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**An Investigation of Nutrition Risk among Hospitalised
Older Adults Admitted to the
Assessment, Treatment and Rehabilitation Wards
of Waitemata District Health Board Hospitals**

A Thesis Presented in Partial Fulfilment of the
Requirements for the Degree of

Master of Science in Nutrition and Dietetics

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Abstract

Background: The proportion of older adults in New Zealand is increasing. Studies shows compromised nutrition status is prevalent in older adults, and can exacerbate poor health. It is therefore important to identify those who are malnourished, or those who are at nutrition risk for early nutrition intervention. Nutrition screening tools allow for the identification of nutrition risk status and initiation of nutritional care to result in improved health outcomes. Current data on the prevalence of nutrition risk in hospitalised older adults in New Zealand is limited.

Design: Cross-sectional, observational study as part of a multicentre prospective study.

Aim: To investigate the prevalence of nutrition risk among older adults (65-84 years) in the Assessment, Treatment and Rehabilitation (AT&R) wards of North Shore and Waitakere Hospitals. Potential nutrition risk factors including dysphagia risk, muscle mass and hand grip strength will also be investigated, as well as other relevant physiological and socio-demographic risk factors.

Methods: Participants were recruited within five days of admission to the AT&R wards. Face-to-face interviews and assessments were conducted on the wards. A questionnaire incorporating participant characteristics, health and support data and validated screening and assessment tools were used. Nutrition risk status was assessed by the Mini Nutrition Assessment-Short Form, dysphagia risk status was assessed by the Eating Assessment Tool, cognitive status was assessed by the Montreal Cognitive Assessment and muscle mass was assessed by bioelectrical impedance analysis. Hand grip strength was measured using a hydraulic dynamometer.

Results: A total of 89 participants took part in the study. Nutrition risk and malnutrition was evident in 43.8 and 27.0 percent of the study participants respectively. Indicated by the Mini-Nutrition Assessment-Short Form, participants with poor nutritional status were more likely to report reduced food intake, unintentional weight loss, requiring aid with activities of daily living, having previous dietetic input and being at risk of dysphagia compared to participants with 'normal' nutritional status.

Conclusion: A high percentage of hospitalised older adults recently admitted to the AT&R wards had compromised nutritional status. Routine screening is highly advised to identify nutritional risk and instigate nutritional care.

Keywords: Older Adults, Nutrition Status, MNA-SF, Dysphagia, Muscle Mass, Muscle Strength, AT&R ward

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Table of Contents

Abstract.....	i
Acknowledgments.....	iii
Table of Contents.....	iv
List of Tables.....	vi
List of Figures.....	vii
Abbreviations.....	viii
Chapter 1: Introduction.....	1
Chapter 2: Literature Review.....	4
2.1 Ageing in New Zealand.....	4
2.2 Health Care Service and Cost Implications.....	7
2.3 Hospitalisation with Ageing.....	8
2.4 Ageing in Place.....	9
2.5 Health and Ageing.....	10
2.6 Nutrition and Ageing.....	17
2.7 Malnutrition.....	22
2.8 Factors Affecting the Nutritional Health of Older People.....	24
Chapter 3: Methods.....	37
3.1 Aims and Objectives.....	37
3.2 Study Design.....	37
3.3 Setting.....	37
3.4 Ethics.....	38
3.5 Recruitment of Participants.....	40
3.6 Data Collection.....	41
3.7 Data Handling and Statistical Analysis.....	49
Chapter 4: Results.....	50
4.1 Participant Characteristics.....	50
4.2 Participant Anthropometric, Muscle Mass and Grip Strength Measures.....	52
4.3 Health and Medications.....	53
4.4 Dental Characteristics and Dysphagia Status (EAT-10).....	55
4.5 Support Services.....	56
4.6 Participant Cognition.....	57
4.7 Nutrition Risk Status (MNA-SF).....	58

4.8 Nutrition Risk Associations	61
Chapter 5: Discussion.....	66
5.1 Nutrition Risk Prevalence.....	66
5.2 Nutrition Risk Factors.....	68
5.3 Dysphagia Risk Status and Prevalence	70
5.4 Muscle Mass & Strength.....	71
5.5 Strengths of the Study.....	73
5.6 Limitations of the Study.....	74
Chapter 6: Conclusion and Recommendations	77
6.1 Aim of the Research	77
6.2 Main Findings and Recommendations	77
References.....	82
Appendices.....	91

List of Tables

Table 1: Nutrient Reference Values for Older New Zealand Adults

Table 2: The Four Food Groups: Advice on Servings and Nutrients for Healthy Older Adults

Table 3: Participant Characteristics

Table 4: Participant Anthropometric, Muscle Mass and Grip Strength Measures

Table 5: Regular Prescribed Medications

Table 6: Dental Status of Study Participants

Table 7: Dysphagia Risk Status

Table 8: Support Service Use and Previous Dietetic Input

Table 9: Cognitive Status

Table 10: MNA-SF Scores of Study Participants

Table 11: MNA-SF Participant Specific Answers

Table 12: Associations between Nutrition Risk Prevalence and relevant Physiological and Socio-demographic Risk Factors

List of Figures

Figure 1: Age distribution of population as percentage of total population from 1948 – 2068

Figure 2: Factors contributing to nutrition-related health

Figure 3: The InBody 230 BIA scales and printer set up

Figure 4: Correct form and position of participant on the BIA scales

Figure 5: Dysphagia Status and Nutrition Status

Figure 6: Previous Dietetic Input and Nutrition Status

Abbreviations

Abbreviation	Definition
ADL	Activities of Daily Living
AT&R	Assessment, Treatment and Rehabilitation
BIA	Bioelectrical Impedance Analysis
BMI	Body Mass Index
DHB	District Health Board
EAT-10	Eating Assessment Tool
IADL	Instrumental Activities of Daily Living
IHD	Ischaemic Heart Disease
Kg	Kilogram
MCI	Mild Cognitive Impairment
MNA	Mini Nutritional Assessment
MNA-SF	Mini Nutrition Assessment – Short Form
MoCA	Montreal Cognitive Assessment
MoH	Ministry of Health
MoW	Meals on Wheels
NZ	New Zealand
WDHB	Waitemata District Health Board
WHO	World Health Organisation

Chapter 1: Introduction

1.1 Overview

Like many countries, New Zealand (NZ) is ageing. Those aged 65 years and older make up a large and steadily increasing population. It is projected that by the year 2068 older adults will make up 27.5 percent of the total population, nearly double the current percent as per the national population projections by Statistics NZ (Statistics New Zealand, 2014b). Ageing is often associated with a decline in general health and maintaining functional health, independence and quality of life can be a major challenge (MacPherson, 2014; Ministry of Health, 2002, 2010).

