related loss of muscle mass accelerates. When advanced age is reached, muscle mass is reduced by almost 50% (Lexell, Taylor, & Sjöström, 1988) and, partly, replaced by fat mass (Lexell, 1995). Studies of whole muscle cross sections have reported both a reduction in the number of muscle fibres and type II muscle fibre atrophy with increasing age (Lexell et al.,

1988; Lexell & Taylor 1991; Nilwik et al., 2013), indicating the decline of both number and size of muscle fibres are causative factors for the loss of muscle mass in older adults.

Similarly to skeletal muscle mass, ageing has a serious consequence on muscle strength. Declines in muscle strength become more pronounced after 50 years of age and by the age of 70 approximately 30% of muscle strength is lost (Larsson, Grimby, & Karlsson, 1979). As advanced age is reached, losses in muscle strength further accelerate (Goodpaster et al., 2006). Malnutrition predicts even greater declines in muscle strength; with Norman and co-workers (2011) reporting a 25.8% lower hand grip strength value among hospitalised adults who were malnourished compared to those with a normal nutrition status.

Sarcopenia prevalence among hospitalised older adults (aged 65 years and over) has been estimated to be approximately 22% (ranging from 10% to 46.5%) when diagnosed using the criteria set out by the European Working Group on Sarcopenia in Older Peoples (Gariballa & Alessa 2013; Paola Cerri et al., 2015; Sánchez-Rodríguez et al., 2014; Smoliner, Sieber, & Wirth, 2014).

Combined, the parameters which define sarcopenia have been shown to limit functional ability, with up to two times greater impairment in older men and up to three times greater impairment in older women (Janssen, Heymsfield, & Ross, 2002). Difficulties in activities of daily living, such as eating, food shopping and food preparation can arise, and consequently food intake is reduced (Wu et al., 2014). Nutrition status can become compromised, and nutrition risk among older adults can increase (Gariballa & Alessa 2013; Smoliner et al., 2014; Wham, Carr, & Heller, 2011a).

Researchers have recently begun to investigate the relationship between sarcopenia and dysphagia. Maeda & Akagi (2015) found sarcopenia to be an independent risk factor for dysphagia in hospitalised older adults. Similarly, Shiozu, Higashijima, & Koga (2015) reported sarcopenic older adults had a significant reduction in swallowing function compared with those with normal muscle mass and strength. In the sarcopenic group, the MNA-SF nutrition assessment was significantly lower than the non-sarcopenic group, suggesting that a decreased swallowing function reduces food

intake thus adding to the increase in nutrition risk for sarcopenic older adults (Shiozu et al., 2015). Overall, maintaining a high level of muscle mass and muscle strength is an important factor in maintaining an adequate nutrition status.

#### **2.2.2.1.1 Measuring Muscle Mass**

Several methods can be used to measure muscle mass. Magnetic resonance imaging (MRI) provides precise and reliable measures of skeletal muscle mass through cross-sectional anatomic images of the body (Cesari et al., 2012). Computed tomography (CT) presents a high agreement with MRI and provides similar measures (Cesari et al., 2012). These tools are unfortunately limited by their high technical complexity and the great expense associated with running the equipment (Cesari et al., 2012). More accessible for most studies are the dual-energy x-ray absorptiometry (DXA) and BIA (bioelectrical impedance analysis) tools.

DXA is an indirect method of measuring body composition. Two X-ray beams at different intensities (high energy 70 kiloelectron volts and low energy 40 kiloelectron volts) are passed through the body, which determines the composition of muscle mass, fat mass and bone mineral (Lustgarten & Fielding 2011). DXA is validated against MRI to predict skeletal muscle mass (Kim et al., 2004), however the tool is not portable and therefore its application in studies that occur across multiple locations is limited.

Bioelectrical impedance analysis is an alternative body composition measure that is both inexpensive and time efficient (Kyle et al., 2004). It is achieved by passing one or more electrical currents through the body and measuring resistance of the conductor. Body fat, total body water and extracellular water oppose the electrical current, while lean body mass, which contains mostly water and conducting electrolytes, offers low resistance to the conductor (Kyle et al., 2004). BIA can use single frequencies, where currents are at a low frequency and only pass through extracellular fluid, or multiple frequencies, where currents are at a higher frequency and pass through intracellular as well as extracellular fluid (Kyle et al., 2004). Single-frequency BIA has been reported to give an accurate estimate of muscle mass in older adults (Bosaeus, Wilcox, Rothenberg, & Strauss, 2014). However, given the capability of differentiating between body fluid compartments, multi-frequency BIA is a more accurate method



(Kyle et al., 2004). Using DXA as a reference standard, Karelis and co-workers (2013) found the InBody 230, a multi-frequency BIA scale, to have a strong correlation for percentage body fat ( $r=0.97$ ,  $p=0.01$ ).

#### **2.2.2.1.2 Measuring Muscle Strength**

The European Working Group on Sarcopenia in Older People highlighted that the tools available to measure muscle strength in older adults are limited, and thus only three methods were proposed: peak expiratory flow, knee flexion/extension, and hand grip strength (Cruz-Jentoft et al., 2010).

Peak expiratory flow indirectly measures the muscle strength involved in breathing. This process can be limited by the voluntary effort of participants as well as lung disorders such as asthma, which can falsely lower performance (Cruz-Jentoft et al., 2010). Research on the use of this method as a measure of sarcopenia is limited. While Peak expiratory flow is inexpensive and easy to use, the European Working Group on Sarcopenia in Older People concluded that they would not recommended this method as a singular indicator of muscle strength (Cruz-Jentoft et al., 2010).

Leg strength can be measured by the isokinetic testing of knee flexion and extension using specialised equipment (Cruz-Jentoft et al., 2010). This method of measuring muscle strength can be expensive and results can be difficult to interpret without input from a technician (Cruz-Jentoft et al., 2010). While it has been utilised in studies of community-dwelling older adults, it is limited in hospital based studies as the equipment lacks portability (Cruz-Jentoft et al., 2010).

In comparison to the other parameters proposed by The European Working Group on Sarcopenia in Older People, hand grip strength is a reliable and cost effective method that shows strong correlation with leg strength (Lauretani et al., 2003). Hand grip strength is determined by the amount of force that the hand can squeeze around a dynamometer (Roberts et al., 2011). Various dynamometers are available for use and various methods exist for the measurement of grip strength. A review of the literature has identified the Jamar hand dynamometer as a widely used instrument, and it has been accepted as the gold standard of dynamometers (Roberts et al., 2011). The

handle can be positioned five different ways, allowing for smaller or wider grips among participants, although the second position is reported and being the most consistent and reliable (Roberts et al., 2011).

A standardised protocol for performing grip strength measurements has been designed by the American Society for Surgery of the Hand and the American Society of Hand Therapists (Fess, 1992). This involves participants sitting upright with their feet slightly apart, their shoulder adducted and neutrally rotated, their elbow bent at a 90 degree angle and their forearm and wrist of their dominant hand in a neutral position (Fess, 1992). It has been recognised that sitting upright may not be a practical position for all individuals, therefore an alternative protocol has been proposed which involves participants lying at a 30 degree angle with the elbow of their dominant hand supported (Hillman et al., 2005). This method reliably measures grip strength and is comparable to grip strength measured in the seated position ( $p=0.49$ ) (Hillman et al., 2005). In either position it is recommended that hand grip strength is measured consecutively over three trials, with the average being recorded as the participants grip strength value (Fess, 1992; Hillman et al., 2005).

#### **2.2.2.2 Falls, Related Fractures and Osteoporosis**

The prevalence of falls among advanced age adults is high. Trips and slips account for more than half of the falls experienced by this population, and falls have also been attributed to misplacing one's step or losing one's balance (Berg, Alessio, & Tong, 1997). Within the last 12 months, more than a third of New Zealanders in this age group reported they had had a fall (Kerse & LiLACS NZ, 2014a). Older adults who fall are likely to do so again, with findings from the New Zealand Life and Living in Advanced Age study reporting 20% of advanced age adults had fallen more than once, 13% had fallen two or three times and 7% had fallen four or more times within a 12 month period (Kerse & LiLACS NZ, 2014a). More than a third of falls in advanced age result in injury and approximately 20% require hospitalisation (Kerse & LiLACS NZ, 2014a). Nine out of 10 hip fractures in New Zealand are the result of falls (Ministry of Health and Accident Compensation Corporation, 2013), illustrating the serious consequences that falls can have on health.

Falls in the advanced age group are extremely detrimental to overall health. Over 50% of older adults who fall are thought to develop a fear of falling again (Iaboni et al., 2015; Yardley & Smith 2002), and one in four fallers will restrict activities because of this fear (Murphy, Williams, & Gill, 2002a). Fear of falling can lower confidence and decrease independence in older adults, leading to an overall reduction in quality of life and, in some cases, early admission into residential care (Biderman, Cwikel, Fried, & Galinsky, 2002; Lawlor, Patel, & Ebrahim, 2003; Vellas, Wayne, Romero, Baumgartner, & Garry, 1997).

While fall risk is multifactorial, chronic disease has been recognised as a significant contributor to falls. The association between chronic disease and falls has been observed by Sibley and co-workers (2014) in a Canadian study of 16,357 community-dwelling older adults (65 years and over), who determined that fall rates were significantly higher among those with one or more chronic conditions compared to those with no chronic conditions. Furthermore, the risk of falling increases with the number of chronic diseases an older adult has (Lawlor et al., 2003). This has been attributed to the adverse effect chronic disease can have on risk factors of falling, such as muscle weakness and poor balance (Lawlor et al., 2003).

Older adults with inadequate nutrition intake are at risk of both falling and related fractures due to the negative impact it can have on muscles (Meijers et al., 2012; Saka, Kaya, Ozturk, Erten, & Karan, 2010; Torres et al., 2015). In a study of older adults aged 65 years and over attending an outpatient clinic at a Turkish hospital, 44% of those those with a poor nutrition status (MNA score <23) had fallen at least once in the previous year in contrast to 31% of older adults with a normal nutrition status (Saka et al., 2010).

Osteoporosis is associated with a loss of bone density that leads to the structural thinning of bone tissue (Kanis, Delmas, Burckhardt, Cooper, & Torgerson, 1997). Bones naturally lose density and weaken with age; however, osteoporosis is the result of more bone being reabsorbed than new bone formed (Kanis et al., 1997). Characteristic of osteoporosis are weak, brittle bones that can fracture or break without an injury (Kanis et al., 1997). The progression of osteoporosis is slow, thus it

mainly affects older adults. Osteoporosis is more prevalent in women due to changes in sex hormone levels after menopause which accelerates bone loss (Kanis et al., 2013). In New Zealand, almost one in five non-Māori women and one in ten Māori women aged 65 years and older have been diagnosed with osteoporosis (Ministry of Health, 2008). The percentage of non-Māori men aged 65 years and older diagnosed with osteoporosis is 2.7%, however for Māori men in the same age category the prevalence is 4.5 times higher (Ministry of Health, 2008). This disparity between ethnicity groups may reflect the higher levels of smoking and alcohol intake (Ministry of Health, 2015b), which act as risk factors for osteoporosis (Kanis et al., 2005a; Kanis et al., 2005b).

Adequate nutritional intake is needed for the normal development and maintenance of bone tissue. This helps to ensure key nutrients for bone health are provided: calcium, vitamin D and protein (Sahni, Mangano, McLean, Hannan, & Kiel, 2015). A concern for older adults is that they may not meet the nutritional recommendations, leading to an increased risk of osteoporosis and bone fracture. Osteoporosis risk has been found to increase more than two-fold among older adults with poor nutrition status (Salminen, Sääf, Johansson, Ringertz, & Strender, 2006).

### **2.2.3 Mental Health**

The ability to perform everyday tasks and manage life stresses requires overall good mental health and wellbeing. When changes in mental health occur, older adults may face difficulties in maintaining an adequate nutrition status (Khater & Abouelezz, 2011). As the population ages, mental health conditions are expected to become more prevalent, highlighting the importance of early nutritional interventions to address problems associated with mental health changes.

#### **2.2.3.1 Mood and Anxiety Disorders**

One in four older adults aged 75 years and over have been diagnosed with depression (10.9%) or a mood/anxiety disorder (13.7%) (Ministry of Health, 2015b). There is a lower prevalence of these conditions in older age than younger age (Ministry of Health, 2015b). Older adults often mistake these conditions as part of the ageing

process, therefore the lower prevalence in this population may reflect the fact that older adults undermine the severity of their symptoms, and thus do not seek help from a health professional. These conditions can arise due to feelings of helplessness and hopelessness, both of which are strongly related to chronic disease, certain medications, and associated health loss (Barnett et al., 2012; Cole & Dendukuri 2003). As the population ages, the number of older adults with mood and anxiety disorders is expected to grow, corresponding with the more common onset of chronic disease in older age (Bruce et al., 2002; Harris et al., 2006b). This, combined with the loss of family and friends, reduced social support, and impaired physical strength can result in a depressive state (Cole & Dendukuri 2003). Older adults displaying depressive symptoms are at higher risk of becoming hospitalised, and are likely to have longer admissions and poorer outcomes, compared with older adults without symptoms of depression (Prina et al., 2013).

Nutrition status can be negatively impacted by mood and anxiety disorders, particularly depression. Reduced appetite and low motivation to eat are commonly reported among depressed older adults (González-Gross, Marcos, & Pietrzik, 2001). As a result, poor nutrition status is common among these individuals (Feldblum et al., 2007; German et al., 2008), with one study identifying more than half of older adults who had depressive symptoms were malnourished using the MNA-SF compared with only 8% of those without symptoms of depression (Pereira, Bulik, Weaver, Holland, & Platts-Mills, 2015). Treating mood and anxiety disorders has been shown to promote weight gain and improve nutrition status among older adults (Thomas, Hazif-Thomas, & Clement, 2003).

### **2.2.3.2 Cognitive Changes with Age**

Increasing age is often associated with decreasing cognitive function; reports indicate between 10.7% and 19.3% of adults aged 65 years and older have age-associated cognitive decline (Di Carlo et al., 2000; Graham et al., 1997; Ritchie, Artero, & Touchon, 2001). Symptoms associated with this include inhibited decision making and reaction time, poor memory and trouble comprehending new tasks (Petersen, 2011). The

ability to perform activities of daily living may be impaired, impacting on the nutrition status of older adults.

#### **2.2.3.2.1 Dementia**

Cognitive decline can progress into a neurological disorder known as dementia. Nationally, 48,189 people are estimated to be affected by dementia (Ministry of Health, 2013b). This figure is estimated to quadruple by 2050, with 146,699 New Zealanders, 2.6% of the population, projected to be living with dementia (Deloitte Access Economics, 2012). Older adults are primarily affected by dementia, and dementia rates continue to increase in advanced age (Corrada, Brokkmeve, & Berlau, 2008; Lucca, Garri, & Nobili, 2009).

The onset of dementia is often gradual. Slowly, dementia can disrupt brain functioning, causing forgetfulness and impacting on language, learning and judgements (Jansen et al., 2015). The inability to perform activities of daily living can occur during the early stages of dementia, and can progress to a stage where individuals become completely dependent on help for these tasks (Jansen et al., 2015). This loss of independence can lead to mealtime difficulties, such as challenges in preparing food and self-feeding (Andrieu et al., 2001; Roque, Salva, & Vellas, 2013). Mealtime difficulties can also arise from cognitive changes causing older adults to forget meals, become indifferent to eating, and refuse foods (Jansen et al., 2015; Silva, Kergoat, & Shatenstein, 2013). Older adults with dementia-specific mealtime difficulties are therefore at greater risk of inadequate oral intake and unintentional weight loss, increasing nutrition risk among this population (Roque et al., 2013).

#### **2.2.3.2.2 Measuring Level of Cognition**

Early detection of changes in cognitive function is important for the clinical care of older adults. Various screening tools are available for this purpose; however few are validated in older adults, particularly in those of advanced age (Cullen, O'Neill, Evans, Coen, & Lawlor, 2007). Two different screening tools are commonly used in New Zealand hospitals: the Mini Mental State Examination (MMSE) and the Montreal Cognitive Assessment (MoCA) (Strauss, Leathern, Humphries, & Podd, 2012).

The MMSE was developed by Folstein and co-workers in 1975 to identify dementia among older adults (Folstein, Folstein, & McHugh, 1975). The original version of this tool recommended that individuals screened should be aged less than 85 years, limiting its use among advanced age adults. It has since been revised to make it more sensitive to changes associated with ageing, and has increased the upper age limit to 100 years. The MMSE is widely used worldwide, but has been largely moved away from the context of dementia. Its application in assessing milder forms of cognitive impairment is limited, as it has been reported to have poor sensitivity in this area (Nasreddine et al., 2005).

In 2005, an attempt was made to capture mild cognitive impairment among older adults and the MoCA was developed. This 30-point screening tool involves four components: visuospatial abilities and executive function (8 points); language (6 points); attention, concentration, and working memory (5 points); short-term memory recall (5 points); and orientation to time and place (6 points). To correct for education effects, an additional point is given if the individual has had 12 years or less of education. The MoCA is scored out of a possible 30 points, with higher scores indicating higher cognitive functions. A score of 26 or more out of 30 is indicative of normal cognitive function while a score of less than 26 indicates some form of cognitive impairment (Nasreddine et al., 2005).

The original validation study of the MoCA involved 277 older adults: 90 had no cognitive impairment, 94 had mild cognitive impairment, and 93 had been diagnosed with mild Alzheimer's disease (Nasreddine et al., 2005). The MoCA had a high sensitivity for detecting mild cognitive impairment (90%) and mild Alzheimer's disease (100%), which was in contrast to the MMSE which only detected 18% of those with mild cognitive impairment and 78% of those with Alzheimer's disease. The MoCA was also found to have high specificity (87%) (Nasreddine et al., 2005). Most studies are in agreement with this (Alagiakrishnan, Zhao, Mereu, Senior, & Senthilselvan, 2013; Hoops et al., 2009; Wittich, Phillips, Nasreddine, Chertkow, 2010), and it has been recognised that in contrast to the MMSE, the MoCA has a higher sensitivity to detect impaired cognitive ability (Smith, Gildeh, & Holmes, 2007). Discussion has been raised over the cut-off score of 26, with some studies finding this high score may falsely

identify older adults as having cognitive impairment. Instead, these studies have recommended that the cut-off be changed to 23 (Lee et al., 2008; Luis, Keegan, & Mullan, 2009; McLennan, Mathias, Brennan, & Stewart, 2010).