National data illustrates older adults are more likely to have chronic health conditions, non-communicable diseases, disability and be in need of assistance with activities of daily living (ADLs) compared to younger age groups (15-64 years) (MacPherson, 2014; Ministry of Health, 2010; Wang, Walls, Blakey, & Green, 2006). Furthermore, health and disability services are used significantly more by older adults as reflected in a higher per capita public health expenditure on these services for this age group (Cornwell & Davey, 2004; Ministry of Health, 2002).

A key concern is therefore the impact an increasing population will have on the demand for health care and disability services, as well as health care expenditure. As the proportion of older adults increases, the share of the public health budget for this group is projected to increase further (Ministry of Health, 2002).

The growth in the proportion of older adults will impact District Health Board's (DHB) across NZ differently. Currently Canterbury DHB has the highest number of people aged 65 years and older, but by 2021 Waitemata (WDHB) is predicted to overtake and become the DHB with the largest proportion of older adults in NZ (Ministry of Health, 2002). Many DHBs, like WDHB, will need to consider and appropriately address the health care needs of an older catchment.

Previous literature shows nutrition risk and malnutrition in older adult's leads to increased risk of poorer health outcomes, functional decline, reduced quality of life, increased hospitalisation and longer length of admission (Agarwal et al., 2012; H. H. Keller, Ostbye, & Goy, 2004; Mowe, Bohmer, & Kindt, 1994). Because of this, nutritional

status becomes an important consideration in old age. A number of studies in NZ have found large proportions of hospitalised older adults with compromised nutrition status, with as many as 70 percent of study participants at nutrition risk or malnourished (Goldstraw, 1998; Hanger, Smart, Merrilees, & Frampton, 1999; van Lill, 2002). However, many of these studies were conducted over a decade ago, and there is need for updated data to identify trends and nutrition risk factors.

Nutrition risk screening tools, such as the Mini Nutrition Assessment – Short Form (MNA-SF), allow for quick and efficient identification of those with impaired nutrition status (Guigoz, 2006; Ranhoff, Gjoen, & Mowe, 2005). Identifying those at risk of nutrition risk or malnutrition allows for instigation of nutrition care planning and improved health outcomes (Kruizenga et al., 2005).

The purpose of this study was to therefore investigate the prevalence of nutrition risk in hospitalised older adults within Waitamata DHB. Potential associated risk factors for nutrition risk including dysphagia risk status, muscle mass and hand grip strength will also be investigated, as well as other relevant physiological and socio-demographic risk factors.

1.2 Significance of Research

At the time of data collection, individuals identified as having nutritional or dysphagia risk will be referred to an appropriate health professional for further assessment and care management.

Results from the study will provide a snapshot of nutrition risk in a hospital setting, furthering the understanding of nutrition risk status and associated risk factors in older hospitalised adults in NZ. This will add to the body of evidence to help guide public health policy and the development of appropriate nutritional screening practices in healthcare settings. For research purposes, the study provides further insight for future studies to base hypothesis and guide interventions to improve older people's nutritional status.

1.3 Thesis Structure

This thesis contains six chapters. Chapter 1 explores the study and importance of

conducting this research. Chapter 2 provides a review of the literature on the ageing of the NZ population, trends and impacts of an older population and the current understanding of the health and nutrition risk of older people. Chapter 3 provides a detailed outline of study procedures. Chapter 4 provides the results of the study. Chapter 5 discusses the findings and implications of the study and reflects on the strengths and limitations. Finally, Chapter 6 summarizes the study outcomes and makes recommendations for healthcare screening practices and proposals for future research. The reference and appendix sections are included towards the end of the thesis.

Chapter 2: Literature Review

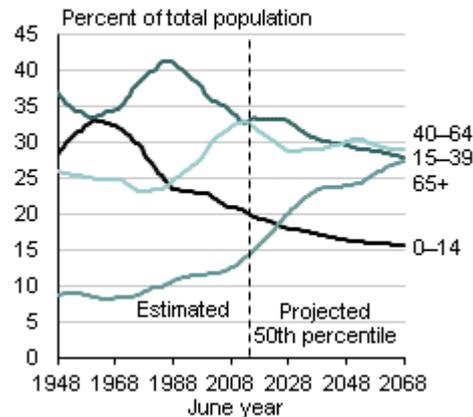
2.1 Ageing in New Zealand

New Zealand (NZ), like many developed countries, is ageing (Ministry of Health, 2002; Statistics New Zealand, 2014c; World Health Organisation, 2002a). People aged 65 years and older make up a large and steadily increasing population as a result of demographic trends such as declining fertility, increase in life expectancy and ageing of the baby boomers generation (Statistics New Zealand, 2014c; Stephenson & Scobie, 2002). Currently, older adults make up 14.4 percent of the total NZ population. By the year 2068 this is projected to increase to 27.5 percent (Statistics New Zealand, 2014b). The fastest growth is expected in the population of adults in advanced age, i.e. those that are 85 years and older. It is projected that by 2068, adults of advanced aged will make up 6.3 percent of the total population. This is approximately a four-fold increase from the 1.7 percent currently (Statistics New Zealand, 2014b).

An indication of an older population is the rise in the median age, which continues to increase due to significant changes in the age structure of the population. By the year 2068 it is forecasted half the NZ population could be older than 45 years as the median age increases to 45.3 years. By 2028 it is projected there will be more people aged 65 years and older than children aged 15 years and younger (Statistics New Zealand, 2014b, 2014c).

Below, **Figure 1** shows the projected age distribution of the population in 50 years with substantial growth seen in the age groups 65 years and older (Statistics New Zealand, 2014c)

Age distribution of population 1948–2068



Source: Statistics New Zealand

Figure 1. Age distribution of the New Zealand population as percentage of total population from 1948 – 2068 (Statistics New Zealand, 2014c)

2.1.1 Life Expectancy is Increasing

In the period 2012-14 life expectancy at birth was 79.5 years for males and 83.2 years for females. Māori had a slightly lower life expectancy with 73.0 years for men and 77.1 years for females. Life expectancy has increased by 1.5 years for males and 1.0 year for females since 2005-07 (Statistics New Zealand, 2015). Yet as life expectancy and growth in the older population continues, the number of years a person is at full health (termed independent life expectancy) is lagging (Wang et al., 2006). The independent life expectancy, which is the number of years a person could expect to live independently from birth free from any functional limitation or assistance, is 77 years for men and 79 years for women (Wang et al., 2006). As a result, older people who reach their predicted life expectancy may spend the last two to four years of their lives in poor health, which has implications in health care costs and expenditure as well as quality of life.

2.1.2 Older Adults are a Heterogeneous Population

Older adults are a heterogeneous population (Hickson, 2006; Ministry of Health, 2002, 2010). In NZ people aged 65 years and older are usually defined as ‘elderly’ or an older person (Ministry of Health, 2010; Wang et al., 2006). An exception to this are Māori and

Pacific people, as they have a lower life expectancy that is five to ten years shorter than other New Zealanders, due to the health disparities that exist. The Māori Health Profile 2015 illustrates that Māori have significantly higher rates of heart disease and stroke, diabetes, respiratory disease, mental disorders, hospitalisations, injuries and mortalities compared to non-Māori (Robson, Purdie, Simmonds, Waa, & Rameka, 2015). For this reason Māori and Pacific people over the age of 55 years are generally considered older adults (Statistics New Zealand, 2015; Waitemata District Health Board, 2006).

Many researchers categorise old age in phases, distinguishing young-old (65-74 years), from old-old (74-84 years) and the oldest-old (85+), and have shown differences in health status between the young old and oldest old in their studies (Menec & Chipperfield, 1997; Smith, Borchelt, Maier, & Jopp, 2002). Studying older adults in phases, for example those aged 65 to 84 years or those 85+, may produce more insightful results. From a public health perspective it may help allocate resources and services accordingly.

2.1.3 Increasing Ethnic Diversity

Ethnic diversity will also be seen in the older population as proportions of Māori, Pacific and Asian groups grow (Statistics New Zealand, 2010). NZ's Māori, Pacific and Asian populations are projected to reach 810,000, 480,000 and 790,000 respectively by 2026, alongside the projected population increase of 3.47 million 'European or Other' in the same year (Statistics New Zealand, 2010). Māori, Pacific and Asian populations currently have a youthful age structure compared to NZ European, which will result in a greater momentum of growth (Statistics New Zealand, 2010). It is predicted the largest growth will be seen in the Asian population, which is expected to grow by 211 percent in 2016 (Wang et al., 2006). The populations of older Māori and Pacific people are predicted to grow by 115 and 125 percent respectively (Wang et al., 2006). Although there is a larger number of older 'European and Other', it is projected this population will have the slowest growth of only 49 percent (Statistics New Zealand, 2010; Wang et al., 2006).

Māori, Pacific and Asian people will make up a growing proportion of the overall NZ population; a likely reflection of changes in fertility, intermarriage and migration

patterns (Statistics New Zealand, 2010). With the significant increases in the proportion of older ethnic groups, health service frameworks will need to address culturally appropriate services to cater for an increasingly diverse older population.

2.2 Health Care Service and Cost Implications

A key concern with an increasing older population is the impact it will have on the demand for health care and disability services as well as health care expenditure. The process of ageing is often associated with some decline in functional and cognitive capability, mainly caused by chronic disease which disproportionately affects older adults. This contributes to disability, lower quality of life and need for on-going health care assistance compared to younger age groups (Cornwell & Davey, 2004; NZIER, 2004). The likelihood of having a disability and needing assistance increases with age (Ministry of Health, 2002). Older people are significant users of both health and disability support services, which is reflected in a higher per capita public health expenditure on these services for this group (Ministry of Health, 2002).

In NZ, expenditure on public health is funded by Vote Health and Vote Accident Compensation Corporation, and includes health expenditure on personal and mental health, disability support services and public health programmes (Ministry of Health, 2002). In 2001/02 the estimated annual per capita expenditure for people aged 65 – 74 was \$3643, \$6863 for 75-84 and \$13,568 for those aged 85+ compared to \$949 and \$1329 for age groups less than 15 years and 15 – 64 years respectively (Ministry of Health, 2002).

Overall Vote Health expenditure on the population aged 65 and over was \$2671.5 million (GST exclusive) during the 2001/02 financial year. This was around 39 percent of the total public health expenditure (Ministry of Health, 2002). As the older population increases, the share of the public health budget is projected to increase to 63 percent by 2051 (Ministry of Health, 2004).

In light of the evidence presented, it is of note that independent life expectancy has not caught up to expected life expectancy. Many older adults experience the burdens of chronic disease and disability as they age, indicating that it may not be strictly old age

that will exacerbate future health costs, but rather increasing years of poor health (Shaw, 2002).

2.3 Hospitalisation with Ageing

Older adults have distinct patterns of service use and care needs. Many older adults are high users of hospital services, pharmaceuticals and laboratory tests compared to younger age groups (Cornwell & Davey, 2004; Ministry of Health, 2002). In 2000/01, there were 170,000 medical and surgical admissions of people aged 65 years and over, which was a third of total publicly funded medical and surgical hospital admissions. Hospitalisation rates also increased at older ages, with much higher rates for adults aged 85 and over (534 per 1000) than for adults aged 65 -74 years (260 per 1000) (Ministry of Health, 2002).

Circulatory system disorders and diseases (cardiovascular disease) were the most common cause of hospitalisation in older adults aged 65-84 years, with musculoskeletal conditions being the second most common cause of admission in this age group. For older adults aged 85 and over, musculoskeletal conditions were the most likely cause of hospital admission with circulatory system disorders being the second most common (Ministry of Health, 2002).

The AT&R wards, which cater towards restoring functional ability in people with disabilities, also provide geriatric patient care and management. In 2001/02, 89 percent of hospitalisations to the AT&R wards were for people aged 65 years and over. People aged 85 and over had the highest AT&R hospitalisation rate (113 per 1000) than any other group (Ministry of Health, 2002).

2.3.1 Implications for District Health Boards in New Zealand

District Health Boards (DHB) are responsible for providing funding and provision of health care services to their district. The number of older people living in each DHB catchment varies considerably. Canterbury DHB currently have the highest number of people aged 65 years and over (62,688), closely followed by Waitemata (52,941), Waikato (42,720), Auckland (38,769) and Counties Manukau (38,148) (Ministry of Health, 2014). Older populations in DHBs are projected to grow at different rates

depending on current population structures and assumptions about fertility, mortality and net migration (Ministry of Health, 2002). It is predicted by 2021, Waitemata DHB (WDHB) will have the largest population of people aged 65 years and over (Ministry of Health, 2002).

It is inevitable that the proportion of health care resources consumed by the 65 and over age group will be substantial. DHBs will need to ensure they can cope with the demand by providing appropriate health and disability support services. Numerous health frameworks have been developed to provide health guidance in addressing the rise in the older population.

2.4 Ageing in Place

Numerous frameworks produced nationally and internationally aim to promote healthy ageing. The World Health Organisation (WHO) produced the document *Active Ageing: a Policy Framework*, which defines active ageing as ‘the process of optimizing opportunities for health, participation and security in order to enhance quality of life as people age’ (page 12)(World Health Organisation, 2002a).