#### **2.2.4 Perceived State of Health**

The perception of one's own health and wellbeing is defined as self-rated health (Ministry of Health, 2015b). This is known to deteriorate with age (Ministry of Health, 2015b), and has been associated with low satisfaction in life, comorbidities, functional dependency and low physical activity (Söderhamn, Flateland, Jessen, & Söderhamn, 2011). In spite of this, research has shown that the majority of older adults perceive themselves to be ageing successfully (Montross et al., 2006). A report from the New Zealand Ministry of Health shows an agreement with this, as 88.5% of adults aged 65-74 years and 81.2% of adults aged 75 years and over consider their health to be good, very good, or excellent (Ministry of Health, 2015b).

Poor self-rated health is associated with an increased nutrition risk (Park & Suh, 2007; Wham et al., 2011a). In New Zealand, as self-rated health declined among community-dwelling older adults, malnutrition increased (Wham et al., 2011a). Similar results were reported in a study of adults living in the United Kingdom; those who rated their health to be bad/very bad were significantly more likely to be at high nutrition risk than have a low nutrition risk (Margetts, Thompson, Elia, & Jackson, 2003). This may be contributed to a reduction in appetite observed in older adults with low self-rated health (Lainscak et al., 2014).

### **2.3 Nutritional Health of Older Adults**

Good nutrition is required during ageing to maintain body function and prevent nutritional deficiencies. A concern for older adults with poor nutrition status is that quality of life may be affected as a result of adverse changes in functional status and mental health (Drewnowski & Evans, 2001). This is becoming more of a concern as the population continues to age.



### **2.3.1 Nutritional Requirements of Older Adults**

New Zealand recommendations for older adults' nutrient requirements are based on the Nutrient Reference Values for Australia and New Zealand (NRVs) (National Health and Medical Research Council, 2006). Evidence collated by the US and Canadian Dietary Reference Intakes review was used as a baseline for the development of the NRVs; however recommendations from the United Kingdom and Germany, and key organisations such as the Food and Agricultural Organisation of the United Nations and the WHO were also considered (National Health and Medical Research Council, 2006). The National Health and Medical Research Council of Australia, which managed this project, established NRVs for two categories of older adults: those aged 51 to 70 years of age, and those aged over 70 years. This distinction reflects the body of evidence which suggests older adults have different requirements to younger adults (National Health and Medical Research Council, 2006). Based on this evidence, the NRVs recommend a higher intake of protein, calcium, vitamin D and vitamin B6 in older adults. Conversely, the recommendation for the intake of energy declines with increasing age (National Health and Medical Research Council, 2006).

#### **2.3.1.1 Energy**

The large diversity among the older adult population means energy requirements across this demographic are varied. Overall, however, there is a reduction in energy needs in older age due to age-related physiological changes which contribute to lower levels of physical activity and declines in both lean body mass and basal metabolic rate (National Health and Medical Research Council, 2006).

As adults age it is likely they will encounter a variety of factors that cause them to struggle to meet their energy requirements, such as a reduced appetite, chewing and swallowing difficulties and taste changes (Logemann, Curro, Paukoski, & Gensler, 2013; Mojet, Christ-Hazelhof, & Heidema, 2001; Solemdal et al., 2012a). Energy intakes were lower among older adults aged 71 years and older than younger adults in the 2008/09 New Zealand Adult Nutrition Survey (2008/09 NZANS) (University of Otago and Ministry of Health, 2011). The intake of nutrients in the diet is positively correlated with total energy intake, thus nutrient deficiencies can arise in older adults with poor

energy intake (University of Otago and Ministry of Health, 2011). These deficiencies can exacerbate functional decline and may lead to further impairment of health status (Mohajeri, Troesch, & Weber, 2015).

### **2.3.1.2 Macronutrients**

Protein, fat, carbohydrate and alcohol are macronutrients which serve as an energy source. In order to achieve optimal health and reduce the risk of chronic disease, it is suggested that protein, fat, and carbohydrate should be consumed within an Acceptable Macronutrient Distribution Range (AMDR); 45-65% of total energy for carbohydrate and slightly lower for protein and fat (15-25% and 20-35%, respectively) (National Health and Medical Research Council, 2006).

#### **2.3.1.2.1 Protein**

Older adults rely on an adequate protein intake to maintain muscle mass and strength and prevent a loss of functionality and independence with age (Houston et al., 2008). In order to support this, protein requirements are 25% higher for those aged 70 years and older (National Health and Medical Research Council, 2006). This accommodates the reduced ability of older adults to utilise available protein due to high splanchnic extraction and impaired insulin and anabolic responses. It also helps to offset the greater need for protein due to inflammation and catabolism associated with both acute and chronic disease. Therefore, the recommended daily intake (RDI) for men and women aged over 71 years are 81g and 57g, respectively (National Health and Medical Research Council, 2006).

Despite the greater protein requirements in older age, adults aged 75 years and older have been found to have slightly lower protein intakes than younger adults. The 2008/09 NZANS reported men in this age category had a median intake of 72.7g while women demonstrated a median intake of 62g. This was in contrast to men and women aged 65-74 years, who had median protein intakes of 82g and 64g, respectively (University of Otago and Ministry of Health, 2011).

Barriers in meeting protein requirements have been explored in older adults, and include perceived higher costs of purchasing and consuming protein rich foods,

chewing and swallowing difficulties, and taste changes (Best & Appleton, 2013; van der Zanden, van Kleef, de Wijk, & van Trijp, 2014). Additionally, it has been suggested that older adults in New Zealand may not be aware of their additional protein requirements (McElnay et al., 2012).

#### **2.3.1.2.2 Fat**

Dietary fat, when consumed in appropriate amounts, aids in the absorption of fat soluble vitamins and may stimulate muscle protein synthesis (Smith et al., 2011; University of Otago and Ministry of Health, 2011), however in excess they can increase the risk of obesity, certain chronic diseases such as cardiovascular disease and dementia (National Health and Medical Research Council, 2006).

For older adults, a low intake of fat can be a concern due to possible weight loss and associated increase in nutrition risk (Lichtenstein & Van Horn, 1998). Results of the 2008/09 NZANS found that although total fat intake for older adults fell within the AMDR, older adults aged 71 years and over were found to have lower total fat intakes than younger adults (University of Otago and Ministry of Health, 2011).

#### **2.3.1.2.3 Carbohydrate**

Meeting the carbohydrate requirements is important for older adults due to its role in providing energy to the brain and body (National Health and Medical Research Council, 2006). This also helps older adults to achieve an adequate fibre intake. Fibre plays a fundamental role in the functioning of the digestive system, and may help to prevent constipation and diverticular disease (Gallegos-Orozco, Foxx-Orenstein, Sterler, & Stoa, 2012). Fibre is also indicated in the reduction of inflammation and chronic disease risk (Anderson et al., 2009; Ma et al., 2008). When fibre is consumed in excess of requirements, early satiety may result (Nieuwenhuizen, Weenen, Rigby, & Hetherington, 2010), and nutritional intake may be impaired.

The recommended daily intake of fibre is consistent during adulthood, with men suggested to have 30g per day and women 25g per day. It has been found that adults over 71 years of age have the lowest fibre intake, with men averaging 21g per day and women demonstrating an average intake of 17.6g per day (University of Otago and

Ministry of Health, 2011). This may be a contributing factor to the high prevalence of constipation among older adults (Campbell, Busby, & Horwath, 1993), and in turn may contribute to polypharmacy if laxatives are prescribed.

### **2.3.1.3 Micronutrients**

#### **2.3.1.3.1 Iron**

Iron has many critical roles in the body, including being an essential component of two oxygen-binding proteins: haemoglobin and myoglobin. In older age, iron is also important for normal cellular functioning and cognition (Ng, Feng, Niti, & Yap, 2008).

The recommended daily intake of iron for both men and women aged over 70 years is 8mg/day. While iron requirements are the same for men regardless of age, older women have significantly lower requirements than younger women as they no longer need to make up for menstrual blood loss (National Health and Medical Research Council, 2006).

Mean iron intakes among older adults have been reported to be above the RDI for both men and women (11.8g/day and 9.3g/day, respectively) (University of Otago and Ministry of Health, 2011). However, iron status can be affected by factors other than dietary intake. Iron can interact with certain medications, which is of concern for older adults where levels of polypharmacy are often high. Medications of concern include proton pump inhibitors, such as omeprazole, which reduce the acidity of stomach contents, which in turn reduces iron absorption (Humphrey, Barkhordari, & Kaakeh, 2012).

#### **2.3.1.3.2 Zinc**

Zinc is an essential micronutrient for older adults due to the critical role it plays in biochemical and immunological functions. Specifically, zinc is needed for protein and DNA synthesis, neurosensory functions and the metabolism of both bone and thyroid hormones (National Health and Medical Research Council, 2006). Zinc deficiency is a concern for older adults due to the adverse effect it has on appetite and taste sense (Aliani et al., 2013).

Zinc absorption appears to be similar across the life course, therefore the recommended daily intake of zinc is the same regardless of age (National Health and Medical Research Council, 2006). Despite this, older adults are more susceptible to poorer zinc status due to polypharmacy and the adverse effect certain medications have on zinc absorption (Pepersack et al., 2001). Older adults are also at risk of deficiency due to their low zinc intake; the 2008/09 NZANS estimated 89.7% of men and 28.3% of women aged over 70 years of age had an inadequate intake of zinc (University of Otago and Ministry of Health, 2011). This has been attributed to reductions in food intake due to decreased energy needs, poor appetite and low intakes of zinc rich foods such as meat (University of Otago and Ministry of Health, 2011).

#### **2.3.1.3.3 Selenium**

Selenium is an essential micronutrient for human health, specifically due to its role within selenoproteins. These proteins are crucial for thyroid hormone metabolism and redox homeostasis. Selenoproteins also play a functional role in antioxidant defence, protecting the body from oxidative stress and inflammation (Papp, Lu, Holmgren, & Khanna, 2007).

Regardless of age, adults have a RDI of 70µg for men and 60µg for women (National Health and Medical Research Council, 2006). Despite these recommendations, the mean intake of selenium in both men and women aged over 70 years is low. Almost two thirds of men (63.8%) and more than three quarters of women (78.5%) aged over 70 years were estimated to have an inadequate intake of selenium. This estimated prevalence was consistently higher than younger adults (University of Otago and Ministry of Health, 2011), which is of concern as insufficient selenium may exacerbate immunodeficiency among older adults, adversely affecting their ability to fight infections (Rayman, 2012). Low selenium status has also been associated with increased risk of cognitive decline (Berr et al., 2000).

#### **2.3.1.3.4 Calcium**

Calcium plays an important role in the development and maintenance of bone tissue, as well as in neuromuscular and cardiac function (National Health and Medical Research Council, 2006). Older adults have increased requirements for calcium (RDI 1300mg/day) in contrast to younger adults (RDI 800mg/day) to accommodate their reduced intestinal absorption and their lower production of hormonally active metabolite of vitamin D, calcitriol (National Health and Medical Research Council, 2006).

Despite these increased requirements, 86.0% of men aged 71 years and older and 92.8% of women aged 71 years and older aged were found to have inadequate intakes of calcium (University of Otago and Ministry of Health, 2011). This is of concern as bone loss can be accelerated, putting older adults at greater risk of osteoporosis (Gennari, 2001).

#### **2.3.1.3.5 Vitamin D**

The regulation of calcium and phosphate homeostasis is reliant on adequate vitamin D levels within the body (St-Arnaud, 2008). Vitamin D also exerts its effects to build and protect the bones (Holick, 2004). Older adults are at high risk of vitamin D deficiency due to various risk factors. Ageing is accompanied by a reduction in food intake, skin thickness, intestinal absorptive capacity, and vitamin D hydroxylation in the liver and kidney, which all contribute to low vitamin D status (Dawson-Hughes et al., 2010; MacLaughlin & Holick, 1985; Ministry of Health, 2012). This population are also more likely to have low mobility and are prone to being housebound, which in turn leads to diminished sun exposure and vitamin D<sub>3</sub> production (MacLaughlin & Holick, 1985).

The 2008/09 NZANS reported vitamin D deficiency was higher among the older adult population, with 6.6% of adults aged 75 years and older were deficient, compared with 5.2% in those aged 65-74 years, and 3.9% in those aged 55-64 years (Ministry of Health, 2012).

A consensus statement released by the Ministry of Health and Cancer Society of New Zealand (2012) has suggested groups at risk of vitamin D deficiency may benefit

from supplementation. Older adults taking vitamin D supplements are reported to have a reduction in bone loss and a reduced risk of fracture (Bischoff-Ferrari et al., 2005; Ooms et al., 1995), suggesting that supplementation may benefit adults as they reach old age.

#### **2.3.1.3.6 Vitamin C**

Vitamin C is a water soluble vitamin required by the body for numerous functions such as antioxidant protection against free radicals (Beyer, 1994). Vitamin C is also a cofactor required for the synthesis of different biological compounds, including the protein collagen, which plays a role in tissue maintenance; the molecule carnitine, which is utilised in fatty acid oxidation; as well as neurotransmitters and peptide hormones (Carr, Bozonet, Pullar, Simcock, Vissers, 2013; Grosso et al., 2013).

The RDI of vitamin C remains unchanged throughout adulthood, and is set at 45mg/day (National Health and Medical Research Council, 2006). The 2008/09 NZANS found the mean daily vitamin C intake for adults aged over 70 years of age was 103mg for men and 98mg for women. Estimates from this survey suggested 2.2% of men and 4.1% of women aged over 70 years had an inadequate intake of vitamin C. Almost a third of older adults' vitamin C intake came from vegetables, followed by fruit and potatoes, kūmara and taro (University of Otago and Ministry of Health, 2011).

#### **2.3.2 Malnutrition**

Malnutrition is defined as a state of nutritional imbalance which causes an adverse effect on body composition and functional status, and impaired quality of life and clinical outcome. Malnutrition can be further categorised into over-nutrition, which occurs when energy, protein, and other nutrients are in excess, and under-nutrition, which occurs when there is a lack of intake or uptake of these nutrients (Malnutrition Action Group, 2003).

##### **2.3.2.1 Over-nutrition**

Over-nutrition, defined as energy intake in excess of energy expenditure, is a leading cause of overweight and obesity (Chopra, Galbraith, & Darnton-Hill, 2002). People who are over-nourished can still be malnourished if the foods eaten are low in specific

nutrients such as vitamins or minerals (Chopra et al., 2002). The prevalence of older adults in New Zealand with a high BMI is increasing. The 2014/15 New Zealand Health Survey found 66.5% of adults aged 75 years and older had a BMI of  $>25\text{kg/m}^2$ , an increase from 2011/12 when the prevalence was 62.1% (Ministry of Health, 2015b). High BMI is associated with increased risk of mortality from conditions such as diabetes, hypertension and cardiovascular disease, gall bladder disease, pulmonary disease, and certain cancers (Must et al., 1999; World Health Organisation, 2003). Older adults with a high BMI may also suffer from symptomatic osteoarthritis, gout and sleep apnoea, and are more likely to face complications during surgery and have social problems (Blagojevic, Jinks, Jeffery, & Jordan, 2010; Must et al., 1999; Punjabi, 2008). Obesity negatively affects physical functioning, with obese older adults at risk of reduced exercise capacity and decline in walking speed (Houston et al., 2009; Stenholm et al., 2009). Consequently, obese older adults are at significantly higher risk of developing mobility disability.

Obesity rates are higher among older adults aged 65-74 years than those of advanced age ( $\geq 75$  years). In 2015, 37.2% of older adults aged 65-74 years were found to be obese, compared to 25.1% of those aged 75 years and older (Ministry of Health, 2015b). Several factors have been attributed to this decline; older adults have a lower energy intake than younger adults (University of Otago and Ministry of Health, 2011), and with age lean body mass decreases and is partly replaced by fat mass (Lexell, 1995; Lexell et al., 1988). Of greater concern is the premature mortality of obese younger adults, which in turn decreases the mean body weight and BMI of surviving older adults (Roberts & Rosenberg, 2006).

### **2.3.2.2 Under-nutrition**

Under-nutrition, commonly referred to in the literature as malnutrition, is a significant condition that disproportionately affects older adults (Stratton et al., 2004). Poor nutrition status can result from a combination of changes related to ageing, including loss of muscle mass, sensory impairment, widowhood and poor oral health (Gopinath et al., 2015; Lee et al., 2004; Shahar et al., 2001). These changes, together with acute or chronic diseases, polypharmacy, or cognitive impairment, may compromise dietary



intake and increase the risk of malnutrition in older adults (Brownie, 2006; Roque et al., 2013; Wham, Redwood, & Kerse, 2014a).

Malnutrition is a greater threat to older adults than over-nutrition due to the adverse effects it has at both the cellular and physical level (Allison, 2000; Holmes, 2007; Kubrack & Jensen, 2007). Malnutrition can lead to a downward spiral of poor health, as immune, muscle, respiratory, and cognitive function can become impaired (Faggioni, Feingold, & Grunfeld, 2001). These factors have a direct effect on functional decline, which in turn reduces quality of life and can predict early mortality.

Nutrition risk is known to precede malnutrition. While less severe than malnutrition, it is still a significant problem for older adults as it limits functional ability and impairs health status (Stuck et al., 1999). Therefore, the early identification of older adults at risk of malnutrition is important to prevent the progression into a poorer nutrition state.

### **2.3.3 Nutrition Screening and Tools**

Nutrition screening is an important element of the nutritional wellbeing of older adults. The American Society for Parenteral and Enteral Nutrition has defined nutrition screening as “a process to identify an individual who is malnourished or who is at risk of malnutrition to determine if a detailed nutrition assessment is indicated” (Mueller et al., 2011). It is recommended that nutrition screening is carried out within 24 hours of admission to allow for early intervention in those identified at risk of poor nutrition status (Joint Commission on Accreditation of Healthcare Organizations, 2007).

In hospital settings, nutrition screening is often completed by medical, nursing, or allied health professionals, who may have minimal or no training on how to complete the tool. Therefore, in order to be effective, nutrition screening tools should be simple, non-invasive and easily understood by both patients and health professionals (Kondrup, Allison, Elia, Vellas, & Plauth, 2003).