Similarly in NZ, to support older people, the Ministry of Social Development created *The New Zealand Positive Ageing Strategy* in 2001(Ministry of Social Development, 2001). It aimed to improve the opportunities for older people to participate in the community in the way that they choose and viewed older people as a valuable resource. Independent and active older people who contribute to society not only benefit themselves but also the community and the country as a whole (Ministry of Social Development, 2001). The *NZ Positive Ageing Strategy* had ten goals for central and local government agencies and communities to help with achieving the vision of ageing positively. These ten aspirational goals are described below (Office for Senior Citizens, 2015):

1. Income – secure and adequate income for older people
2. Health – equitable, timely, affordable and accessible health services for older people
3. Housing – affordable and appropriate housing options for older people
4. Transport – affordable and accessible transport options for older people

5. Ageing in the Community – older people feel safe and secure and can age in the community
6. Cultural Diversity – a range of culturally appropriate services allows choices for older people
7. Rural Services – older people living in rural communities are not disadvantaged when accessing services
8. Positive Attitudes – people of all ages have positive attitudes to ageing and older people
9. Employment Opportunities – elimination of ageism and the promotion of flexible work options
10. Opportunities for Personal Growth and Participation – increasing opportunities for personal growth and community participation

The strategy not only focuses on the older individual by encouraging them to take control and act more autonomously to maintain their wellbeing, personal growth and take opportunities to contribute to society, but also aims to create supportive social environments where any ageist discrimination is eliminated by fostering positive attitudes in younger generations. This along with greater access to health care and resources will give older people opportunities to continue living safely and independently in their homes and communities (Ministry of Social Development, 2001; Office for Senior Citizens, 2015).

These frameworks strive for ageing to be a positive experience. However, many factors influence the health of older adults which need to be acknowledged (Ministry of Health, 2010). Disease states and nutritional status are major determinants of health and wellbeing and need to be considered when addressing the health concerns of older people (American Dietetic Association, 2005).

2.5 Health and Ageing

Older adults are an extremely heterogeneous group that arrive at old age with dramatic differences in nutritional, health and social status. This may range from being healthy and independent, with minimal health issues to being extremely frail and dependent with myriad of chronic diseases and disabilities.

National data illustrates many adults aged 65 years and over are more likely to be burdened by disease and disability than those of younger ages (e.g. those aged 15-64 years). Many older adults are likely to suffer from cardiovascular disease, diabetes mellitus, respiratory conditions, cancer and musculoskeletal disorders (Ministry of Health, 2010, 2015a, 2015b). These conditions can give rise to a decline in physical function, frailty and poorer quality of life (Ministry of Health, 2010).

Many factors determine the health of older people and include physiological, social and psychosocial factors (Ministry of Health, 2010). As the proportion of the older population increases, understanding the health status, the impact and burden of health conditions older people currently face, will help guide future intervention to address the increased health needs of this diverse group.

2.5.1 Chronic Diseases and Health Conditions of Older People

With increase in life expectancy and exposure to a lifetime of risk factors, older people experience a greater burden of chronic conditions and non-communicable disease (Ministry of Health, 2010). Chronic conditions and diseases are the leading cause of death in older adults (Wang et al., 2006). Ischaemic heart disease was noted as the leading cause of death for both females and males in old age according to the Older People's Health Chart Book (Wang et al., 2006). Other leading chronic diseases and conditions included stroke, chronic obstructive pulmonary disease and lung, colorectal and prostate cancers (Wang et al., 2006).

2.5.1.1 Cardiovascular Conditions

Findings from national reports illustrates older adults (65+ years) are significantly more likely to have high blood pressure and high cholesterol compared to younger adults (15-64 years) (Ministry of Health, 2015b; Wang et al., 2006). Both these are risk factors associated with cardiovascular disease (Jackson, 2000), a general term that describes a disease of the heart or blood vessels.

In the most recent NZ Health Survey, 43 percent of those aged 65-74, and 55 percent of adults aged ≥ 75 years reported taking medication for high blood pressure (Ministry of Health, 2015b). In the same age groups 13 percent, of 65-74 year olds, and 20.9 percent,

of 75+ year olds, were taking medications for high cholesterol. In comparison, in age groups <65 years of age less than 30 percent of individuals were taking medications for both high blood pressure and high cholesterol, illustrating a higher prevalence of these conditions in older adults (Ministry of Health, 2015b).

Hospitalisations and mortality rates for cardiovascular disease and ischaemic heart disease (IHD) are also significantly higher in older age groups (65+ years) (Wang et al., 2006). The prevalence of diagnosed ischaemic heart in the Health Survey for those aged 65-74 was 13.4 percent and 21 percent for those aged 75+ years (Ministry of Health, 2015b)

Cerebrovascular disease (i.e. stroke) was the third leading cause of death in 2013, after cancer and IHD for older adults (Ministry of Health, 2015d). In the 2014/15 Health Survey less than two percent of the adult population aged <65 years had experienced stroke, however the incidence steeply increased in the older age groups, particularly in those aged 75+ years (Ministry of Health, 2015b). One in twelve adults (8 %) aged 75+ previously had a stroke, which was the highest of any age group (Ministry of Health, 2015b).

Māori adults of general age (≥ 15 years) were also 20 to 80 percent more likely to have high blood pressure, high cholesterol, IHD and stroke compared to non-Māori (Ministry of Health, 2015b).

2.5.1.2 Cancer

Cancer was the leading cause of death for both males and females in 2012 (Ministry of Health, 2015c, 2015d), and refers to a group of diseases that occur when malignant forms of abnormal cell growth develop in one or more organs (Ministry of Health, 2003). In 2012, cancer registrations were largely recorded in older adults aged 65 years and older; this population accounted for nearly 60 percent of new cancer cases and at least 70 percent of cancer deaths. The most common types of cancer registrations and deaths included lung, colorectal, prostate and breast cancers (Ministry of Health, 2015c). Males aged 65 years and older had much higher rates than females, owing to prostate cancer which was the most commonly diagnosed form of cancer (Ministry of Health, 2015c).

2.5.1.3 Diabetes

The number of individuals with diabetes has increased over time, and is particularly frequent in those who are old or overweight (Ministry of Health, 2015a, 2015b).

Diabetes is a metabolic condition where the body cannot regulate its' blood glucose (sugar) levels properly, either due to the body not being able to produce insulin due to a pancreatic functional defect (termed type 1 diabetes) or due to reduced insulin secretion and insulin resistance by the body's cells (termed type 2 diabetes) (Ministry of Health, 2010). Type 2 diabetes is more common in older adults due to physiological decline (Gambert & Pinkstaff, 2006). It is also more prevalent in the general population due to overweight, physical inactivity and poor diet common in adults (Ministry of Health, 2013).