Numerous nutrition screening tools which were originally developed for younger hospitalised adults can be applied to older populations (Baker et al., 1982; Elia, 2003; de Kruif & Vos, 2003; Ferguson, Capra, Bauer, & Banks, 1999; Gerasimidis, Drongitis,

Murray, Young, & McKee, 2007; Kondrup et al., 2003; Kovacevich, Boney, Braunschweig, Perez, & Stevens, 1997; Kruizenga, Seidell, de Vet, Wierdsma, & van Bokhorst-de van der Schueren, 2005; Ottery, 2000; Reilly, Martineau, Moran, & Kennedy, 1995; Thorsdóttir, Eriksen, & Eysteinsdóttir, 1999; Weekes, Elia, & Emery, 2004). Furthermore, a wide variety of tools have specifically been developed for the purpose of screening hospitalised older adults at risk of poor nutrition status (**Table 2.2**). The items in these tools range from assessing appetite and food intake to analysing anthropometry and biochemical markers. Unfortunately, the lack of validation for many of these tools limits their effectiveness as a nutrition risk screening tool for older adults.

No consensus has been formed on the best tool to use to screen nutrition risk among hospitalised older adults; although the European Society for Clinical Nutrition and Metabolism has suggested the MNA is the most appropriate tools to use in this population group (Kondrup et al., 2003). Meanwhile, the use of the MNA-SF in this population has been supported by the New Zealand Dietetic Association and the Dietitians Association of Australia (Dietitians Association of Australia, 2009).

### **2.3.3.1 The Mini Nutritional Assessment**

Guigoz and co-workers (1994) recognised the importance of identifying nutrition risk among older adults and thus developed the MNA screening tool. The MNA consists of four assessment components: anthropometry; health; dietary; and self-reported health status (Guigoz, Vellas, & Garry, 1994).

Since its development in 1994, the MNA has been validated across a wide range of older adult populations, including those with a good health status and those with a poor health status (Guigoz et al., 1994, Vellas et al., 1999). It has been found to have high sensitivity (96%), high specificity (98%), as well as a high predictive value (97%) (Vellas et al., 1999).

While benefited by its numerous anthropometric, functional, and nutritional indices, the MNA assessment takes longer to administer than other screening tools (10-15

minutes). The MNA was therefore adapted into a more practical version, known as the MNA-SF.

#### **2.3.3.1.1 The Mini Nutritional Assessment-Short Form**

The MNA-SF is a simple nutrition screening tool which retains the validity and diagnostic accuracy of the original MNA, while benefiting from a shorter administration time (approximately three minutes). The tool has six key items: food intake, weight loss, mobility, psychological stress/acute disease, neuropsychological issues and BMI (Rubenstein et al., 2001). The MNA-SF recognised that BMI may not be available for all participants; this item can be replaced with calf circumference if needed (Rubenstein et al., 2001). This parameter has a positive correlation with nutrition status when assessed as part of the MNA-SF (Leandro-Merhi, De Aquino, & De Camargo, 2012).

Each multi-choice response has a score ranging from 0 to 3, with lower scores associated with greater nutrition risk. A maximum score of 14 can be attained in the MNA-SF. Those who score 12 or more are categorised as having a normal nutrition status, while those who score lower are recognised as being at risk of malnutrition (8-11) or malnourished ( $\leq 7$ ) (Rubenstein et al., 2001).

The original validation study of the MNA-SF found the screening tool to be strongly correlated with the original MNA ( $r=0.945$ ), and the sensitivity, specificity and predictive value were all high (07.9%, 100%, and 98.7%, respectively) (Rubenstein et al., 2001). When the validity was assessed among older adults receiving rehabilitation at an Australian hospital, the MNA-SF was found to have high sensitivity (100%) but low specificity (22.6%) (Marshall, Young, Bauer, & Isenring, 2015), suggesting that the cut-offs should be lowered or results interpreted with caution to ensure nutrition risk is not overestimated.

#### **2.3.4 Nutrition Risk in Hospitalised Older Adults**

There is a vast amount of literature regarding the nutrition risk status of hospitalised older adults but differences in defining, screening, and diagnosing malnutrition means the exact prevalence to be unknown (Guigoz, 2006; Skates & Anthony, 2012). One

review of nutrition risk prevalence, in which all studies used the MNA tool, found 69% of hospitalised older adults had poor nutrition status (malnourished: 23%; at risk of malnutrition: 46%) in contrast to 26% of community-dwelling older adults (malnourished: 2%; at risk of malnutrition: 24%) (Guigoz, 2006). This highlights the importance of routine screening of nutrition risk status in hospital settings.

Without routine screening, poor nutrition status in hospitalised older adults can go unrecognised, and consequently untreated. This has a negative effect on the functional recovery of these older adults, leading to increased complications during their admission, such as pressure ulcers, poor wound healing, and impaired immune, muscle and respiratory function (Katona & Katona-Apte, 2008; Norman et al., 2008; Shahin et al., 2010). The nutrition status of hospitalised older adults significantly affects medication requirements, with malnourished patients reported to require more medications than patients with a normal nutrition status (Jyrkkä, Enlund, Lavikainen, Sulkava, & Hartikainen, 2011). Furthermore, malnutrition among hospitalised older adults is associated with an extended length of stay. A 2013 Australasian study of 3,122 patients and a 2001 Australian study of 819 patients found that malnutrition was associated with 1.5 times the length of stay compared to patients with normal nutrition status (Agarwal et al., 2013; Middleton et al., 2001). Longer hospital admission worsens the prevalence and degree of malnutrition. This is contributed by low appetite, interruptions to meals and nil-by-mouth diets before hospital procedures, and unappetising or unfamiliar foods provided by the hospital (Dupertuis et al., 2003).

The clinical outcome of hospitalised older adults is significantly affected by nutrition status during admission (Neumann et al., 2005; Visvanathan et al., 2004). Middleton and co-workers (2001) found malnourished older adults had a higher incidence of mortality during hospital admission than patients with normal nutrition status. Malnourished older adults are more likely to be discharged to residential care than return to the community (Charlton et al., 2012; Marshall et al., 2015). Following discharge, quality of life is reported to be poor among older adults regardless of whether they were discharged to the community or higher level care. This is due to the vulnerable nutritional state of these older adults who often remain malnourished

at discharge and face hospital readmission (Beck et al., 2012). Nutrition status during hospital admission has been found to predict mortality up to three years post discharge. A study of 476 patients in Australia found the hazard rate for death among malnourished patients was over three times that of patients with normal nutrition status at 18-month follow up (Charlton et al., 2012), while a Singaporean study found malnutrition posed a three-fold increase in risk of death at three year follow up (Lim et al., 2012).

### **2.3.5 Prevalence of Nutrition Risk in New Zealand**

The prevalence of nutrition risk among older adults in New Zealand has been estimated to range from 31-68% in nine studies across a range of settings in New Zealand (Hanger et al., 1999; McElnay et al., 2012; van Lill 2002; Watson, Zhang, & Wilkinson, 2010; Wham & Bowden 2011; Wham et al., 2011a; Wham, Teh, & Kerse, 2011b; Wham et al., 2014a; Wham et al., 2014b). Of these studies, only two focused on hospitalised older adults, however neither specifically looked at nutrition risk status in advanced age.

As shown in **Table 2.3**, the first study of nutrition status among hospitalised older adults was carried out almost 20 years ago at Christchurch Hospital in hip fracture patients aged 65 years and over (mean age 81.5 years). Using anthropometric measures (triceps skinfold thickness and mid upper arm circumference) and biochemical analysis (serum albumin and pre-albumin) it was found that 42% of participants were malnourished (Hanger et al., 1999). The second New Zealand study was undertaken in 2002 in the AT&R wards at Middlemore Hospital. Using the MNA tool, a quarter of the 71 older adults involved in the study (mean age 81 years) were identified as being malnourished, while a further 44% were at risk of malnutrition (van Lill 2002).

The limited recent research in hospitalised older adults, especially of those in advanced age suggests further studies are needed to determine the true prevalence of nutrition risk in this population.

**Table 2.2 Nutrition Screening Tools for Hospitalised Older Adults**

Tool (Reference)	Country of Origin	Population Group	Format & Areas Covered	Risk Categories
Birmingham Nutrition Risk Score (Reilly et al., 1995)	United Kingdom	Hospitalised Adults	5-item tool Weight loss, BMI, appetite, ability to eat/retain food, stress factor	Maximum score: 15 *did not clarify how risk could be obtained from the total score
Glasgow Nutritional Screening Tool (Gerasimidis et al., 2007)	United Kingdom	Hospitalised Adults	6-item tool Weight, appetite, ability to eat and drink, skin condition, gut function, medical condition	Maximum score: 30 0-5: low risk 6-9: medium risk ≥10: high risk
Malnutrition Screening Tool (Ferguson et al., 1999)	Australia	Hospitalised Adults	2-item tool Weight loss, appetite	Maximum score: 16 ≥2: at risk of malnutrition
Malnutrition Universal Screening Tool (Elia, 2003)	United Kingdom	Hospitalised Adults	4-item tool Weight, BMI, weight loss, nutritional intake	Maximum score: 6 0: low risk 1: medium risk ≥2: high risk
Mini Nutritional Assessment (Guigoz et al., 1994)	Switzerland	Hospitalised Older Adults	18-item tool Anthropometry, social factors, perceived state of health, lifestyle, medication, mobility, dietary assessment, subjective assessment	Maximum score: 30 0-17: malnourished 17-23.4: at risk 24-30: normal
Mini Nutritional Assessment-Short Form (Rubenstein et al., 2001)	Switzerland	Hospitalised Older Adults	6-item tool BMI or CC, dietary intake, weight loss, mobility, psychological stress/acute disease, neuropsychological problems	Maximum score: 14 0-7: malnourished 8-11: at risk 12-14: normal
Minimal Eating Observation and Nutrition Form-Version II (Vallén et al., 2011)	Sweden	Hospitalised Older Adults	6-item tool Weight loss, BMI or CC, eating problems, swallowing problems, appetite, clinical signs of malnutrition	Maximum score: 8 0-2: no/low risk 3-4: moderate risk ≥5: high risk
Nursing Nutritional Screening Form (de Kruijf & Vos, 2003)	The Netherlands	Hospitalised Adults	6-item tool Weight loss, clinical appearance, appetite, food intake, GI function, severity of illness/treatment	A: mild risk B: moderate risk C: severe risk
Nutrition Risk Classification (Kovacevich et al., 1997)	United States	Hospitalised Adults	2 categories Acute/chronic disease diagnosis, nutrition history, ideal body weight, weight loss	Low nutritional risk At nutritional risk

Nutrition Risk Screening 2002 (Kondrup et al., 2003)	Denmark	Hospitalised Adults	7-item tool	BMI, weight loss, dietary intake, acute/chronic disease, age	Maximum score: 7 ≥3: at risk
Nutrition Screening Initiative (Posner et al., 1993)	United States	Hospitalised Older Adults	10-item tool	Medical condition, meal frequency, dietary intake, alcohol intake, mouth problems, financial constraints, polypharmacy, weight loss, functional capacity	Maximum score: 21 0-2: no risk 3-5: moderate risk ≥6: high risk
Nutrition Screening Tool (Weekes et al., 2004)	United Kingdom	Hospitalised Adults	2-item tool	Weight loss, food intake	Maximum score: 5 0: low risk 2-3: medium risk 4-5: high risk
Nutritional Form for The Elderly (Söderhamn & Söderhamn, 2001)	Sweden	Hospitalised Older Adults	15-item tool	Weight loss, dietary intake, fluid intake, appetite, portion sizes, food attainment, shared meals, physical activity, swallowing difficulties, gastrointestinal conditions, polypharmacy	Maximum score: 30 *did not clarify how risk could be obtained from the total score
Patient Generated Subjective Global Assessment (Ottery, 2000)		Hospitalised Adults	8-item tool	Weight loss, dietary intake, disease symptoms, functional capacity, metabolic exam, physical examination	Maximum score: 47 0-8: no risk ≥9: at risk
Rapid Screen (Visvanathan et al., 2004)	Australia	Hospitalised Older Adults	2-item tool	BMI, weight loss	Maximum score: 2 0: normal ≥1: undernourished
Screening Sheet (Thorsdóttir et al., 1999)	Iceland	Hospitalised Adults	9-item tool	BMI, weight loss, age, food avoidances, appetite, swallowing problems, polypharmacy, acute/chronic conditions	Maximum score: 92 ≥2: malnourished
Short Nutritional Assessment Questionnaire (Kruizenga et al., 2005)	The Netherlands	Hospitalised Adults	3-item tool	Weight loss, appetite, nutritional support	Maximum score: 5 0-2: well nourished 2: moderately malnourished ≥3: severely malnourished
Subjective Global Assessment (Baker et al., 1982)	Canada	Hospitalised Adults	4-item tool	Weight loss, dietary intake, disease symptoms, functional capacity	A: normal nutrition status B: mild malnutrition C: severe malnutrition

Body mass index, BMI; Calf circumference, CC; Gastrointestinal, GI.

**Table 2.3** *Prevalence of Nutrition Risk among Older Adults in New Zealand*

Reference	Participants	Age (years)	Setting	Nutrition Screening Tool	Prevalence of Nutrition Risk
Hanger et al., 1996	n=66	81.5 <sup>1</sup>	Hospital, Christchurch	Nutritional indices: TSF, MUAC, S-Alb, P-Alb	Malnourished: 42%
McElnay et al., 2012	n=473 207M, 236F, 30 unspecified	74.0 <sup>1</sup>	Community, Hawkes Bay	SCREEN II	High risk:32.8% At risk:23.7%
van Lill, 2002	n=71	81.0 <sup>1</sup>	Hospital, Auckland	MNA	Malnourished: 24% At risk: 44%
Watson et al., 2010	n=152 57M, 95F	79.5 <sup>1</sup>	Community, Christchurch	SCREEN II	High risk: 31% At risk:23%
Wham & Bowden 2011	n=12 12M, 0F	79-87 <sup>2</sup>	Community, Auckland	SCREEN II	High risk: 50%
Wham et al., 2011a	n=51 15M, 36F	82.4 ± 1.7 <sup>3</sup>	Community, Auckland	SCREEN II	High risk: 52%
Wham et al., 2011b	n=108 48M, 60F	85.2 ± 0.6 non-Māori <sup>3</sup> 76.6 ± 1.8 Māori <sup>3</sup>	Community, North Island	SCREEN II	High risk: 31%
Wham et al., 2014a	n=3480 1600M, 1872F, 8 unspecified	≥75 non-Māori ≥65 Māori	Community, New Zealand	ANSI	High risk:38% Moderate risk: 27%
Wham et al., 2014b	n=45 24M, 31F	85-86 <sup>2</sup>	Community, Bay of Plenty	SCREEN II	High risk: 33% At risk: 27%

<sup>1</sup> Mean only, no standard deviation available

<sup>2</sup> Range

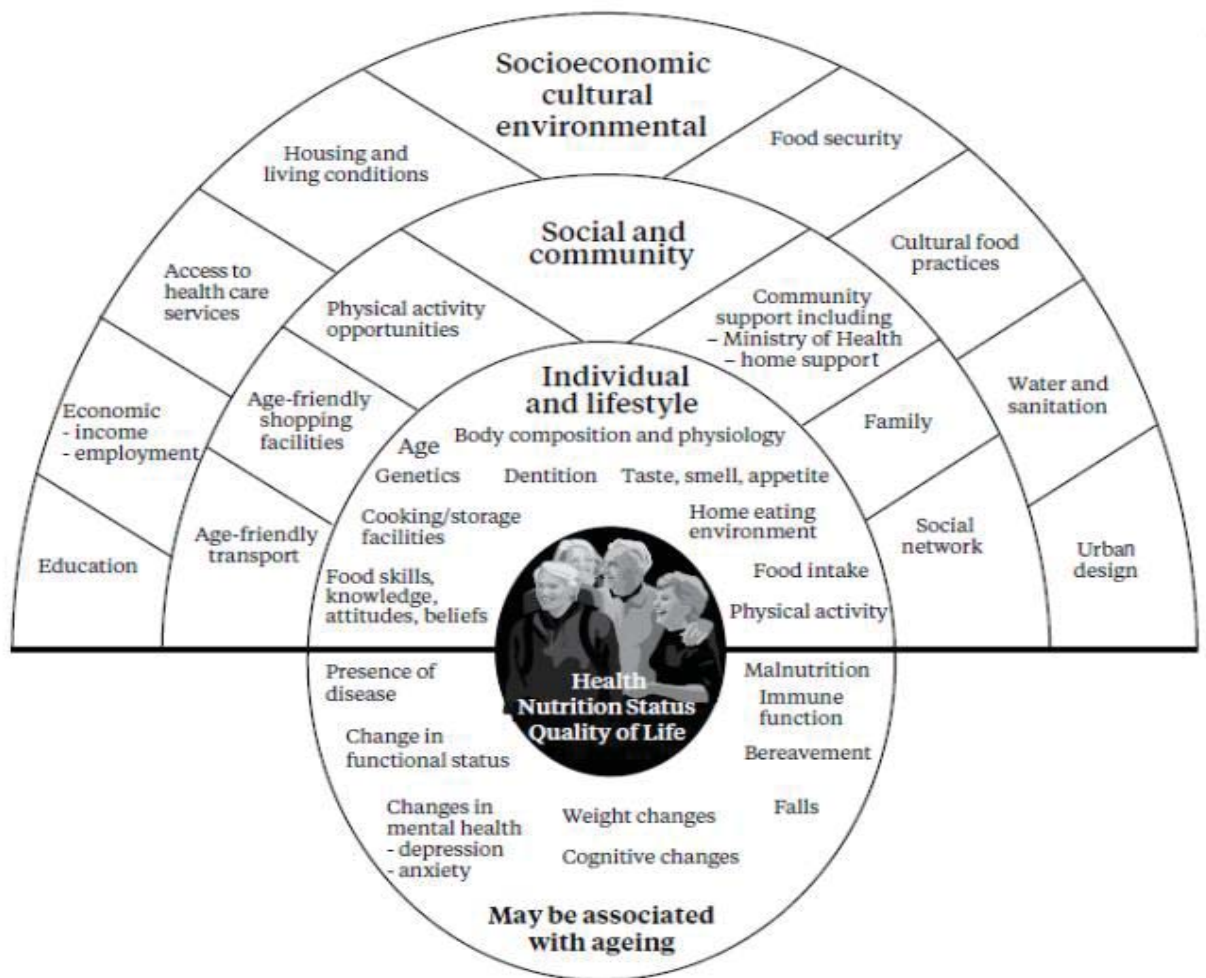
<sup>3</sup> Mean ± SD

Male, M; Female, f; Triceps skinfold thickness, TSF; Mid upper arm circumference, MUAC; Serum albumin, S-Alb; Pre-albumin, P-Alb; Seniors in the Community: Risk Evaluation for Eating and Nutrition, Version II, SCREEN II; Mini Nutritional Assessment, MNA; Australian Nutrition Screening Initiative, ANSI

## 2.4 Factors Affecting the Nutrition Status of Older Adults

Several factors are known to affect the nutrition status of older adults. Such factors include sociodemographic influences: marital status and living arrangements, sourced income and education level; and health influences: polypharmacy, oral health, swallowing impairment and sensory changes (**Figure 2.2**).





**Figure 2.2** Factors Affecting the Nutrition Status of Older Adults (Ministry of Health, 2013)

## 2.4.1 Sociodemographic Influences

### 2.4.1.1 Marital Status and Living Arrangement

The majority of older adults aged 65 years and older in New Zealand are partnered (62.1%), while 21.9% are widowed and 7.5% are divorced. By the age of 85, partnership rates drop to less than a third (29.4%) while rates of widowhood double to 47% (Statistics New Zealand, 2015). This is of concern as widowhood causes the social environment of the surviving partner to be greatly impacted. Results from longitudinal studies indicate that widowhood is linked to a decline in both diet quality and variety, with lower intakes of vegetables and red meat often reported (Kwon et al., 2006; Lee et al., 2005; Shahar et al., 2001). In contrast to married older adults, those who have suffered recent bereavement are reported to frequently skip meals and have a poor appetite (Shahar et al., 2001).

Qualitative data has helped to describe eating behaviour changes in widowhood. Poor appetite results from emotional changes caused by bereavement and sadness at mealtimes when thinking about how those meals were previously shared and enjoyed with their spouse. This leads to widows and widowers having less motivation to cook, causing meals to be skipped or less healthy choices to be made (Johnson, 2002). One-on-one interviews with widowed older women identified that in spite of previously enjoying preparing, cooking and eating meals, bereavement left them feeling like eating was a chore and eating alone highlighted to them how lonely they felt (Rosenbloom & Whittington, 1993).

These factors can negatively impact on the weight status of widowed older adults. An American longitudinal study of 80,944 women found widowhood was significantly associated with weight loss over a four year period (Lee et al., 2005). An earlier study by Shahar and co-workers (2001) reported the prevalence of weight loss following the loss of a spouse was 41%. Consequently, widowhood places older adults at increased nutrition risk (Wham et al., 2014a).

Living situations change with advancing age, reflecting the increased rates of widowhood. Compared to any other stage in life, older adults are more likely to be living alone (Statistics New Zealand, 2015). This has been related to an increased risk of poor nutrition status. A New Zealand study found nutrition risk was 3.5 times greater in community-dwelling older adults who lived alone compared to those who lived with others (McElnay et al., 2012). Nutritional challenges, such as low appetite and altered diets, that occur in older adults who live alone often stem from the nutritional impact of widowhood.

#### **2.4.1.2 Sourced Income**

The New Zealand Superannuation, most commonly referred to as the pension, is available to most adults over the age of 65 years. With increasing age, the pension becomes the only source of income for the majority of older adults (Statistics New Zealand, 2015). After tax, the amount received each week ranges from \$262.64 to \$374.53, depending on factors such as marital status and living situation (Work and Income, 2015). However, it has been acknowledged that this income may not be

enough to maintain a healthy lifestyle in advanced age (O'Sullivan et al., 2012). The price of food is a key factor for meal decisions among older adults (Kamphuis, de Bekker-Grob, & van Lenthe, 2015), thus when income is a concern diet quality can be compromised (Dijkstra et al., 2015). An Australian study of community-dwelling older men (mean age 81 years) found those who had other sources of income on top of their pension had better diet quality and higher nutritional intakes than those whose only source of income was the pension (Waern et al., 2015).

#### **2.4.1.3 Education Level**

Higher education among older adults is associated with better nutrition status and greater access to health resources (Locher et al., 2005). This suggests these older adults may be more familiar with the changes in nutritional needs that occur with increasing age. In a study of community-dwelling older adults living in New Zealand, those who had less than six years of education (primary level only) were significantly more likely to have high malnutrition risk (Wham et al., 2014a). It is important to note that education level does not directly correspond with nutrition-specific knowledge. A study of older men in New Zealand found more than half had low general nutrition knowledge, despite most having at least a secondary level education (Wham et al., 2014b). When nutrition knowledge is low, older adults may not meet their nutrient requirements (McElnay et al., 2012), putting these individuals at increased nutrition risk.

#### **2.4.2 Health Influences**

##### **2.4.2.1 Polypharmacy**

Medications are most often prescribed to improve health and help individuals to maintain or enhance their quality of life. Polypharmacy, taking five or more medications concurrently, is common among older adults, with the majority of this demographic taking multiple medications each day to manage comorbidities and lower health risks. A New Zealand study of GP prescribing rates among 139,359 older adults (65 years and over) found high polypharmacy rates in this population, which increased with advancing age. (Martin, Hall, & Gardner, 2002). In those aged 80 to 84 years an

average of 23 medications were taken concurrently, in contrast to an average of 16 medications in those aged 65 to 69 years (Martin et al., 2002).

Physiological changes that occur with increasing age impact the body's ability to utilise medications. Polypharmacy can increase the risk of adverse health outcomes as older adults are more sensitive to the side effects associated with these medications outcomes (Gnjidic et al., 2012). Higher polypharmacy rates are associated with a higher risk of an adverse drug reaction. When five medications are taken concurrently, the risk is estimated to be 58%, but with the use of seven or more medications risk increases to 82% (Prybys et al., 2002). Consequently, these adverse drug reactions are estimated to account for 10% of hospital admissions in older adults aged 65 years and over (Marcum et al., 2012).

The use of multiple medications is a contributing factor to a poor nutrition status in older adults. This has been attributed to the adverse effect medications can have on taste, appetite, gastrointestinal function, and mental health status (Jyrkkä et al., 2011). Medications can also cause drug-nutrient interactions, where the absorption and metabolism of certain nutrients is impaired (Mallet, Spinewine, & Huang, 2007). Older adults at high nutrition risk tend to use more medications than those at low nutrition risk (Wham et al., 2014a).

#### **2.4.2.2 Oral Health**

The Ministry of Health defines oral health as:

“A natural, functional, acceptable dentition which enables an individual to eat, speak, and socialise without discomfort, pain or embarrassment, for a lifetime, and which contributes to general well-being” (Ministry of Health, 2006b, p.2).

Poor oral health is prevalent among older adults in New Zealand, with a longitudinal study finding a quarter of adults aged 80 years and over experiencing chewing difficulties (24%), and more than three quarters (76%) wearing dentures. A high prevalence of gum disease and teeth and mouth pain was also found. Despite these oral health concerns, less than a third (28%) reported they had seen a dentist in the previous year (Kerse & LiLACS NZ, 2014b).

The above definition highlights the nutritional importance of good oral health, as it helps individuals maintain the ability to chew foods. This allows for the taste and texture of food to be enjoyed, encouraging the population to maintain an adequate nutrition status (Solemdal, Sandvik, Willumsen, Mowe, & Hummel, 2012b). When oral health is compromised, older adults may avoid certain foods with hard textures, such as fruits, vegetables, nuts and meat (Iwasaki et al., 2015). Instead, a preference for soft and bland foods may develop. Adapting to new food textures to accommodate poor oral health may lead to a decrease in appetite as the pleasure of eating is lost (N’Gom & Woda, 2002). In turn this may result in poor oral intake and subsequent micronutrient deficiencies, consequently impairing nutrition status (Solemdal et al., 2012a). A Japanese cross-sectional study found poor oral health was a risk factor for malnutrition among community-dwelling older adults (mean age 83.2 years) (Kikutani et al., 2013). Malnutrition risk was 3.2 times greater among edentulous older adults compared to adults with no oral health concerns (Kikutani et al., 2013). Even when dentures were worn, malnutrition risk was still 1.7 times higher (Kikutani et al., 2013), suggesting that dentures do not fully compensate for missing teeth.

#### **2.4.2.3 Swallowing Impairment**

The swallowing process can be impacted by increasing age due to changes in swallowing function. Difficulty in swallowing at any of the three stages involved (oral, pharyngeal or oesophageal) is known as dysphagia (Humbert & Robbins, 2008). In the oral phase difficulties may arise as older adults may have trouble sucking, chewing and creating a bolus with food (Logemann et al., 2013). Changes in the connective tissues of the neck with age may impair swallowing in the pharyngeal stage (Kendall & Leonard, 2001), while the age-related decline in oesophageal motor activity may impact the final stage of swallowing (Grande et al., 1999).

The percentage of New Zealand older adults at risk of dysphagia is unknown, but based on international research it could range between 5-59%, depending on demographic characteristics and the assessment tool used (Kawashima, Motohashi, & Fujishima, 2004; Mann et al., 2013; Roy, Stemple, Merrill, & Thomas, 2007; Takeuchi et al., 2014). The prevalence of dysphagia risk increases with age, with an American hospital based

study (n=4038) finding over two thirds (70%) of dysphagia referrals were for older adults (60 years and over), and almost half of these (42%) were for adults of advanced age (80 year and over) (Leder & Suiter, 2009). Dysphagia risk is also more prevalent with certain conditions: up to 50% of stroke patients and 95% of Parkinson's disease patients are affected (Mann, Hankey, & Cameron, 2000; Tjaden 2008).

An important nutritional consideration of dysphagia among older adults is the effect it can have on food intake, and in turn on overall nutrition status. Dysphagia has been found to be significantly associated with malnutrition. In Japan, 27% of community-dwelling older adults at risk of dysphagia were malnourished, in contrast to 20.6% not at risk of dysphagia (Takeuchi et al., 2014), while in Spain, the prevalence of malnutrition in hospitalised older adults (over 70 years of age) was 36.8% in those with dysphagia, compared with only 13.2% in those without any swallowing impairment (Cabre et al., 2010). Compensatory strategies such as diet modifications can be put in place in the hope of improving the nutrition status of these individuals, however it has been found that energy and protein intake still remains lower than their estimated requirements (Wright, Cotter, Hickson, & Frost, 2005).

#### **2.4.2.3.1 Screening for Dysphagia**

Without systematic screening in place, dysphagia can go undiagnosed and untreated, causing hospital admissions to be longer and mortality rates to be higher (Altman, Yu, & Schaefer, 2010).

A wide variety of screening tools are available to identify dysphagia risk among hospitalised patients (Belafsky et al., 2008; Edmiaston, Connor, Loehr, & Nassief, 2010; Martino et al., 2009; Trapl et al., 2007), however many lack the key components of a good screening tool: quick, easily understood by both patients and health professionals, and validated. The 10-item Eating Assessment Tool (EAT-10) was developed in 2008 to specifically address the lack of a suitable dysphagia risk screening tool (Belafsky et al., 2008). This tool has 10 items which covers the extent of swallowing related problems such as: swallowing liquids, solids and tablets; and weight loss, stress and pain associated with swallowing. It also includes questions on the pleasure of eating and whether swallowing interferes with going out for meals. Using

a scale of 0 (low) to 4 (high), participants are asked to rate how problematic the scenario is for them. Based on the participant's answers, their risk of a swallowing problem is identified, with those scoring less than three points categorised as 'not at risk' while scores of three or more categorise them as at risk of a swallowing problem (Belafsky et al., 2008).

The EAT-10 meets the characteristics of a good screening tool: the self-administered questions take less than two minutes to complete; it is easily understood by the majority of patients; and is easily scored by health professionals (Belafsky et al., 2008; Burgos et al., 2008). It has strong reproducibility, reliability and validity, making it an appropriate tool to use among hospitalised adults of advanced age (Belafsky et al., 2008).

#### **2.4.2.4 Sensory Changes**

The deterioration of chemosensory systems is common in older adults and appears to increase with advancing age. These changes bring about an impaired ability to distinguish different tastes and smells. Olfaction (sense of smell) slowly reduces from early adulthood (Murphy et al., 2002b), however this progression accelerates in older age, with 62.5-75% of advanced age adults reported to have olfactory impairment (Doty et al., 1984; Murphy et al., 2002b). Older adults also have significantly lower taste ability than younger populations (Mojet et al., 2001). The role of chronic disease and polypharmacy in taste impairment was highlighted in a cross-sectional study of hospitalised older adults and community-dwelling controls, where those in hospital were found to have significantly lower taste perception than the older adults who were living at home (Solemdal et al., 2012b). This is of concern as these qualities promote appetite and play an important role in the enjoyment of food. Diet quality can consequently be reduced and appetite suppressed, putting older adults at increased nutrition risk (Aschenbrenner et al., 2008; Gopinath et al., 2015; Rolls, 1999).

## **2.5 Summary**

The nutritional needs of advanced age adults vary greatly from any other stage of adulthood. This population faces unique challenges in meeting these needs which if

not addressed can lead a high prevalence of nutrition risk and malnutrition. There is a growing amount of international literature regarding the nutrition status of hospitalised adults of advanced age but no studies have been carried out in New Zealand hospital populations. With the older adult population growing at a faster rate than any other population group in New Zealand, it is important to identify the current prevalence of poor nutrition risk status and associated risk factors. This can help to shape interventions in the hope of improving the nutrition status of the ageing population, which in turn will help to keep this demographic independently living in the community for as long as possible. This research will therefore endeavour to establish the prevalence of nutrition risk among hospitalised adults of advanced age.



## **Chapter 3 Methods**

### **3.1 Study Design**

The study was a cross-sectional study conducted within the Waitemata District Health Board (WDHB) catchment in Auckland, New Zealand. The aim of this study was to establish the prevalence of nutrition risk among adults of advanced age (85 years and older) recently admitted to the AT&R wards at North Shore and Waitakere Hospitals.

### **3.2 Ethics Approval**

Ethical approval was obtained from the Health and Disability Ethics Committee: Northern A (Application 14/NTA/70). All participants gave informed consent to participate in the study.

Approval from WDHB was sought to recruit participants from the AT&R wards at North Shore Hospital and Waitakere Hospitals.

### **3.3 Setting**

The research was conducted in the AT&R wards at North Shore and Waitakere Hospitals. North Shore Hospital is located on Auckland's North Shore, while Waitakere Hospital is located in West Auckland. The AT&R wards provide specialist services to hospitalised older adults whom reside within the WDHB catchment area. These wards are responsible for improving and maintaining the health and independence of their patients. Combined, these hospitals have 98 beds, of which six are specifically for orthogeriatrics. The majority of referrals to these wards are received from inpatient services at North Shore and Waitakere Hospitals; however GPs can also refer patients from the community (Ministry of Health, 2004).

### **3.4 Participants**

The population of this study were older adults recently admitted to the AT&R wards at North Shore Hospital and Waitakere Hospitals between June 2015 and August 2015. Patients who met the inclusion criteria, with nil excluding factors, were eligible for this study regardless of their sex or ethnicity.

The inclusion criteria for this research study were patients:

- Adults aged 85 years and older
- Admitted to the AT&R ward less than five days previously
- Able to complete self-assessment questionnaire
- Willing to undergo anthropomorphic and body composition measures, and measures of muscle strength and physical function

Exclusion criteria were patients:

- With terminal illness or receiving palliative care
- Residing outside of the WDHB catchment
- With a psychiatric eating disorder e.g. Anorexia nervosa
- With cancer of the larynx
- With oesophageal abnormalities e.g. Zenker diverticulum
- With limited functioning or perforation of their gastrointestinal tract e.g. fistula, impaired absorption
- Receiving enteral or parenteral nutritional support

### **3.4.1 Participant Recruitment**

Participants were recruited from patients admitted to the AT&R wards at North Shore Hospital and Waitakere Hospital on a daily basis. A list of patients that complied with the inclusion and exclusion criteria was compiled by the student researchers on weekdays during the study period.

Eligible patients were visited by the student researchers and their identity verified. The purpose of the research study was explained and participants were provided with an information sheet (Appendix A) to read in their own time. They were encouraged to discuss the research study with family, whanau, friends, or healthcare providers. The student researchers returned to the patient at an acceptable time and any questions they may have had regarding the research study were answered. On agreement to participate in the research study, a written consent (Appendix B) was obtained from the participants.

### **3.5 Anthropometric Measures**

Training was provided prior to data collection by a qualified research technician to ensure anthropometric measurements were accurate and reliable. This covered the correct set-up of the BIA scales and the correct position for demi-span, calf circumference measures, and grip strength measures.

#### **3.5.1 Weight**

Body mass (kg) was measured and recorded to the nearest 0.1kg using electronic scales (InBody230, Biospace, Cerritos, CA, USA). The participants were weighed in accordance with the instructions in the MNA-SF user guide (Nestle Nutrition Institute 2004): wearing light hospital or indoor clothing without shoes. Participants who were bedbound or too frail to step onto the electronic scales were excluded from this measurement. Instead, weight measurements were taken from the weight recorded in the participants' clinical notes upon admission to the AT&R wards.

#### **3.5.2 Height**

Height (m) measurements were taken from the height recorded in the participants' clinical notes upon admission to the AT&R wards. Where height was not recorded, it was predicted using the participants' demi-span. Demi-span (cm) was measured in accordance with the user guide for the MNA-SF (Nestle Nutrition Institute, 2004). Participants were asked to outstretch their left arm horizontally, in line with their shoulder. With the arm flat and wrist straight, their demi-span was measured using a tape measure (Lufkin Executive Thinline, 2m W606PM) from the middle point of the suprasternal notch to the web between the third and fourth finger. Demi-span was recorded to the nearest 0.1cm. The estimated height was calculated using the predictive equation derived from the Malnutrition Action Group (2003):

Predictive equation for height using demi-span:

Men: height (cm) = (1.40 x demi-span in cm) + 57.8

Women: height (cm) = (1.35 x demi-span in cm) + 60.1

### 3.5.3 Body Mass Index

BMI was calculated based on the participants' measured weight and the measured height or estimated height from demi-span ( $\text{weight}/\text{height}^2$ ). Classification of BMI was based on the WHO international classification (**Table 3.1**).

**Table 3.1** WHO International BMI Classification<sup>1</sup>

Classification	BMI ( $\text{kg}/\text{m}^2$ )
Underweight	<18.50
Normal range	18.50-24.99
Overweight	$\geq 25.00$
Obese	$\geq 30.00$

<sup>1</sup> Recognised classification for BMI as per the WHO (World Health Organisation, 2006)  
World Health Organisation, WHO  
Body Mass Index, BMI

For bedbound participants, where BMI could not be determined, a calf circumference measurement was taken. Calf circumference was measured in accordance with the instructions in the MNA-SF user guide (Nestle Nutrition Institute, 2004). Participants were asked to lie in the supine position with their left leg uncovered and bent at a 90 degree angle. The circumference of the calf was measured at the widest point using a tape measure (Lufkin Executive Thinline, 2m W606PM). Calf circumference was measured to the nearest 0.1cm.