The 65-74 age range group had the highest number of adults diagnosed with diabetes. The prevalence of diagnosed diabetes in the 2014/15 Health Survey for 65-74 years was 15.4 percent, and 14.7 percent for those aged 75+ years. This included diagnoses for both type 1 and type 2 diabetes and illustrates that a high proportion of older adults are affected by this condition (Ministry of Health, 2015a).

Again, Māori adults of general age (15+ years) were disproportionately affected and were nearly twice (rate ratio: 1.81) as likely to be diagnosed with diabetes compared to non-Māori (Ministry of Health, 2015a).

2.5.1.4 Neurological Disorders

Neurological conditions are those that affect the function of the brain and nervous system. These conditions include dementia, epilepsy, Parkinson's disease, multiple sclerosis, motor neuron disease, muscular dystrophy, migraine, intellectual impairment and insomnia (Ministry of Health, 2013). In 2006, neurological conditions accounted for seven percent of health loss, which is a measure of years lost due to early death, disability, or ill health among general adults. Health loss from neurological disorders were largely due to dementia which accounted for two percent of health loss (Ministry of Health, 2013). Dementia is common in those 65 years and older but can affect those as young as 45. It was estimated 48,000 New Zealanders had dementia in 2011

(Ministry of Health, 2013). As the population ages the prevalence of and health loss attributable to dementia will likely increase.

2.5.1.6 Respiratory Disorders

Respiratory disorders affect many older adults and include a range of conditions that affect the airways, most typically in the form of airflow restriction (Ministry of Health, 2013). In 2006 respiratory conditions accounted for 6.3 percent of health loss overall. Chronic obstructive pulmonary disease (COPD) and asthma contributed the highest health loss of any other respiratory condition (3.7 % and 1.6 % respectively) (Ministry of Health, 2013).

According to the 2006/07 NZ Health Survey 6.6 percent of adults aged 45 years and older were diagnosed with COPD. This increased in older aged groups where 10 percent of adults aged 75 years and older were affected (Ministry of Health, 2008).

Older adults diagnosed with asthma (medicated) included 11.6 percent of those aged 65-74 years and 12.3 percent of those aged 75+ years. Women were more likely to have asthma than men (13 % and 9 % respectively) and Māori were 1.51 times more likely to have asthma than non-Māori (Ministry of Health, 2015a, 2015b).

2.5.1.7 Musculoskeletal Disorders

Musculoskeletal disorders affect the body's muscles, joints, tendons and ligaments. These include conditions such as arthritis, back disorders and chronic musculoskeletal pain syndromes (Ministry of Health, 2013). Arthritis (which includes osteoarthritis and rheumatoid arthritis) is the most common form of musculoskeletal disorder in older adults (Ministry of Health, 2013, 2015b). Around 32 percent of those aged 65-74 years and 39 percent of those aged 75+ years had diagnosed osteoarthritis, the highest of any age group (Ministry of Health, 2015b). Diagnosed rheumatoid arthritis and gout were also higher in older adults, but were less prevalent compared to osteoarthritis with less than 10 percent of older adults affected (Ministry of Health, 2015b).

Chronic arthritis can result in chronic pain and deformity and is a major cause of disability. In 2006, 2.2 and 1.1 percent of health loss was attributable to osteoarthritis and rheumatoid arthritis respectively (Ministry of Health, 2013).

2.5.2 Functional Health of Older People

The prevalence of disability and functional limitation rises steadily with age (MacPherson, 2014; Ministry of Health, 2002). Functional status is a term used to describe the physical abilities and limitations in activities of daily living (ADL) and instrumental activities of daily living (IADL). ADLs are basic self-care tasks and include, but are not limited to, bathing, dressing, eating, grooming, toileting and walking (Stone, 2000). IADLs on the other hand are tasks required to support an independent lifestyle and include tasks such as managing money, shopping, telephone use, travel in community, housekeeping, preparing meals and taking medications correctly (Stone, 2000).

Good functional status (and functional health) is the ability of an individual to perform normal daily activities required to meet basic needs, fulfil usual roles, and maintain health and well-being (Leidy, 1994; Wilson & Cleary, 1995). The maintenance of functional status is important for independence, quality of life, and decreased morbidity and mortality in older people (Stuck et al., 1999).

2.5.2.1 Disability

When functional status declines, the likelihood of getting a disability increases. Disability refers to ‘an impairment or limitation that may be physical, sensory, neurological, psychiatric or intellectual’ (page 155)(Ministry of Health, 2013). A likely consequence of increasing disability with age, is an increase in the number of older adults requiring hospital and residential care support (Ministry of Health, 2013).

In NZ, the 2013 Disability Survey showed 59 percent of people aged 65 or over were identified as having a disability. This was nearly triple the prevalence compared to adults under 65 years, which was 21 percent (Statistics New Zealand, 2014a). Older women had slightly higher rates of disability than men (60 % vs 58 % respectively). Māori were also noted to have a higher rate of disability (32 %) and prevalence (26 %)

compared to non-Māori general adults, whose rate of disability was 27 percent and had a prevalence of 24 percent (Statistics New Zealand, 2014a).

The most common type of disability in older adults was physical impairment. This affected 49 percent of those 65 years and older. Ranked second was sensory impairment, notably hearing and vision impairment, where 11 percent had vision impairment which could not be eliminated with glasses (Statistics New Zealand, 2014a).

Older adults with disability may require the need for more assistance, health care support and specialised equipment. Poor functional health and disability can also negatively impact nutritional status (Guigoz, 2006). Older adults who have limited functional health or disability may struggle with food procurement, preparation or consumption (Sharkey, 2002).

Summary

Many people may develop chronic disease and disability as part of the ageing process, and a large number of older adults are likely to have multiple health conditions. These conditions may negatively impact health and jeopardize independency. Chronic disease and disability can be lifelong and further complications may arise if not managed well.

Even at old age, risk factors for chronic disease remain influential and modifiable however. The root cause of many health conditions in older adults are the dietary and lifestyle choices made over a lifetime (Ministry of Health, 2010). Older adults adopting an active lifestyle, optimal dietary habits and avoiding tobacco use may experience greater health benefits (World Health Organisation, 2002a). Hence, nutrition deserves special attention in old age as good nutrition may significantly reduce, or even postpone chronic disease and its consequences (American Dietetic Association, 2005; Ministry of Health, 2010).

The next part of the literature review will look at how nutrition and nutrition risk factors play a key role in the health of older adults.