### 3.5.4 Muscle Mass

Skeletal muscle mass and body fat mass were estimated by direct segmental multi-frequency bioelectrical impedance analysis (BIA), obtained on the InBody230 (Biospace, Cerritos, CA, USA). Participants were instructed to wear light clothing and remove shoes. After self-calibration of the bioelectrical impedance analyser, participants' identification number, age, gender, and height were entered into the device. Participants were asked to stand stationary on the BIA device, for 30 seconds, whilst holding the handgrips, slightly abducted from the body, until the measurement was completed. Participants who were bedbound or too frail to step onto the BIA device were excluded from these measurements. Furthermore, participants fitted with a pacemaker or internal electrical devices, as well as those with peripheral oedema, were excluded.

### **3.5.5 Muscle Strength**

Muscle strength was estimated by measuring hand grip strength. A Jamar hydraulic hand dynamometer (model 5030J1, Lafayette, IN, USA), with the handle in the second position, was used to measure hand grip strength of participants. The participants were required to measure their hand grip strength in the dominant hand thrice. Prior to testing grip strength, the participants were asked if they had any physical limitation of their dominant hand, such as arthritis or hand paralysis. These were noted, along with any bandages or casts which may have affected the grip strength of the participant's dominant hand. The participants were instructed to sit upright in a chair with their feet slightly apart, their shoulder adducted and neutrally rotated, their elbow bent at a 90 degree angle and their forearm and wrist in a neutral position. Participants were asked to grip the dynamometer with the scale facing forward, and were encouraged to squeeze the dynamometer as hard as possible. If participants were too frail to sit upright in a chair, they were asked to lie in their hospital bed, which was positioned at a 30 degree angle. In this position, their elbow was supported and grip strength measurements were taken. The final grip strength was the average of the three measurements, recorded to the nearest 0.5kg.

### **3.6 Questionnaire**

The questionnaire was comprised of four sections: demographic characteristics (Appendix C), the Mini Nutritional Assessment-Short Form (Appendix D), the 10-item Eating Assessment Tool (Appendix E), and the Montreal Cognitive Assessment (Appendix F). Pilot testing of this questionnaire was previously carried out in a population of older adults in the WDHB catchment area (Buhs-Catterall 2015).

#### **3.6.1 Demographic Characteristics**

##### *Sociodemographic Characteristics*

Seven question items were asked to determine the participants' sociodemographic characteristics: age, in years; gender; ethnicity; marital status; living situation; sourced income; and education level.

Based on the participants' age, they were categorised into two groups: 85-89 years and 90 years and older.

Ethnicity was determined based on participants' response to four different ethnic groups: New Zealand European, Māori, Pacific, and 'Other'. If participants identified as 'Other' they were asked to expand on their ethnicity. Participants were able to belong to more than one ethnic group.

Participants were asked to define their marital status based on four categories: married/partnered, widowed, divorced/separated, and never married. Participants were then asked if they lived alone, with their spouse only, or with others. Participants were asked to clarify if they answered 'living with spouse only' yet had defined their marital status as widowed, divorced/separated, or never married.

Participants were asked if they received any income in addition to their pension. Income sources included wages, salary, self-employment income, and investment income, as defined by Statistics New Zealand (2015).

Education level was determined based on participants' response to their highest level of education: primary, secondary, and tertiary.

#### *Health Characteristics*

Six items were asked to determine the participants' health characteristics. These covered participants' key comorbidities and health issues, prescribed and over-the-counter medications, nutrition supplements and dental status.

Information on participants' key-comorbidities, health issues, and prescribed medication was gathered from the clinical notes in the ward. Items were clarified with the participants, with corrections made if necessary. Participants were also asked if they took any regular over-the-counter medications or supplements in addition to the ones prescribed by their doctor. Examples such as Complian and vitamins/minerals were given to prompt the recall of participants'.

Classification of participants' dental status was based on three categories: dentate, edentulous, and dental appliance. Dentate referred to a full set of teeth. Participants

with missing teeth were characterised as edentulous, however those with partial or full dentures were characterised as having a dental appliance.

### *Social Support*

The final section included two items about the participants' social support. The first item identified if participants received any subsidised support services such as personal cares or household support, and the second item asked if participants required help with activities of daily living.

### **3.6.2 Mini Nutritional Assessment-Short Form**

The researcher was trained by a New Zealand registered dietitian to use the MNA-SF to assess the nutrition status of participants according to a standardised protocol (Nestle Nutrition Institute, 2004). Participants were asked to reflect on the past three months and answer whether their food intake had declined, how much weight loss they had had over this period, and if they suffered any psychological stress or acute disease. Participants were also asked about their mobility and whether they were suffering from any neuropsychological problems. The MNA-SF also asked about the BMI, or calf circumference if not BMI was available, of participants. A total score of 14 could be attained in the MNA-SF. Participants who scored less than eight points were identified as being malnourished, while those who scored between eight and 11 were found to be at risk of malnutrition. Participants who scored 12-14 points were recognised as having a normal nutrition status.

The MNA-SF used different cut-off points for BMI than the WHO, with participants found to be at the most risk if their BMI was less than 19.

### **3.6.3 10-item Eating Assessment Tool**

The researcher was trained by a New Zealand registered dietitian to use the validated EAT-10 to assess the dysphagia specific quality of life of participants (Belafsky et al., 2008). The questions covered aspects of swallowing liquids, solids and tablets, as well as weight loss, stress and pain associated with swallowing. Participants were asked to rate from 0 to 4 how severe they found the swallowing related problem, with lower scores relating to less of a problem and higher scores relating to more of a problem.

Based on the participant's answers, their risk of a swallowing problem was identified. Participants who scored less than three points were categorised as 'not at risk', while those who scored three points or higher were found to be at risk of a swallowing problem.

#### **3.6.4 Montreal Cognitive Assessment**

The researcher was trained by a New Zealand registered dietitian to use the validated MoCA to assess the cognitive ability of participants. Following the standardised protocol, the MoCA assessed the participant's orientation to time and place, language, attention, concentration, working memory and visospatial abilities (Nasreddine et al., 2005). It also included questions which assessed short-term memory recall. A maximum score of 30 could be attained in the MoCA. Participants who scored 26 or more were considered to have 'normal cognition', while those who scored less than 26 were considered to have some form of cognitive impairment.

The MoCA was carried out as close to the participants discharge as possible. It was presumed that cognitive testing within five days of admission could have been falsely lowered by hospital induced delirium or stress and therefore not give an accurate representation of true cognitive ability.

#### **3.7 Statistical Analysis**

Statistics analysis was completed using IBM SPSS package version 22 (IBM Corporation, Chicago, IL, USA). Variables were tested for normality using the Kolmogorov-Smirnov and Sharipo-Wilk tests, together with examining the normality plots. Normally distributed data was reported as mean  $\pm$  standard deviation (SD). Counts and percentages were used to describe categorical data. Independent T-Tests and one-way analysis of variance (ANOVA) were used and Bonferroni post-hoc tests were performed to compare differences between groups of parametric scale data. Pearson Chi-Square was used to examine differences between groups for categorical data. Pearson correlations were performed to identify correlations between participant characteristics and nutrition risk status. A p-value<0.05 was considered statistically significant.



## Chapter 4 Results

### 4.1 Participant Sociodemographic Characteristics

Eighty eight participants (31 men and 57 women) admitted to the AT&R wards at North Shore and Waitakere Hospitals between June and August 2015 (12 weeks) were recruited for this study.

The mean age of the participants was  $90.0 \pm 3.7$  years, with a range of 85 years to 101 years. More than half of the participants were aged 90 years or older (55.7%). The majority of participants identified themselves as New Zealand European (67%). Twenty nine participants (33%) were of 'other' ethnicities. These participants identified their ethnicity to be British (n=20), Danish (n=3), Dutch (n=3), Australian (n=1), German (n=1), and Sri Lankan (n=1). No participants identified themselves as Māori or Pacific. Less than a third of participants were married or partnered (29.5%). The majority of participants were widowed (67.0%), while the remaining participants were divorced/separated (1.1%) or had never married (2.3%). More than half of the participants lived with others; 23.3% of participants lived with their spouse and 30.7% lived with others. The remaining 45.5% of participants lived alone. The pension was the only source of income for two thirds of the participants (65.9%), with 34.1% of participants having other sources of income in addition to the pension. Secondary school was reported to be the highest level of education for almost three quarters of participants (70.5%). Seventeen percent of participants reported primary school their highest level of education. Tertiary education was reached by the remaining 12.5% of participants. The sociodemographic characteristics of the participants are summarised in **Table 4.1**.

**Table 4.1** Participant Sociodemographic Characteristics†

	Total n (%) n=88	Men n (%) n=31	Women n (%) n=57
Age (years) ‡	$90.0 \pm 3.7$	$89.7 \pm 4.0$	$90.2 \pm 3.5$
85-89 Years	39 (44.3)	15 (48.4)	24 (42.1)
≥90 Years	49 (55.7)	16 (42.1)	33 (57.9)
Ethnicity			
New Zealand European	59 (67.0)	20 (64.5)	39 (68.4)
'Other'	29 (33.0)	11 (35.5)	18 (31.6)
Marital Status			
Married/Partnered	26 (29.5)	16 (51.6)	10 (17.5)

Widowed	59 (67.0)	14 (45.2)	45 (78.9)
Divorced/Separated	1 (1.1)	0 (NA)	1 (1.8)
Never Married	2 (2.3)	1 (3.2)	1 (1.8)
Living Situation			
Living Alone	40 (45.4)	9 (29.0)	31 (54.4)
Living with Spouse Only	32 (23.9)	14 (45.2)	7 (12.3)
Living with Others	27 (30.7)	8 (25.8)	19 (33.3)
Sourced Income			
Pension Only Income	58 (65.9)	19 (61.3)	39 (68.4)
Pension Plus Other Income	30 (34.1)	12 (38.7)	18 (31.6)
Education Level			
Primary	15 (17.0)	7 (22.6)	8 (14.0)
Secondary	62 (70.5)	19 (61.3)	43 (75.4)
Tertiary	11 (12.5)	5 (16.1)	6 (10.5)

† Unless otherwise indicated, values reported as frequencies: count (percentage)

‡ Values reported as mean  $\pm$  SD

## 4.2 Participant Anthropometric Characteristics

All participants had a weight measurement recorded, while 98.8% of participants had height recorded. Due to medical reasons, one remaining participant had a calf circumference measurement.

The mean weight of participants was  $59.8\text{kg} \pm 12.2\text{kg}$  and the mean height was  $161.8\text{cm} \pm 8.7\text{cm}$ . Women were found to be both lighter ( $55.6 \pm 12.4$  vs.  $65.7 \pm 9.4$ ,  $p=0.001$ ) and shorter ( $157.8 \pm 5.2$  vs.  $169.5 \pm 8.9$ ,  $p<0.001$ ) than men. Participants had a mean BMI of  $22.8\text{kg}/\text{m}^2 \pm 4.2\text{kg}/\text{m}^2$ , with no significant difference found between men and women ( $p=0.966$ ). Two thirds of participants (62.1%) had a BMI within the normal range ( $18.5\text{--}24.99\text{kg}/\text{m}^2$ ), with 13.8% of participants considered to be underweight. Almost a quarter of participants (24.1%) had a BMI within the overweight or obese category. The mean BMI for this category was  $28.3\text{kg}/\text{m}^2 \pm 3.3\text{kg}/\text{m}^2$ , with women in this group found to have a significantly higher BMI than men ( $29.4 \pm 3.6$  vs.  $26.2 \pm 1.0$ , respectively,  $p=0.007$ ).

The mean grip strength of the participants' dominant hand was  $13.1\text{kg} \pm 6.6\text{kg}$ . Grip strength was significantly stronger in the dominant hand of male participants than females ( $17.4 \pm 7.1$  vs.  $10.5 \pm 4.8$ , respectively,  $p<0.001$ ). Only seven participants were eligible to have body composition measurements using the BIA scales. This was due to the difficulty in assessment among more frail participants and restrictions on use of the BIA scales among those with internal electrical devices. The mean fat mass was  $17.8 \pm 5.4\text{kg}$  and the mean muscle mass was  $22.9 \pm 3.9\text{kg}$ . No statistical difference was

found in body composition between men and women ( $p=0.285$  and  $p=0.225$ , respectively). The anthropometric measurements of participants are shown in **Table 4.2**.

**Table 4.2 Participant Anthropometric Measurements**

	Total	Men	Women	p-value
Weight (kg) n=88	59.8 ± 12.2	65.7 ± 9.4	55.6 ± 12.4	0.001*
Height (cm) n=87	161.8 ± 8.7	169.5 ± 8.9	157.8 ± 5.2	<0.001*
Body Mass Index (kg/m <sup>2</sup> ) n=87	22.8 ± 4.2	22.8 ± 2.6	22.8 ± 4.8	0.966
Underweight <18.5kg/m <sup>2</sup> n=12	17.1 ± 1.6	17.8 ± 0.8	17.1 ± 1.7	0.559
Normal 18.5-24.99kg/m <sup>2</sup> n=54	22.0 ± 1.8	22.1 ± 1.7	21.8 ± 1.9	0.555
Overweight/Obese ≥25kg/m <sup>2</sup> n=21	28.3 ± 3.3	26.2 ± 1.0	29.4 ± 3.6	0.007*
Grip Strength, Dominant Hand (kg) n=80	13.1 ± 6.6	17.4 ± 7.1	10.5 ± 4.8	<0.001*
Fat Mass (kg) n=7	17.8 ± 5.4	21.6 ± 1.3	16.3 ± 5.8	0.285
Muscle Mass (kg) n=7	22.9 ± 3.9	25.9 ± 2.6	21.7 ± 3.9	0.225

All values reported as mean ± SD

Comparison between genders determined by Independent T-Tests

\* Significant difference between genders,  $p<0.05$

### 4.3 Participant Health Characteristics

#### Key Comorbidities

The number of key comorbidities ranged from one to 16 per participant, thus all 88 participants had at least comorbidity. The mean number of comorbidities was  $6.5 \pm 2.7$ . As shown in **Table 4.3**, only 22.7% of participants had less than five key comorbidities. The majority of participants had between five and 10 key comorbidities (71.6%), while five participants (5.7%) had more than 10 key comorbidities. There was no significant difference between genders in terms of the number of comorbidities experienced ( $p=0.673$ ).

**Table 4.3 Health Conditions Experienced by Participants**

	Total n (%) n=88	Men n (%) n=31	Women n (%) n=57	p-value
<5 Key Comorbidities	20 (22.7)	6 (19.4)	14 (24.6)	0.673
5-10 Key Comorbidities	63 (71.6)	24 (77.4)	39 (68.4)	
>10 Key Comorbidities	5 (5.7)	1 (3.2)	4 (7.0)	

All values reported as frequencies: count (percentage)

Comparison between genders determined by Fisher's Exact Test

### *Prescription Medications*

Five or more prescription medications were taken by the majority of participants (70.5%), with less than a third of participants (29.5%) taking fewer than five medications (**Table 4.4**). The mean number of prescription medications taken by participants was  $6.3 \pm 3.0$ , with a range between 0-15 medications. Of the 26 participants taking less than five medications, only one was not taking any regular prescription medication.

Among participants, a total of 550 prescription medications were reported to be taken. Aspirin was the most commonly reported medication (n=37), taken by 42.0% of participants. Almost a third of participants were taking Metoprolol (n=29, 33.0%), a  $\beta$ -blocker which reduces blood pressure; Paracetamol (n=28, 31.2%), and Frusemide (n=27, 30.7%), a diuretic. Other medications commonly taken by participants included Simvastatin (n=23), to help lower high cholesterol and triglyceride levels; and Omeprazole (n=22), to reduce reflux oesophagitis and acid-related dyspepsia.

**Table 4.4** *Prescribed Medications Taken by Participants*

	Total n (%) n=88	Men n (%) n=31	Women n (%) n=57	p-value
Less Than 5 Medications	26 (29.5)	13 (41.9)	13 (22.8)	0.0.6
5 or More Medications	62 (70.5)	18 (58.1)	44 (77.2)	

All values reported as frequencies: count (percentage)  
Comparison between genders determined by Pearson Chi-Square

### *Prescribed Nutrition Supplements*

More than half of the participants (n=46, 52.6%) were prescribed nutritional supplements along with their regular medication. More than a third of participants (38.7%) were taking Cholecalciferol, a vitamin D compound. Participants also reported being prescribed iron supplements (ferrous fumarate, ferrous sulphate), vitamin and mineral supplements (multivitamin, vitamin B12 injections, folic acid, thiamine, calcium carbonate), and therapeutic oral supplements (Renilon). Of the participants prescribed nutrition supplements, the majority were only regularly taking one (76.1%); however, the number of prescribed supplements ranged from one to five.

### *Over-The-Counter Medications*

In addition to their regular prescribed medication, four participants (4.5%) reported taking over-the-counter medications. These medications varied from muscle relaxants to joint care to Metamucil to Lutein Defence.

### *Over-The-Counter Nutrition Supplements*

Aside from prescribed nutrition supplements, 21 participants (23.9%) also reported taking over-the-counter nutrition supplements. These supplements included fish oils (krill oil, cod liver oil, omega 3), vitamins and minerals (multivitamin, vitamin B, vitamin C, magnesium), therapeutic oral supplements (Ensure, Complan), coenzyme Q10, green barley, and herbal laxatives. The number of over-the-counter nutrition supplements taken by these participants ranged from one to four, although the majority (71.7%) took one supplement per day.

### *Dental Status*

**Table 4.5** shows some form of dental appliance was worn by most (63.6%) participants. Two thirds of women (66.7%) and 58.1% of men wore a dental appliance, with no significant difference between the genders ( $p=0.591$ ). Of the 32 participants who did not wear some form of dental appliance, only 13 were dentate. The remaining 21.6% of participants were found to be edentulous, due to missing one or more teeth.

**Table 4.5** *Dental Status of Participants*

	Total n (%) n=88	Men n (%) n=31	Women n (%) n=57	p-value
Dentate	13 (14.8)	4 (12.9)	9 (15.8)	0.591
Edentulous	19 (21.6)	9 (29.0)	10 (17.5)	
Dental Appliance	56 (63.6)	18 (58.1)	38 (66.7)	

All values reported as frequencies: count (percentage)

Comparison between genders determined by Fisher's Exact Test

### *Cognition*

There were 61 participants (69.3%) who had a completed MoCA. Of the 27 participants that did not complete, the majority (77.8%) were discharged before the researcher was able to assess their cognitive function, while the remaining six participants declined to complete the assessment.

The mean MoCA score was  $17.8 \pm 5.1$ , with scores ranging from seven to 27. Cognitive function was found to be below normal for the majority of participants (93.4%), as only four participants scored 26 or higher on the assessment (**Table 4.6**). No statistical difference was found in cognitive function between men and women ( $p=0.175$ ).

**Table 4.6 Cognitive Function<sup>1</sup> of Participants Determined by the MoCA**

	Total n (%) n=61	Men n (%) n=21	Women n (%) n=40	p-value
Normal Cognitive Function (26-30)	4 (6.6)	0 (NA)	4 (10.0)	0.175
Below Normal Cognitive Function (<26)	57 (93.4)	21 (100.0)	36 (90.0)	

Montreal Cognitive Assessment, MoCA

All values reported as frequencies: count (percentage)

Comparison between genders determined by Fisher's Exact Test

<sup>1</sup> Recognised cut-offs for cognitive function as per the MoCA (Nasreddine et al., 2005)

#### 4.4 Participant Social Support Characteristics

The majority of participants received regular subsidised support services (62.5%) with household management, such as washing and cleaning, and personal cares such as showering, dressing, and meal preparation. The majority of participants also required help with activities of daily living (70.5%, **Table 4.8**). No statistical difference was found in support services received ( $p=0.167$ ) and daily help required ( $p=0.368$ ) between men and women (**Table 4.7 & Table 4.8**).

**Table 4.7 Support Services Received by Participants**

	Total n (%) n=88	Men n (%) n=31	Women n (%) n=57	p-value
Receiving Regular Support Services	55 (62.5)	16 (51.6)	39 (68.4)	0.167
Not Receiving Regular Support Services	33 (37.5)	15 (48.4)	18 (31.6)	

All values reported as frequencies: count (percentage)

Comparison between genders determined by Pearson Chi-Square

**Table 4.8 Daily Help Required by Participants**

	Total n (%) n=88	Men n (%) n=31	Women n (%) n=57	p-value
Requires Daily Help	62 (70.5)	20 (64.5)	42 (73.7)	0.368
Does Not Require Daily Help	26 (29.5)	11 (35.5)	15 (26.3)	

All values reported as frequencies: count (percentage)

Comparison between genders determined by Pearson Chi-Square

#### 4.5 Dysphagia Risk Status

EAT-10 scores ranged from 0 to 27, with the mean score found to be  $3.4 \pm 5.9$ . Almost a third of participants (29.5%) were found to be at risk of dysphagia. The mean EAT-10

score of participants at risk of dysphagia was  $10.0 \pm 7.2$ . There was no significant difference between men and women at risk of dysphagia ( $p=0.556$ ). The mean EAT-10 score of participants not at risk of dysphagia was  $0.6 \pm 0.8$ . There was no significant difference between men and women who were not at risk of dysphagia ( $p=0.900$ , **Table 4.9**).

**Table 4.9** *Dysphagia Risk Status<sup>1</sup> of Participants Determined by the EAT-10*

	Total n=88	Men n=31	Women n=57	p-value
Not At Risk (<3) <sup>‡</sup>	$0.6 \pm 0.8$	$0.6 \pm 0.7$	$0.6 \pm 0.8$	0.900 <sup>‡</sup>
n (%) <sup>†</sup>	62 (70.5)	23 (74.2)	39 (68.4)	
At Risk ( $\geq 3$ ) <sup>‡</sup>	$10.0 \pm 7.2$	$8.9 \pm 6.0$	$10.6 \pm 7.8$	0.556 <sup>‡</sup>
n (%) <sup>†</sup>	26 (29.5)	8 (25.8)	18 (31.6)	

10 Item Eating Assessment Tool, EAT-10

<sup>†</sup> Values reported as frequencies: count (percentage). Comparison between genders for categorical data determined by Pearson Chi-Square. No significant difference between genders ( $p=0.371$ , not shown in table)

<sup>‡</sup> Values reported as mean  $\pm$  SD. Comparison between genders for continuous data determined by Independent T-Tests

<sup>1</sup> Recognised cut-offs for dysphagia risk as per the EAT-10 (Belafsky et al., 2008)

#### 4.6 Nutrition Risk Status

MNA-SF scores ranged from two to 14, with the mean score found to be  $9.6 \pm 2.9$ . The majority of participants (43.2%) were found to be at risk of malnutrition. The mean score of these participants was  $9.7 \pm 1.1$ . A further 28.4% were identified as malnourished, with a mean score of  $6.0 \pm 1.3$ . Of the 88 participants, only 25 had a normal nutrition status (28.4%) with a mean score of  $13.6 \pm 0.6$ . There were no significant differences between genders in any of the three MNA-SF nutrition status groups (normal:  $p=0.105$ ; at risk:  $p=0.952$ ; malnourished:  $p=0.223$ , **Table 4.10**).

**Table 4.10** *Nutrition Risk Status<sup>1</sup> of Participants Determined by the MNA-SF*

	Total n=88	Men n=31	Women n=57	p-value
Normal Nutrition Status (12-14) <sup>‡</sup>	$13.6 \pm 0.6$	$13.3 \pm 0.7$	$12.9 \pm 0.5$	0.105 <sup>‡</sup>
n (%) <sup>†</sup>	25 (28.4)	10 (32.3)	15 (26.3)	
At Risk of Malnutrition (8-11) <sup>‡</sup>	$9.7 \pm 1.1$	$9.7 \pm 1.2$	$9.7 \pm 1.1$	0.952 <sup>‡</sup>
n (%) <sup>†</sup>	38 (43.2)	12 (38.7)	26 (45.6)	
Malnourished (0-7) <sup>‡</sup>	$6.0 \pm 1.3$	$6.3 \pm 0.5$	$5.8 \pm 1.5$	0.223 <sup>‡</sup>
n (%) <sup>†</sup>	25 (28.4)	9 (29.0)	16 (28.1)	

Mini Nutritional Assessment-Short Form, MNA-SF

<sup>†</sup> Values reported as frequencies: count (percentage). Comparison between genders for categorical data determined by Pearson Chi-Square. No significant difference between genders ( $p=0.787$ , not shown in table)

<sup>‡</sup> Values reported as mean  $\pm$  SD. Comparison between genders for continuous data determined by Independent T-Tests

<sup>1</sup> Recognised cut-offs for nutrition status as per the MNA-SF (Kaiser et al., 2009)

Results of the six items that make up the MNA-SF by nutrition risk group (**Table 4.11**) are as follows:

1. More than half (59.1%) of participants reported having no decrease in food intake in the past three months while nearly a third (31.8%) had a moderate decrease. Less than 10% of participants reported a severe decrease in food intake. Those in the normal nutrition group had a higher prevalence of no decrease in food intake compared to those in the malnourished group (88% vs. 28%, respectively). Likewise, the malnourished group had a higher prevalence of participants with both a moderate (40%) and severe (32%) decrease in food intake, compared to those in the normal nutrition group (12% and 0%, respectively).

2. Over a third (36.4%) of participants reported no weight loss in the past three months, while 34.1% of participants did not know if they had any weight loss. Almost 10% of participants reported they had lost 1-3kg in the past three months, and 20.5% reported weight loss greater than 3kg. Participants in the malnourished group had the highest prevalence of weight loss, with more than half (52.0%) of these participants reporting a weight loss greater than 3kg.

3. The majority of participants (60.2%) had maintained good mobility and were still able to go out. Of the remaining participants, only three considered themselves to be bed or chair bound. The prevalence of participants who were still able to go out was lower in the normal nutrition group (88%) than in the malnourished group (52%).

4. Two thirds of the participants (64.8%) had not experienced any psychological stress or acute disease in the past three months (zero in the normal nutrition group (0%) versus 88% in the malnourished group).

5. Three quarters of the participants (78.4%) did not have any neuropsychological problems; however almost a quarter (21.6%) of participants had suffered from depression or dementia. Of these 19 participants, six had severe dementia or depression. The prevalence of mild or severe neuropsychological problems was highest among those who were malnourished and at risk of malnutrition (12% and 7.9%, respectively).



6. A BMI was recorded for all but one participant. The majority of participants had a BMI greater than 23kg/m<sup>2</sup>. The BMI of 16.4% of the participants was lower than 19kg/m<sup>2</sup>. The malnourished group had the highest prevalence of participants with a BMI lower than 19kg/m<sup>2</sup> (41.7%), while the normal nutrition group had the highest prevalence of BMI greater than 23kg/m<sup>2</sup> (80%). Calf circumference was used in place of BMI for one participant who did not have a height or weight taken. This participant had a calf circumference less than 31cm, and was classified as malnourished.

**Table 4.11 MNA-SF Questionnaire Item Scores**

	Total n (%) n=88	Normal n (%) n=25	At Risk n (%) n=38	Malnourished n (%) n=25
<b>Food Intake</b>				
Severe Decrease	8 (9.1)	0 (NA)	0 (NA)	8 (32.0)
Moderate Decrease	28 (31.8)	3 (12.0)	15 (39.5)	10 (40.0)
No Decrease	52 (59.1)	22 (88.0)	23 (60.5)	7 (28.0)
<b>Weight Loss</b>				
Weight Loss >3kg	18 (20.5)	0 (NA)	5 (13.2)	13 (52.0)
Does Not Know	30 (34.1)	1 (4.0)	19 (50.0)	10 (40.0)
1-3kg Weight Loss	8 (9.1)	0 (NA)	6 (15.8)	2 (8.0)
No Weight Loss	32 (36.4)	24 (96.0)	8 (21.1)	0 (NA)
<b>Mobility</b>				
Bed/Chair Bound	3 (3.4)	0 (NA)	2 (5.3)	1 (4.0)
Able To Get Out Of Bed/Chair But Does Not Go Out	32 (36.4)	8 (32.0)	13 (34.2)	11 (44.0)
Goes Out	53 (60.2)	22 (88.0)	23 (60.5)	13 (52.0)
<b>Psychological Stress/Acute Disease</b>				
Yes	31 (35.2)	0 (NA)	9 (23.7)	22 (88.0)
No	57 (64.8)	25 (100)	29 (76.3)	3 (12.0)
<b>Neuropsychological Problem</b>				
Severe Dementia/Depression	6 (6.8)	0 (NA)	3 (7.9)	3 (12.0)
Mild Dementia	13 (14.8)	3 (12.0)	6 (15.8)	4 (16.0)
No Psychological Problems	69 (78.4)	22 (88.0)	29 (76.3)	18 (72.0)
<b>Body Mass Index (BMI)<sup>1</sup> n=87</b>				
BMI <19	14 (16.1)	0 (NA)	4 (10.5)	10 (41.7)
BMI 19 to <21	16 (18.4)	1 (4.0)	12 (31.6)	3 (12.5)
BMI 21 to <23	17 (19.5)	4 (16.0)	7 (18.4)	6 (25.0)
BMI ≥23	40 (46.0)	20 (80.0)	15 (39.5)	5 (20.8)

Mini Nutritional Assessment-Short Form, MNA-SF

All values reported as frequencies: count (percentage)

<sup>1</sup>Recognised cut-offs BMI as per the MNA-SF (Rubenstein et al., 2001)

#### 4.7 Factors Related to Nutrition Risk

Participants with a normal nutrition status and those at risk of malnutrition were significantly ( $p=0.015$ ) less likely to be at risk of having dysphagia (20% and 21%,

respectively). On the other hand, participants who were malnourished were more likely to be at risk of dysphagia (52.0%,  $p=0.015$ , **Figure 4.1**).

No significant difference between MNA-SF nutrition status groups were seen for other variables (**Table 4.12**).

**Table 4.12** Nutrition Risk Status and Participant Sociodemographic, Health, and Social Support Risk Factors

	Normal n (%) n=25	At Risk n (%) n=38	Malnourished n (%) n=25	p-value
<b>Age Category</b>				
85-89 Years	13 (52.0)	15 (39.5)	11 (44.0)	0.619
≥90 Years	12 (48.0)	23 (60.5)	14 (56.0)	
<b>Gender</b>				
Male	10 (40.0)	12 (31.6)	9 (36.0)	0.787
Female	15 (60.0)	26 (68.4)	16 (64.0)	
<b>Marital Status</b>				
Married/Partnered	8 (32.0)	10 (26.3)	8 (32.0)	0.973
Widowed	16 (64.0)	26 (68.4)	17 (68.0)	
Divorced/Separated	0 (NA)	1 (2.6)	0 (NA)	
Never Married	1 (4.0)	1 (2.6)	0 (NA)	
<b>Living Situation</b>				
Living Alone	10 (40.0)	19 (50.0)	11 (44.0)	0.800
Living with Spouse Only	8 (32.0)	8 (21.1)	5 (20.0)	
Living with Others	7 (28.0)	11 (28.9)	9 (36.0)	
<b>Sourced Income</b>				
Pension Only Income	14 (56.0)	25 (65.8)	19 (76.0)	0.329
Pension Plus Other Income	11 (44.0)	13 (34.2)	6 (24.0)	
<b>Education Level</b>				
Primary	4 (16.0)	6 (15.8)	5 (20.0)	0.665
Secondary	17 (68.0)	26 (68.4)	19 (76.0)	
Tertiary	4 (16.0)	6 (15.8)	1 (4.0)	
<b>Health Conditions</b>				
<5 Key Comorbidities	6 (24.0)	8 (15.8)	3 (60.0)	0.542
5-10 Key Comorbidities	16 (64.0)	27 (50.0)	2 (40.0)	
>10 Key Comorbidities	3 (12.0)	19 (35.2)	0 (NA)	
<b>Prescribed Medications</b>				
<5 Medications	5 (20.0)	15 (39.5)	6 (24.0)	0.196
≥5 Medications	20 (80.0)	23 (60.5)	19 (76.0)	
<b>Prescribed Nutrition Medication</b>				
Taking Prescribed Nutritionals	13 (52.0)	19 (50.0)	14 (56.0)	0.896
Not Taking Prescribed Nutritionals	12 (48.0)	19 (50.0)	11 (44.0)	
<b>Over-The-Counter Nutrition Supplements</b>				
Taking Nutrition Supplements	5 (20.0)	12 (31.6)	4 (16.0)	0.316
Not Taking Nutrition Supplements	20 (80.0)	26 (68.4)	21 (84.0)	
<b>Dental Status</b>				
Dentate	4 (16.0)	7 (18.4)	2 (8.0)	0.776
Edentulous	5 (20.0)	7 (18.4)	7 (28.0)	
Dental Appliance	16 (64.0)	24 (63.2)	16 (64.0)	
<b>Dysphagia Risk Status</b>				
Not At Risk	20 (80.0)	30 (78.9)	12 (48.0)	0.015*
At Risk	5 (20.0)	8 (21.1)	13 (52.0)	

Cognition <sup>2</sup>				
Normal Cognitive Function	2 (11.1)	1 (3.3)	1 (7.7)	0.537
Below Normal Cognitive Function	16 (88.9)	29 (96.7)	12 (92.3)	
Support Services				
Receiving Regular Support Services	14 (56.0)	23 (60.5)	18 (72.0)	0.478
Not Receiving Support Services	11 (44.0)	15 (39.5)	7 (28.0)	
Daily Help				
Requires Daily Help	15 (60.0)	28 (73.8)	19 (76.0)	0.392
Does Not Require Daily Help	10 (40.0)	10 (26.3)	6 (24.0)	

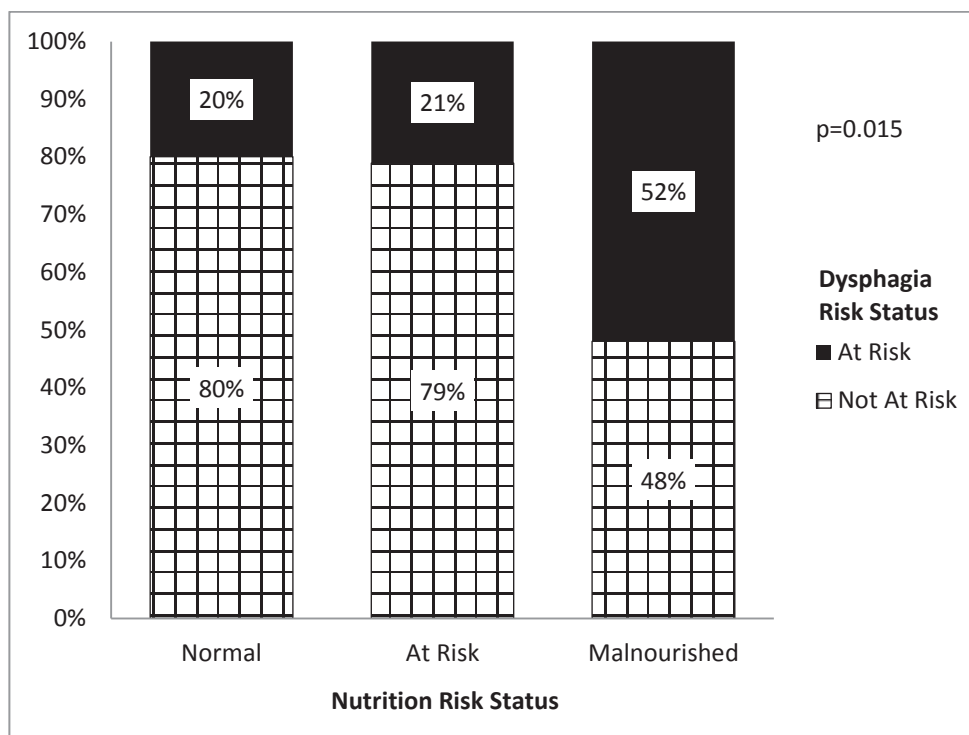
All values reported as frequencies: count (percentage)

Comparison between groups determined by Pearson Chi-Square

\* Significant difference between groups,  $p < 0.05$

<sup>1</sup> Missing data (n=87)

<sup>2</sup> Missing data (n=62)



**Figure 4.1** *Dysphagia Risk Status Represented by Nutrition Risk Status*

One-way ANOVA revealed there was a significant effect of grip strength ( $p=0.004$ ) and dysphagia risk score ( $p=0.017$ ) on nutrition risk status. Bonferroni post-hoc tests showed grip strength was significantly stronger among participants with normal nutrition status compared to those at risk of malnutrition, and dysphagia risk score was significantly lower among participants with normal nutrition status compared to malnourished participants. No significant relationship was found between the nutrition risk status and age, number of key comorbidities, medication, supplements, or cognition (**Table 4.13**).