2.6 Nutrition and Ageing

Nutrition is one of the major determinants of successful ageing. Optimal nutrition not only has an important influence on independence and physical well-being but also contributes to one's social, cultural, and psychological quality of life (American Dietetic Association, 2005; Ministry of Health, 2010). Nutrition can either have beneficial or negative effects on the ageing process. Good nutrition is widely promoted because it can lower the risk of chronic disease, prevent disability and support cognitive and physical function (American Dietetic Association, 2005; Ministry of Health, 2010).

Nutrients are involved in the many processes of the body. Without them the human body cannot work as effectively or efficiently (Ministry of Health, 2010; University of Otago and Ministry of Health, 2011). Because nutrients are vital for well-being, dietary guidelines were developed to help individuals achieve optimal nutrient intake. As dietary patterns are made up of food and fluid, the guidelines are based around consumption of various food groups as opposed to single nutrients. Food and nutrition guidelines also vary according to different age groups (Ministry of Health, 2010; University of Otago and Ministry of Health, 2011).

2.6.1 Dietary Guidance for Older Adults

The Food and Nutrition Guidelines for Healthy Older People was developed by the Australian National Health and Medical Research Council and the NZ Ministry of Health (MoH). It outlined up-to-date recommendations on food and nutrition intake for achieving and maintaining the best possible health for older people (Ministry of Health, 2010; National Health and Medical Research Council, 2006). Healthy food and nutrition are essential at old age and older adults who meet their recommended dietary guidelines will be providing themselves the nutrients required to maintain good health, function and quality of life (Ministry of Health, 2010). **Table 1** and **Table 2** below show the nutritional and food group recommendations for older adults adapted from the *Food and Nutrition Guidelines for Healthy Older People* by the MoH (Ministry of Health, 2010).

Table 1.*Nutrient Reference Values for Older New Zealand Adults*

Nutrient	Women Aged 51-70 Years	Women Aged >70 years	Men Aged 51-70 Years	Men Aged >70 years
Macronutrients				
Protein (g/day)	46	57	64	81
Fat (g %/day)‡	20-35	20-35	20-35	20-35
Carbohydrate (g %/day)‡	45-60	45-60	45-60	45-60
Fibre (g/day)	25 (AI)	25 (AI)	30 (AI)	30 (AI)
Micronutrients				
Calcium (mg/day)	1300	1300	1000	1300
Vitamin D (µg RE/day)*	10 (AI)	15 (AI)	10 (AI)	15 (AI)
Iodine (µg/day)	150	150	150	150
Folate (µg DFE/day)	400	400	400	400
Zinc (mg/day)	8	8	14	14
Vitamin B12 (µg/day)	2.4	2.4	2.4	2.4
Sodium (mg/day)	460-920 (AI)	460-920 (AI)	460-920 (AI)	460-920 (AI)
Potassium (mg/day)	2800 (AI)	2800 (AI)	3800 (AI)	3800 (AI)

AI = adequate intake; RE = retinol equivalent; DFE = dietary folate equivalent

* Assumes minimal sun exposure

‡ Approximate percentage of total daily energy intake

(National Health and Medical Research Council, 2006)

Energy

Energy is required to maintain metabolic processes, physiological functions, muscular activity, growth and production of new cells. Energy comes from all foods, in the form of macronutrients which include carbohydrates, protein, fat and alcohol (University of Otago and Ministry of Health, 2011).

Energy requirements for each individual vary and is dependent on gender, body size and physical activity. Older adults generally have lower energy requirements than the average adult due to changes in body composition and a lower basal metabolic rate (Ministry of Health, 2010; World Health Organisation, 2002b). Older adults who do not meet their energy requirements may become at risk of losing weight, affecting their health status and independence (Ministry of Health, 2010).

Micronutrients

Micronutrients are dietary components, referred to as vitamins and minerals. Although required in small amounts they have very important roles in the prevention and modulation of chronic disease, tissue growth and development and cell structure integrity. Micronutrients are also involved in influencing fluid balance, metabolic functioning and in regulatory processes (Broadley, Brown, Çakmak, Rengel, & Zhao, 2011; Shenkin, 2006). Nutritional deficiency can result in biochemical or physiological consequences, but fortunately are recognisable and treatable if managed early (Shenkin, 2006).

Table 2.*The Four Food Groups: Advice on Servings and Nutrients for Healthy Older Adults*

Food Group	Advice	Nutrients Provided
Vegetables and fruit (includes fresh, frozen, canned and dried)	Eat at least 5 servings per day: at least 3 servings of vegetables and at least 2 servings of fruit.	<ul style="list-style-type: none">- Carbohydrates- Dietary fibre- Vitamins: especially folate, vitamin A (yellow and green vegetables) and vitamin C (dark-green vegetables and most fruit, potatoes)- Minerals: magnesium, potassium
Breads and cereals (includes breakfast cereals, breads, grains, rice and pasta)	Eat at least 6 servings per day (preferably wholegrain breads and cereals)	<ul style="list-style-type: none">- Carbohydrates- Dietary fibre- Protein- Vitamins: all B group (except B12), E (rich in wheatgerm)- Minerals (particularly in wholegrain breads and cereals): magnesium, calcium, iron, zinc and selenium
Milk and milk products (includes milk, cheese, yoghurt and ice-cream) and alternatives	Eat at least 3 servings per day	<ul style="list-style-type: none">- Protein- Fats- Vitamins: riboflavin, B12, A, D- Minerals: calcium, phosphorus, zinc and iodine
Lean meat, poultry, seafood, eggs, nuts and seeds, and legumes	Eat at least 1 serving per day	<ul style="list-style-type: none">- Protein- Fats- Vitamins: B12, thiamin, niacin,- Minerals: iron, zinc, magnesium, copper, potassium, phosphorus and selenium, iodine

(Ministry of Health, 2010)

2.6.2 Nutritional Health of Older People

As indicated by the most recent NZ survey on the health and nutrition of the population, many older adults struggle to meet their nutritional requirements (Ministry of Health, 2015a, 2015b), which may be due to age-related changes that interfere with optimal food intake (Ministry of Health, 2010). Nutritional intake in the NZ Health Survey of 2014/15 and the 2008/09 NZ Adult Nutrition Survey was collected by face-to-face interview using 24 hour data, dietary recalls and questionnaires to assess dietary habits and dietary supplement use. However the data are aggregated for all older people aged over 70 years and over 55 years for Māori and may not reflect the food habits of the oldest old. Similarly with limited data available the NRVs for Australia and NZ are based on extrapolation from younger age groups (National Health and Medical Research Council, 2006).

Nevertheless, it is valuable to observe the dietary trends of older people. These are discussed below in more detail.