**Table 4.13** One-Way ANOVA Comparison of Nutrition Risk Status and Participant Characteristics

	Normal	At Risk	Malnourished	p-value
Age (n=88)	89.2 ± 2.4	90.7 ± 4.4	89.9 ± 3.5	0.258
Grip Strength, Dominant Hand (kg) (n=80)	16.5 ± 7.4 <sup>†</sup>	10.8 ± 4.9 <sup>†</sup>	13.0 ± 6.7	0.004*
Key Comorbidities (n=88)	6.9 ± 3.2	6.3 ± 2.8	6.3 ± 2.1	0.654
Prescribed Medication (n=80)	6.0 ± 2.3	6.5 ± 3.7	6.0 ± 2.6	0.758
Prescribed Nutrition Medication (n=80)	0.8 ± 1.1	0.6 ± 0.7	0.7 ± 0.8	0.666
Over-The-Counter Nutrition Supplements (n=80)	0.2 ± 0.4	0.6 ± 1.1	0.2 ± 0.5	0.090
Cognition (n=61)	19.1 ± 5.1	17.2 ± 5.0	17.5 ± 5.3	0.451
Dysphagia Risk Score (n=88)	1.6 ± 2.8 <sup>†</sup>	2.8 ± 5.4	6.0 ± 7.7 <sup>†</sup>	0.017*

All values reported as mean ± SD

\* Differences between groups were analysed with One-Way ANOVA,  $p < 0.05$  was considered statistically significant. Bonferroni post-hoc tests were performed. Means in a row with the same symbol<sup>†</sup> differed significantly ( $p < 0.05$ )

The MNA-SF score was inversely correlated with the EAT-10 score ( $r = -0.383$ ,  $p < 0.001$ ). As the MNA-SF score decreased (and nutrition risk status worsened), the EAT-10 scores increased, thus dysphagia risk increased. The MNA-SF score was positively correlated with BMI ( $r = 0.484$ ,  $p < 0.001$ ) and the grip strength of the participants' dominant hand ( $r = 0.250$ ,  $p = 0.026$ ). Therefore, higher nutrition risk was significantly related to a lower BMI and lower grip strength in the dominant hand. No significant correlation was found between the participants' nutrition risk status and their age, level of cognition or number of key comorbidities, medications or use of supplements (**Table 4.14**).

**Table 4.14** Correlations between Nutrition Risk Status and Participant Characteristics

	MNA-SF Nutrition Risk Score	
	Pearson Correlation (r)	p-value
Age (years)	-0.008	0.941
Body Mass Index ( $\text{kg}/\text{m}^2$ )	0.484	<0.001*
Grip Strength, Dominant Hand (kg)	0.250	0.026*
Key Comorbidities	0.024	0.824
Prescribed Medication	-0.032	0.767
Prescribed Nutrition Medication	0.014	0.897
Over-The-Counter Nutrition Supplements	0.045	0.675
Cognition	0.170	0.190
Dysphagia Risk Status	-0.383	<0.001*

Mini Nutritional Assessment-Short Form, MNA-SF

\* Significant difference,  $p < 0.05$

## Chapter 5 Discussion

This study aimed to establish the prevalence of nutrition risk among older adults over 85 years recently admitted to the Admission, Treatment and Rehabilitation (AT&R) wards at North Shore and Waitakere Hospitals.

Of the advanced age participants; 39 were octogenarians (85-89 years), 48 were nonagenarians (90-99 years), and one a centenarian (100 years and older). The mean age of the men was  $89.7 \pm 4.0$  years and slightly older for women ( $90.0 \pm 3.7$  years). The participants therefore have aged successfully and exceeded life expectancy estimates for New Zealanders (79.5 years for men and 83.2 years for women) (Statistics New Zealand, 2015).

Two thirds (67.0%) of the participants were New Zealand European, nearly a third British or European descendants and none identified themselves as Māori or Pacific. The large proportion of New Zealand European participants was anticipated as most adults over 85 years (95.1%) identified themselves as New Zealand European in the 2013 Census (Statistics New Zealand, 2015). The large proportion of British and European participants was also unsurprising given the long history of immigration into New Zealand (Ministry for Culture and Heritage, 2014). Māori and Pacific populations have lower life expectancies than New Zealand Europeans, and only make up 1.1% and 1.3% of the WDH population over 85 years (Statistics New Zealand, 2014), thus in this group Māori and Pacific ethnicities were not under represented.

Almost a third (29.5%) of participants were found to be married or partnered, and two thirds (67.0%) were widowed, slightly higher than the proportion of widowed adults of advanced age (57.8%) in the 2013 Census (Statistics New Zealand, 2015). The majority of participants lived with others (living with spouse only: 23.9%; living with others (family, friends, rest home setting: 30.7%). Less than half of the participants lived alone (45.4%), slightly lower than the national average of 54% for adults aged 85 years and older (Statistics New Zealand, 2015).

In general, the participants were highly educated; 83% had a secondary education or higher, compared with the national average of 61% for adults over 65 years (Statistics

New Zealand, 2015). This may reflect the area from which participants were recruited; the WDHB is the third least-deprived DHB in New Zealand, and following Auckland DHB and Capital and Coast DHB has the third highest level of education (Waitemata District Health Board, 2015).

Using the validated MNA-SF tool, this study revealed that nutrition risk among participants was high: 43.2% were at risk of malnutrition and 28.4% were malnourished. This meant less than a third (28.4%) of these hospitalised older adults had a normal nutrition status. To date, only two other studies have reported the prevalence of nutrition risk in hospitalised older adults in New Zealand. The first study, undertaken in 1999, found 42% of older adults (mean age 81.5 years) admitted to Christchurch hospital with a hip fracture were at risk of malnutrition (Hanger et al., 1999), while a more recent study reported that nutrition risk was prevalent among 68% of older adults (mean age 81 years) on admission to the AT&R ward at Middlemore Hospital in Auckland (Van Lill, 2002). Nutrition status is reported to decline with age (Forster & Gariballa, 2005), thus the higher prevalence of nutrition risk in the present study may reflect the older age of participants. Van Lill (2002) screened for nutrition risk using the MNA. This tool has a strong correlation with the MNA-SF used in the present study (Rubenstein et al., 2001); therefore, the difference in age of participants is more likely to explain the difference in nutrition risk prevalence than the screening tool used. Conversely, Hanger and co-workers (1999) determined nutrition risk status using four nutritional indices: triceps skinfold thickness, mid upper arm circumference, serum albumin, and pre-albumin. These parameters measure the manifestation of a poor nutrition status, and due to the long latency period between cause and effect nutrition risk may have been unidentified in some participants (Forster & Gariballa 2005). This may in turn explain why nutrition risk prevalence in their study was found to be lower than that found by both Van Lill (2002) and in the present study.

In Australia, a study conducted in an Adelaide rehabilitation hospital using the MNA found the prevalence of nutrition risk in older adults (mean age 78.6 years) was 43.1% (Visvanathan, Penhall, & Chapman, 2004). Using the MNA-SF a slightly higher prevalence of nutrition risk (47%) was found among 133 older adults (mean age 81

years) at a different rehabilitation hospital in Adelaide (Neumann, Miller, Daniels, & Crotty, 2005). Similarly to the abovementioned studies, the lower incidence of nutrition risk compared with the present study may reflect the younger age of the participants.

A further study in Adelaide found 45% of hospitalised patients were malnourished and an additional 39% were at nutrition risk when screened using the MNA tool (Dent, Chapman, Piantadosi, & Visvanathan, 2015). While these patients were younger (mean age 85.2 years) than participants in the present study, polypharmacy rates were higher (76% vs. 70.5%, respectively). The association of polypharmacy, defined as the concurrent use of five or more medications, with a decline in nutritional status partly reflects the impaired health and multiple comorbidities experienced by older adults. High medication use may contribute to poor nutrition status due to the adverse effect it can have on eating, such as poor appetite, nausea and taste changes (Jyrkkä et al., 2011). A Finnish study found polypharmacy and excessive polypharmacy (greater than 10 medications) among adults aged 75 years and older resulted in lower MNA-SF scores compared with non-polypharmacy (Jyrkkä et al., 2011). Polypharmacy with increasing age also increases the risk of drug-nutrient interactions, impairing nutrient absorption (Mallet et al., 2007). A previous study indicated that using five or more medications increased the risk of weight loss by three-fold among older adults compared to older adults using less than five medications (Agostini, Han, & Timetti, 2004). This may have contributed to the higher prevalence of nutrition risk observed by Dent and co-workers (2015).

Poor nutrition status among hospitalised patients has been found to have a negative impact on economic, functional and clinical outcomes. The Australasian Nutrition Care Day Survey study found that, independent of disease status and severity, the median length of stay of malnourished patients was 1.5 times longer than that of well-nourished patients (Agarwal et al., 2012). Studies have also shown that malnourished patients face higher mortality rates (Middleton et al., 2001), are more likely to be discharged into residential care (Charlton et al., 2012), and have a 60% higher readmission risk within 15-days post hospital discharge (Lim et al., 2012).

Compared to hospitalised older adults, nutrition risk prevalence among community-dwelling older adults is lower. A recent study of 473 older adults (mean age 74 years) living in the Hawkes Bay identified nutrition risk was prevalent among 57% of participants (McElnay et al., 2012), while an earlier study of community-dwelling older adults (mean age 82.4 years) living in Auckland found nutrition risk prevalence to be 52% (Wham et al., 2011a). Furthermore, among community-dwelling adults of advanced age (85-86 years) nutrition risk prevalence was found to be 60% (Wham et al., 2014b). This highlights that even when adults are of advanced age, nutrition risk remains lower than among hospitalised older adults. These community studies all used the SCREEN II tool, a valid and reliable nutrition screening tool specifically designed for community-dwelling older adults (Keller, Goy, & Kane, 2005; Wham et al., 2014b). Similar to these New Zealand findings, a large review of international studies screening older adults using the MNA tool identified the prevalence of nutrition risk among hospitalised older adults (n=8596) to be approximately 69%, while among community-dwelling older adults (n=14149) the prevalence was estimated to be 26% (Guigoz, 2006). The higher prevalence of nutrition risk among hospitalised older adults may reflect the higher number of comorbidities in these populations, and the detrimental impact they can have on nutrition status. Multiple chronic conditions can compound nutrient losses and decline physiologic reserves of older adults (Clegg, Young, Iliffe, Rikkert, & Rockwood, 2013). This poses a significant challenge as, in the absence of an adequate nutritional intake, the vulnerability of this population to poor nutrition status increases (Hirose et al., 2014).

In the present study participants had at least one health condition, with the majority (71.6%) having between five and 10 key comorbidities. Similar findings were reported by Formiga and co-workers (2013) in a Spanish study of community-dwelling advanced age adults (85 years and older), with 95.1% of participants found to have more than one health condition. It has been suggested that the number of health conditions increases with age; an Australian study found that multiple morbidities were prevalent among 78% of participants aged 80 years and older compared to approximately 35% in those 40-59 years and 63% in those aged 60-79 years (van den Akker, Buntinx, Metsemakers, Roos, & Knottnerus, 1998). In New Zealand it has



previously been reported that a higher number of comorbidities is associated with high nutrition risk (Wham et al., 2014a). Some health conditions have a greater burden on nutrition status than others, such as those that impair nutrient absorption or increase nutritional requirements (Brownie, 2006). Therefore, it is possible that the lack of association between nutrition risk and total comorbidities may have contributed to the type of health conditions faced by participants. However, as this was not explored in the present study, conclusions cannot be made.

The present study indicates that those at higher nutrition risk had a lower BMI. Considering BMI is assessed in the MNA-SF, this finding was foreseen. Participants had a mean BMI of  $22.8 \pm 4.2 \text{kg/m}^2$ . Men were significantly heavier and taller than women but no significant difference in overall BMI was found between genders. However, in the overweight BMI category, women had significantly higher BMIs. Younger men with a high BMI are at a greater relative risk of mortality (Prospective Studies Collaboration, 2009), therefore it is possible that this difference reflects a reduced survival of overweight men into advanced age.

Current evidence suggests the WHO International BMI Classification for a healthy weight range ( $18.5\text{-}24.9 \text{kg/m}^2$ ) may not be appropriate for older adults. A recent meta-analysis of 32 longitudinal studies, involving 197,940 older adults, found that adults aged 65 years and older with a BMI at the lower end of the WHO healthy weight range ( $<23 \text{kg/m}^2$ ) had a greater risk of mortality than those at the higher end of this range. Accordingly, the mean BMI of participants in the present study places them at a 5% greater risk of mortality than if the mean BMI was between  $23.0$  and  $23.9 \text{kg/m}^2$  (Winter, MacInnis, Wattanapenpaiboon, Nowson, 2014).

Using a range of screening tools, previous studies have indicated a higher prevalence of malnutrition among older adults classified as underweight (Hengstermann, Nieczaj, Steinhagen-Thiessen, & Schulz, 2008; Holst et al., 2013; Winter, Flanagan, McNaughton, & Nowson, 2013). In a population of older adults admitted to three hospitals in Denmark and Sweden, nutrition screening using three different tools (MNA, Malnutrition Universal Screening Tool, Nutrition Risk Screening-2002) found those with poor nutrition status had lower BMI than those with normal nutrition status

(Holst et al., 2013). Similar results were found in a German study by Hengstermann et al. (2008), who screened for nutrition risk in hospitalised older adults using the MNA tool. Among participants with a BMI which classified them as underweight, 3% were found to have a normal nutrition status while 49% were found to be at nutrition risk. These findings also extend to older adults living in the community. Using the MNA-SF; Winter and co-workers (2013) found BMI was significantly lower among older adults with a poor nutritional status, compared to those with a normal nutrition status.

Grip strength was used as the key marker of muscle strength in this study. Current evidence suggests low grip strength in advanced age is associated with increased nutrition risk (Dent et al., 2015; Kaburagi et al., 2011; Wham et al., 2011a). The present study adds to this body of evidence, with grip strength in the dominant hand significantly correlated with MNA-SF score ( $r=0.250$ ,  $p=0.026$ ). Shahar and Hussain (2007) reported a weaker correlation between grip strength and MNA-SF score ( $r=0.209$ ,  $p<0.001$ ) than the present study. Grip strength is known to weaken with age (Kaburagi et al., 2011; Sternäng et al., 2015; Tietjen-Smith et al., 2009), therefore the younger age of participants in Shahar and Hussain's study (mean age 67.7 years) may explain the different results between the two studies.

In line with previous research, there was a clear difference in mean grip strength between men and women (Cooper et al., 2011; Sternäng et al., 2015). However the difference observed between genders in the present study (6.9kg) was much lower than the 16.7kg difference observed by Cooper and co-workers (2011) among 50 to 90 year olds. Men are reported to have a faster decrease in grip strength as they age (Sternäng et al., 2015), therefore the smaller gap between genders in the present may reflect the advanced age of participants. Overall grip strength in the present study was found to be weaker than in a New Zealand study of community-dwelling older adults (Wham et al., 2011). While this difference may be explained by the younger age of participants in their study (mean age Māori 76.6 years, non-Māori 85.2 years), it may also be attributed to the higher BMI of the Māori and non-Māori participants which tends to be associated with higher grip strength (Gale, Martyn, Cooper, & Sayer, 2007).

Nearly a third of the participants were at risk of dysphagia. These participants were significantly more likely to be malnourished than have a normal nutrition status. Studies across a range of settings support this finding, with a consistent link between dysphagia risk and poor nutrition status in older adults reported. A Japanese study of 847 community-dwelling older adults reported 65.6% of malnourished participants were at risk of dysphagia. The prevalence of malnutrition among these participants was significantly higher than those not at risk of dysphagia (Takeuchi et al., 2014). Similarly, in a group of Japanese adults' aged 65 years and older requiring long-term care, the prevalence of dysphagia risk, using the EAT-10, was higher among malnourished participants than those with a normal nutrition status (Wakabayashi & Matsushima, 2015). Age-related changes in muscle mass and connective tissue elasticity can impact on the swallowing process by disrupting the ability to swallow. In order to accommodate this, ageing individuals often reduce their food intake or choose alternative foods, contributing to the development of poor nutrition status. In New Zealand, dysphagia risk is not routinely screened for on hospital admission, thus the silent symptoms of dysphagia may go unnoticed. Investigating dysphagia risk of hospitalised advanced age adults highlights the need for routine screening in this population due to its adverse association with nutrition status and added strength to this study.

Two thirds (64%) of malnourished participants and those at risk of malnutrition (63.2%) wore some form of dental appliance; however, no association with nutrition risk was found. This contrasts to previous studies which have shown that poor dental status, indicated by edentulism or the use of dentures, is associated with an increased nutrition risk (Iwasaki et al., 2015; Kikutani et al., 2013). In a Japanese study of older adults (mean age 81.7 years), those with fewer natural teeth or ill-fitting dentures had impaired chewing ability, influencing their food choice and dietary diversity as less meats, fruits, and vegetables were eaten (Iwasaki et al., 2015). Even when dentures are well fitted nutritional intake is reported to remain lower than dentate older adults (Sheiham et al., 2001). Therefore the finding of the present study cannot be explained, and highlights the need for future research to consider the effect of dental status on nutrition risk.

Among the 61 participants who were screened using the MoCA, only four had a normal cognitive status. This is likely to explain the lack of association between cognitive status and nutrition risk. Typically older adults with cognitive impairment may experience a loss of appetite and a subsequent reduction in food intake (Ikeda et al., 2002). When cognitive impairment advances recognising foods and remembering to eat becomes a challenge. Forgetting how to use utensils leads to difficulty in delivering food into the mouth, and individuals can struggle with chewing and swallowing food (Ball et al., 2015). Using the MNA a study of older adults (mean age 85 years) admitted to a Taiwanese hospital found participants with lower cognitive status were at higher risk for malnutrition (Peng et al., 2015). Pearson and co-workers (2001) found older adults with diminished cognitive function were at more than twice the risk of developing malnutrition. The use of the MoCA may have been a limitation of this study as it appears to have overestimated the prevalence of cognitive impairment among the participants.

Two thirds (65.9%) of participants received the pension as their only source of income. Older adults with low socioeconomic status, often characterised by pension-only income, have previously been reported to be at an increased risk of having a poor nutrition status (Locher et al., 2005; Lokken et al., 2002; Waern et al., 2015). This may arise as the New Zealand pension may be insufficient to maintain a balanced diet (O'Sullivan et al., 2012). Cost concerns among older adults with low income can influence food choice (Dijkstra et al., 2015) and when the pension is the only source of income, older adults are at higher risk of having a poor intake of key nutrients (Waern et al., 2015). However, participants in the present study were also well educated and lived within the WDHB catchment region, an area that has a lower level of deprivation than the New Zealand average (Auckland Regional Public Health Service, 2008). These factors may indicate their socioeconomic status is higher than average, hence a lack of association between nutrition risk and pension-only income.

There was no association between widowhood and malnutrition in the present study. This contrasts with a large body of evidence which has made a well-established link between widowhood and increased nutrition risk among older adults. Results from longitudinal studies indicate that widowhood is linked to a decline in both diet quality

and variety (Kwon et al., 2006; Lee et al., 2005; Shahar et al., 2001), and in contrast to their married peers, those who have suffered recent bereavement are reported to frequently skip meals and have a poor appetite (Shahar et al., 2001). Consequently, widows and widowers have been found to be at greater nutrition risk than those who were not widowed (Feldblum et al., 2007; Wham et al., 2011b; Wham et al., 2014b). Household structure changes as a result of widowhood, and bereaved older adults are often left to live alone (Statistics New Zealand, 2015). This can cause loneliness and reduce motivation to plan, shop, and cook meals (Shahar et al., 2001). In New Zealand, older adults living alone are 3.5 times more likely to have poor nutritional status than those living with others (McElnay et al., 2012). The majority of participants in the present study were living with others, which is reported to lessen the loneliness felt by bereavement and increases the opportunity for socialisation at meal times (Callen & Wells, 2003; Vesnaver, Keller, Sutherland, Maitland, & Locher, 2015), therefore giving possible explanation as to the lack of association between nutrition risk and widowhood.

The majority of participants (70.5%) required daily help with various tasks such as cooking, cleaning, showering and dressing. The high dependency on social support is not surprising given the fact that a progressive loss of independence in daily living activities is characteristic of ageing (Covinsky et al., 2003). A New Zealand study of older adults showed that those with a higher need for assistance with shopping; meal preparation and feeding were more likely to be at nutrition risk than those who did not require assistance (Wham et al., 2011b). This finding is in accordance with a Danish study of hospitalised older adults, which found those with a higher nutrition risk status needed help in meal situations (Holst et al., 2013). Based on these studies, it is interesting that there was no association found between nutrition risk and the need for daily help in the current study. However this may be explained by the fact that nearly two thirds (62.5%) of participants received regular support, they were well educated and more than half of participants were living with others. The subsidised home care support received by these participants' aims to keep them living in their home for as long as possible (Ministry of Health, 2011). Therefore, between family support and government help, these participants appear to have received appropriate

assistance with procurement and preparation of foods, which has enabled them to eat well.

# Chapter 6 Conclusion

## 6.1 Summary of the Study

Multiple factors associated with ageing cause advanced age adults to be at an increased nutrition risk. The prevalence of nutrition risk among hospitalised advanced age adults has not previously been established.

The primary objective of this study was to determine nutrition risk prevalence among adults of advanced age recently admitted to the AT&R wards using the Mini Nutritional Assessment-Short Form. The results showed 43.2% of advanced age adults were at risk of malnutrition, with a further 28.4% identified as malnourished.

The second objective was to determine dysphagia risk prevalence among adults of advanced age using the 10-item Eating Assessment Tool. Almost a third (29.5%) of participants were found to be at risk of dysphagia. Malnourished participants were significantly more likely to be at risk of dysphagia than not at risk ( $p=0.015$ ).

The third objective was to measure body mass and estimate the muscle mass of participants using bioelectrical impedance analysis scales. The mean body mass of the participants was  $59.8 \pm 12.2$ kg. Female participants had significantly lower body mass than males ( $p=0.001$ ). Bioelectrical impedance analysis was performed on only seven participants due to the difficulty in assessment among more frail participants and restrictions on using the BIA scales on those with internal electrical devices. The mean muscle mass of the seven participants was  $22.9 \pm 3.9$ kg, with no significant difference between men and women.

The fourth objective was to assess the muscle strength of adults of advanced age using a grip strength dynamometer. The mean grip strength of the participants was  $13.1 \pm 6.6$ kg and was significantly stronger in the dominant hand of male participants compared to female participants ( $p<0.001$ ).

The final objective was to identify sociodemographic and health factors associated with high nutrition risk. This study found a significant association between participants

at risk of dysphagia and poor nutrition status. Lower grip strength was correlated with higher MNA-SF scores (higher nutrition risk).

## **6.2 Conclusion**

This study highlights a significant level of nutrition risk and malnutrition among hospitalised older adults. Lower BMI, lower grip strength, and higher dysphagia risk were significantly correlated with higher nutrition risk. In line with the final objective, this study highlighted the high prevalence of widowhood, pension-only income, multiple comorbidities, polypharmacy, poor dental status, and impaired cognitive function among the participants, although these factors had no significant effect on nutrition risk status. Ensuring routine nutrition screening is carried out on admission to an AT&R ward is an important first step to improve the nutrition status of advanced age adults. The findings also highlight the importance of screening for dysphagia risk alongside nutrition risk among advanced age adults. Screening on admission to hospital can help to identify those in need of further assessment and can help to shape the interventions aimed at improving their nutrition status.

## **6.3 Strengths**

To date, there is limited research on the nutrition risk status of hospitalised adults of advanced age. The present study builds on the international research in this area and is the first study in New Zealand to provide a snapshot of nutrition risk prevalence among advanced age adults in a hospital setting. It provides evidence that the prevalence of nutrition risk in recently hospitalised older adults is significantly higher than among community-dwelling advanced age adults, and highlights the importance of nutrition screening on admission to hospital to identify those in need of a full nutritional assessment and intervention.

A further strength of the study lies in the use of the validated MNA-SF tool to identify malnutrition and nutrition risk among participants. This tool has been previously validated, and been shown to have high sensitivity, specificity, and low inter-observer variation (Gazzotti, Pepinster, Petermans, & Albert, 1997; Rubenstein et al., 2001). This tool was easy to administer and appeared to be of low burden to participants as it



only took between 3-5 minutes to complete. The MNA-SF has been widely used among the limited international studies investigating the nutrition risk status of hospitalised adults of advanced age, and therefore the present study could be directly compared with international research.

Training was received by both a New Zealand Registered Dietitian and a qualified research technician to ensure consistent, accurate anthropometric measurements were taken. This training also covered how to accurately administer the MNA-SF, EAT-10, and MoCA tools in line with the instruction manuals. This ensures that reliable results were collected, and allows for comparisons to be made with international research.

#### **6.4 Limitations**

Despite the strengths of the study, it is important to acknowledge the limitations. Firstly, the cross-sectional design of this study limited inference on causality, and instead only associations could be reported. Due to time restraints, a three month period was used to recruit participants and collect data. As a result, only 88 hospitalised advanced age older adults were recruited into the study. This limits the ability to extrapolate these results to broader populations. Recruitment of participants over a longer period would have increased the study population and may have ensured a greater ethnic diversity among participants.

Participants were recruited within five days of admission to the AT&R ward; however they may have first been admitted to an acute ward. For these participants, nutrition status may have thus been influenced by their longer hospital admission and may not be a true representation of their nutritional state prior to admission.

Another limitation was the area from which the participants were recruited. Compared to the New Zealand average, the Waitemata District Health Board catchment area is of a slightly higher socioeconomic level (Auckland Regional Public Health Service, 2008), thus the findings may not be representative of the general advanced age older adult population in other geographic areas of New Zealand.

Cognitive screening of participants using the MoCA identified cognitive impairment to be highly prevalent (93.4%). By contrast, less than a quarter of participants (21.6%) had 'neuropsychological problems' when screened by the MNA-SF. The MoCA provides an in-depth screening of cognitive function, and was chosen for use in this study as it is used clinically by geriatricians at North Shore and Waitakere Hospitals. It assesses eight areas of cognition, and requires participants to score 26 or more out of 30 in order to be classified as having normal cognitive function. Based on this recommended cut-off, normal cognitive function was only identified in 6.2% of participants. The MoCA was validated in older adults to have high sensitivity and specificity to detect cognitive impairment (Nasreddine et al., 2005). However, in the present study there appeared to be great variation in the cognitive score of participants and their apparent cognition. The majority of participants appeared to have a good comprehension of the study questionnaire and were able to respond appropriately. Studies of community-dwelling older adults and elderly outpatients also reported participants with normal cognition were falsely identified as having cognitive impairment using the recommended cut-offs of the MoCA (Lee et al., 2008; Luis et al., 2009). Therefore, it appears the MoCA may have overestimated the prevalence of cognitive impairment in the present study.

The final limitation identified was the use of the Inbody 230 BIA scales. Despite the strong, significant correlation for percentage body fat when compared with dual energy X-ray absorptiometry ( $r=0.97$ ,  $p=0.01$ ) (Karelis et al., 2013), the method of obtaining body composition involves conducting a low intensity electrical current through the body, thus restricting participants with internal electrical devices, such as pacemakers, from measurements. Furthermore, body composition measurements could not be taken from participants who were too frail to stand unassisted. This resulted in only seven participants having their body composition measured, who were likely to have had higher muscle mass than those excluded. BIA measurements are sensitive to hydration abnormalities. Therefore, if any of these seven participants had changes in their hydration status, their muscle mass may have been overestimated.

## 6.5 Recommendations for Future Studies

- 1) Further research among hospitalised advanced age adults should consider the recruitment of a larger sample size to give a more accurate representation of nutrition risk prevalence and allow for factors affecting nutrition status to be further examined.
- 2) This research was conducted in one DHB in New Zealand. Investigation of the prevalence of nutrition risk among hospitalised advanced age adults in other DHBs will allow for comparisons to be made between different geographic areas of New Zealand.
- 3) Future ward based hospital studies should identify where participants have been admitted from as this will help to ensure that nutrition risk status had not been influenced by long hospital stays on other wards.
- 3) The validity of the MoCA in evaluating cognitive impairment among this group requires further investigation.
- 4) This study has highlighted that use of BIA scales can be difficult in the assessment of advanced age frail adults. The assessment of body composition using chair scales would provide a more feasible method of assessment.
- 5) Future studies should consider the fit of dentures and the effect of a complete or a partial set of dentures on nutrition risk status.

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# Appendix A Information Sheet



Making a healthy difference to the community

## An investigation of nutrition risk among hospitalised adults of advanced age

### INFORMATION SHEET

You have been invited into this study because you have recently been admitted to a hospital rehabilitation ward. This study is looking at the nutrition of adults over 85 years of age in the Waitemata District Health Board region.

#### Study Description

The aim of this study is to gain an understanding of the nutrition status and swallowing risk of older adults. We will also look at their muscle mass and strength. This will allow those most at risk to be identified.

#### The Research Procedure

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

1. Once you have signed the consent form, you will complete a short questionnaire about your nutrition and swallowing.
2. Your height, weight, and muscle mass will be measured. We will then measure your strength.

This study will take approximately 60-90 minutes, however you may withdraw at any time.

#### Benefits and Risks

It is possible the interviews and measures may identify a problem. If this happens you will be offered appropriate treatment.

Side effects may occur although this is extremely unlikely.

#### Participant's Rights

You do not have to accept this invitation. If you decide to participate, you have the right to:

- Decline to answer any particular question

- Withdraw from the study at any time
- Ask any questions about the study at any time
- Be given a summary of the study findings when it is concluded

Choosing not to participate in this study will in no way affect your current or future care.

### **Confidentiality**

Data collected will only be used for this study. Only investigators of the study will have access to personal information, which will be held securely and treated strictly confidentially. Results of this study may be published or presented at conferences or seminars; however, no individual will be able to be identified. Non-identifiable data from this study may be used in future related studies, which have been given ethical approval from the Ethics Committee.

Research data will be stored for a period of ten years (as required by New Zealand law), after which it will be destroyed.

### **Ethics Approval**

This study has been reviewed and approved by the Health and Disability Ethics Committee: Northern A, Application 14/NTA/70.

### **Further Information**

If you have any questions, concerns or complaints about the study at any stage, you can contact:

#### **Amy Popman**

Dietetic Student, Massey University

Phone: 02102498625

Email: amypopman@hotmail.com

#### **Darshan Patel**

Dietetic Student, Massey University

Phone: 0210410149

Email: d.patel0245@gmail.com

#### **Dr Carol Wham, PhD, NZRD**

Senior Lecturer, Institute of Food, Nutrition & Human Health, Massey University

Phone: (09) 436 644

Email: C.A.Wham@massey.ac.nz

# Appendix B Consent Form



## An investigation of nutrition risk among hospitalised adults of advanced age

### CONSENT FORM

**Declaration by participant:**

I have read the Information Sheet and have had the details of the study explained to me. I have had time to consider whether to take part in this study. I have been given appropriate contact details to obtain further information and to discuss the study. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I have been given a copy of the Information Sheet to keep.

Participant's name:

---

Signature	Date
-----------	------

---

**Declaration by member of research team:**

I have given a verbal explanation of the research study to the participant, and have answered the participant's questions about it.

I believe that the participant understands the study and has been given informed consent to participate.

Researcher's name:

---

Signature	Date
-----------	------

---





## Demographic

### 13. Which of these best describes your ethnicity?

1 = New Zealand European

2 = Māori

3 = Pacific

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:

---

---





**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:

---

---

**25b. Have you previously had any dietetic input?**

Yes	No
1	2

Comments (i.e. when, in relation to what etc):

---

---

## Appendix D Mini Nutritional Assessment-Short Form

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

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

Mobility

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

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

Yes	No
0	2

Neuropsychological problems

Severe dementia or depression	Mild dementia	No psychological problems
0	1	2

If BMI is not available, replace BMI with calf circumference

**Body Mass Index (BMI) (weight in kg) / (height in m<sup>2</sup>)**

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

**Calf circumference (CC) in cm**

CC less than 31	CC 31 or greater
0	3

Comments:

---



---

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

## Appendix E 10-Item Eating Assessment Tool

To what extent do you experience the following problems? Rate from 1-4

**My swallowing problem has caused me to lose weight**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

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

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**Swallowing liquids takes extra effort**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**Swallowing solids takes extra effort**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**Swallowing pills takes extra effort**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**Swallowing is painful**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**The pleasure of eating is affected by my swallowing**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**When I swallow food sticks in my throat**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**I cough when I eat**

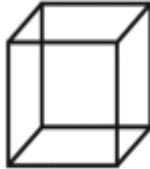
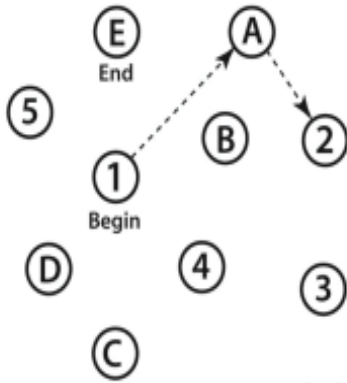

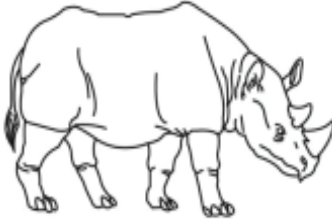

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

**Swallowing is stressful**

0 No problem	1	2	3	4 Severe problem
-----------------	---	---	---	---------------------

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

# Appendix F Montreal Cognitive Assessment

MONTREAL COGNITIVE ASSESSMENT (MOCA) Version 7.1 Original Version		NAME:	Date of birth:	POINTS																	
		Education:	DATE:																		
		Sex:																			
<b>VISUOSPATIAL / EXECUTIVE</b>		 Copy cube Draw CLOCK (Ten past eleven) (3 points)		<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> Contour Numbers Hands ___/5																	
																					
<b>NAMING</b>		 <input type="checkbox"/>  <input type="checkbox"/>  <input type="checkbox"/>		___/3																	
<b>MEMORY</b>	Read list of words, subject must repeat them. Do 2 trials, even if 1st trial is successful. Do a recall after 5 minutes.	<table border="1" style="width: 100%; text-align: center;"> <tr> <td></td> <td>FACE</td> <td>VELVET</td> <td>CHURCH</td> <td>DAISY</td> <td>RED</td> </tr> <tr> <td>1st trial</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2nd trial</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table>		FACE	VELVET	CHURCH	DAISY	RED	1st trial						2nd trial						No points
	FACE	VELVET	CHURCH	DAISY	RED																
1st trial																					
2nd trial																					
<b>ATTENTION</b>	Read list of digits (1 digit/ sec.). Subject has to repeat them in the forward order	[ ] 2 1 8 5 4		___/2																	
	Subject has to repeat them in the backward order	[ ] 7 4 2																			
	Read list of letters. The subject must tap with his hand at each letter A. No points if ≥ 2 errors	[ ] FBACMNAAJKLBAFAKDEAAAJAMOF AAB		___/1																	
	Serial 7 subtraction starting at 100	[ ] 93 [ ] 86 [ ] 79 [ ] 72 [ ] 65	4 or 5 correct subtractions: <b>3 pts</b> , 2 or 3 correct: <b>2 pts</b> , 1 correct: <b>1 pt</b> , 0 correct: <b>0 pt</b>	___/3																	
<b>LANGUAGE</b>	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																	
<b>ABSTRACTION</b>	Similarity between e.g. banana - orange = fruit	[ ] train - bicycle [ ] watch - ruler		___/2																	
<b>DELAYED RECALL</b>	Has to recall words WITH NO CUE	<table border="1" style="width: 100%; text-align: center;"> <tr> <td>FACE</td> <td>VELVET</td> <td>CHURCH</td> <td>DAISY</td> <td>RED</td> </tr> <tr> <td>[ ]</td> <td>[ ]</td> <td>[ ]</td> <td>[ ]</td> <td>[ ]</td> </tr> </table>	FACE	VELVET	CHURCH	DAISY	RED	[ ]	[ ]	[ ]	[ ]	[ ]	Points for UNCUEd recall only	___/5							
FACE	VELVET	CHURCH	DAISY	RED																	
[ ]	[ ]	[ ]	[ ]	[ ]																	
<b>Optional</b>	Category cue Multiple choice cue																				
<b>ORIENTATION</b>	[ ] Date [ ] Month [ ] Year [ ] Day [ ] Place [ ] City			___/6																	
© Z.Nasreddine MD		www.mocatest.org		Normal ≥ 26 / 30																	
Administered by: _____		TOTAL		___/30 Add 1 point if ≤ 12 yr edu																	