Vegetables and Fruit

The NZ 2014/15 Health Survey found 70 to 78 percent of older adults aged 65 years and over met the recommended intake of vegetables, and 62 to 64 percent met the recommendations for fruit intake (Ministry of Health, 2015b). This suggests 22 to 38 percent of older adults struggle to meet the recommendation of having five or more fruits and vegetables daily. Nutrition surveys show overtime, fewer general adults are meeting the guidelines for fruit and vegetables. The recent health survey indicated only 40 percent met the guidelines in 2014/15 compared to 43 percent in 2006/07 (Ministry of Health, 2015b).

Breads and Cereals

In the NZ 2008/09 Adult Nutrition Survey, bread and cereals were the main source of energy for older adults. Older adults were also more likely to consume whole grain bread than any other age group. Seventy-two percent of males and 78 percent of females aged 71+ chose this type of bread compared to 43.8 percent of males and 46.7 percent of females aged 15-64 years (University of Otago and Ministry of Health, 2011).

Milk and Milk Products

Older adults were more likely to consume reduced-fat or trim milk than other types of milk. Forty-nine percent for males and 59.3 percent for females aged 51-70 years consumed reduced-fat or trim milk. Those aged 71+ years had a higher percent with 55.8 percent of males and 61.8 percent of females choosing this type of milk (University of Otago and Ministry of Health, 2011). Notably for frail older adults, it is suggested they have full-fat or standard milk and milk products to help meet their nutritional requirements (Ministry of Health, 2010).

Meat and Meat Products

Older adults were more likely to have red meat 3-4 times per week (42 % to 50.4 %) and chicken 1-2 times per week (56.4 % to 61.1 %). Fresh or frozen seafood was the most common type of seafood consumed (versus battered or canned), with 41.6 to 54.6 percent of older adults consuming fresh or frozen seafood at least once per week (University of Otago and Ministry of Health, 2011)

Other Dietary Trends

Older adults aged 51+ were more likely to eat breakfast daily, regularly remove excess fat from meat, choose low- or reduced-fat and low- or reduced-salt varieties of foods and were less likely to consume takeaway meals compared to younger age groups (University of Otago and Ministry of Health, 2011).

2.7 Malnutrition

Malnutrition is a consequence of being poorly nourished. As defined by the British Association for Parenteral and Enteral Nutrition, malnutrition is 'a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein and other nutrients causes measurable adverse effects on tissue/body form (shape, size and composition), function and clinical outcome' (page 1). Malnutrition can refer to both 'overnutrition' (obesity) and 'undernutrition' (British Association for Parenteral and Enteral Nutrition, 2012).

2.7.1 Overnutrition

Overnutrition, or obesity, was present in 37.2 percent of those aged 65-74 years in the recent NZ Health Survey. This age bracket had the second most number of obese people. Although this trended downwards with increasing age as only 25.4 percent of those aged 75+ were obese (Ministry of Health, 2015b).

Obesity has significant impacts on health. Those that are obese have increased risk of a number of diseases and conditions including type 2 diabetes, cardiovascular diseases, several cancers, gout, sleep apnoea, infertility and musculoskeletal problems (such as osteoarthritis) (Ministry of Health, 2015e).

Obesity is a consequence of many factors at old age. Lack of physical activity can contribute to obesity in older adults, as well as social factors such as income and education levels which influence food choice and accessibility to healthy food. Additionally, physiological and metabolic changes in old age can also impact body composition which may be an important factor (Ministry of Health, 2010). Fortunately many of these factors are modifiable and changes such as being more active and consumption of healthier food options will reduce health complications related to obesity (Ministry of Health, 2010).

2.7.2 Undernutrition

Undernutrition, which is synonymously referred to as malnutrition, is more common in older adults. National studies found 20 to 50 percent of hospitalised older adults are malnourished, and up to 70 percent are at risk of malnutrition (Goldstraw, 1998; Hanger et al., 1999; van Lill, 2002). This is also apparent in the community where Wham et al. (2011) found 31 percent of older adults aged 80 to 85 years were at high risk of malnutrition (C. Wham, Carr, & Heller, 2011).

Malnutrition has serious consequences which include loss of muscle mass, reduced strength, impaired immune function and wound healing, impaired cognition and psychological issues (such as depression), longer length of hospital stay, higher treatment costs and increased mortality (Correia & Waitzberg, 2003; Saunders, Smith, &

Stroud, 2010). These consequences can further deteriorate health status creating a negative cycle of poor health.

Malnutrition results from inadequate energy and nutrient intake to meet dietary requirements (American Dietetic Association, 2005). Nutritional health in older people is complex and multi-factorial. Malnutrition is an exacerbation of nutrition risk, a state which can be influenced by a number of factors. Understanding the range of factors (presented in **Figure 2**) that contribute to the nutritional health of older people will aid in the development of strategies that prevent or treat the burden of malnutrition. This will result in improved well-being for older people (Public Health Advisory Committee, 2005).

2.8 Factors Affecting the Nutritional Health of Older People

The following section will review the factors that play a role in the nutritional health of older adults.

Figure 2 is taken from the *Food and Nutrition Guidelines for Healthy Older People* by the MoH (page 11)(Ministry of Health, 2010), and illustrates the wide range of factors influencing nutritional status.

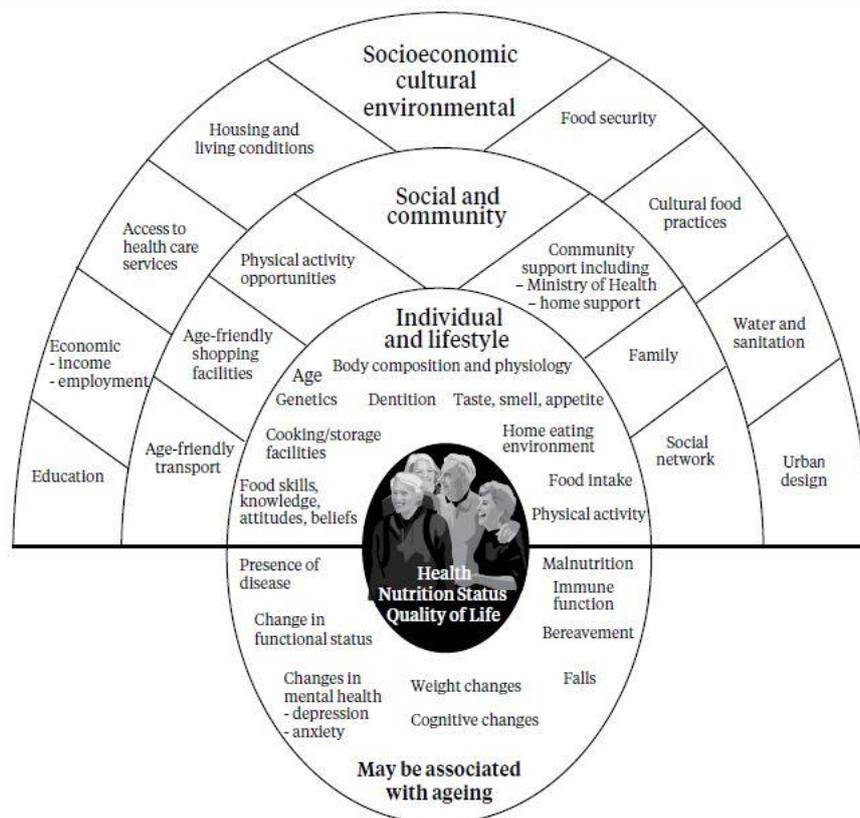


Figure 2. Factors contributing to nutrition-related health (Ministry of Health, 2010)

2.8.1 Health Factors and Nutrition Risk

2.8.1.1 Changes in Body Composition

One of the most notable physical changes that occurs as one ages is the loss of lean body mass (skeletal muscle and bone) with a relative increase in fat mass over time (World Health Organisation, 2002b). Muscle mass is reported to decline at approximately one percent per year after the age of 30, and continues at a similar rate (1-2 %) after 50 years (von Haehling, Morley, & Anker, 2010). An approximate 30 percent reduction in muscle mass is experienced over the age span from 20 to 80 years (Frontera et al., 2000). However, this does not necessarily result in weight loss as decreased muscle mass is offset by an increase in fat mass (International Working Group on Sarcopenia, 2011; Ministry of Health, 2010). This age associated loss of muscle mass is commonly referred to as sarcopenia (von Haehling et al., 2010). Sarcopenia has important functional consequences including reduced strength, physical disability, and abnormalities in gait and balance which all increase risk of fall and related injuries (International Working Group on Sarcopenia, 2011).

The exact cause of sarcopenia is unknown, however it is prevalent in older populations and may be age-related ('primary' sarcopenia), or may be considered 'secondary' sarcopenia when other causes are evident, such as sedentary lifestyle, presence of disease condition or poor diet (Cruz-Jentoft et al., 2010).

A wide range of techniques can be used to assess body composition, these include as body imaging techniques, bioelectrical impedance analysis and anthropometric measures (Cruz-Jentoft et al., 2010). Body imaging techniques such as computed tomography (CT), magnetic resonance imaging (MRI) and dual energy x-ray absorptiometry (DEXA) are considered the gold standard for analysing body composition as the precise imaging systems can distinguish fat mass from fat-free mass. However, the major drawbacks are that they are expensive, time consuming and not portable, limiting their practicality in some research scenarios (Cruz-Jentoft et al., 2010; Svendsen, Haarbo, Heitmann, Gotfredsen, & Christiansen, 1991).

Bioelectrical Impedance Analysis (BIA) estimates volume of fat and muscle body mass in an individual. A drawback is that results can be affected by hydration status which can produce large margins of error. However, the BIA test is inexpensive, easy to use, portable and some models can also assess bedridden participants, making it a good alternative to body imaging techniques. (Cruz-Jentoft et al., 2010; Deurenberg, 1996).

Anthropometric measures include assessments of the body such as mid-upper arm circumference and skin fold thickness. Their major limitation is that they cannot distinguish fat mass from fat-free mass and are highly vulnerable to errors from age-related changes in fat deposits and loss of skin elasticity in older people, making it the least appropriate body composition test in older adults (Cruz-Jentoft et al., 2010; Svendsen et al., 1991).

2.8.1.2 Muscle Strength (Grip Strength)

Along with a decrease in muscle body mass with ageing, a parallel decrease in muscle strength is also seen with an annual decline of 1.5 percent between ages 50 and 60 and by three percent thereafter (von Haehling et al., 2010). Low grip strength is prevalent in older adults (Taekema, Gusekloo, Maier, Westendorp, & de Craen, 2010), and is a clinical marker for poor mobility and predicts a decline in ability to perform ADLs (Cruz-Jentoft et al., 2010). Reduction in both muscle mass and strength can predispose an individual to poor functional health. Older adults who have limited functional health or disability may struggle with food procurement, preparation or consumption (Sharkey, 2002) giving rise to poor nutritional status (S. Lee, Frongillo, EA., 2001).

Testing grip strength is an easy and reliable method of assessing muscle strength, which has also shown to correlate well with lower extremity muscle power (Cruz-Jentoft et al., 2010). The Jamar hydraulic dynamometer is the most commonly used, reported and recommended measure of grip strength (Innes, 1991). Variations in the testing position when using the same instrument can influence results; therefore the standing testing position approved by the American Society of Hand Therapists is widely used. This allows consistency and standardisation of testing procedures (Innes, 1991). This testing procedure is described in the 'methods' section of this paper.

Investigating body composition of older adults is necessary and can provide valuable information. Knowing the extent of decline in muscle mass and distribution of fat mass in a population of older adults can help guide interventions revolved around building muscle mass and strength.

2.8.1.3 Polypharmacy

As the number of health issues increases with age, so does the number of medications used to treat those ailments. Polypharmacy, which is the concurrent use of five or more prescribed medications, is common in older adults and rises in frequency with age (Health Quality & Safety Commission New Zealand, 2015; Heuberger, 2012). The Health Quality & Safety Commission NZ reports that on average, 35 percent of adults aged 65 years and older are prescribed five or more long-term medications. Polypharmacy is present in 26 percent of those aged 65-74 years and 56.6 percent of those aged 85+. Those aged 85+ were also more likely to have 11+ long term medicines than those aged 65-74 years (Health Quality & Safety Commission New Zealand, 2015).

Polypharmacy puts older adults at risk of food-drug interactions. This can result in possible side effects including loss of appetite, nausea and vomiting, as well as affecting nutriture (Heuberger, 2012). With use of frequent multiple medications in old age, many older adults may be at increased risk of poor nutrition status.

2.8.1.4 Dental Status

Oral health is important for good nutrition. The ability to chew food requires adequate teeth or dentures and saliva flow. Those with either missing teeth, or ill-fitting dentures, are more likely to restrict consumption of variety of food putting them at poor nutrition risk (Mann, Heuberger, & Wong, 2013; Ministry of Health, 2010; Sheiham & Steele, 2001).

In a study looking at the impact of dental status and the consumption of food, results showed those who were edentulous (have few natural teeth) had significantly greater difficulty eating foods than those who were dentate (have all natural teeth). A variety of foods were reported difficult to eat or were not eaten by those who were edentulous including apples (50 %), nuts (42 %), raw carrots (41 %), steak (33 %) and tomatoes

(20 %) (Sheiham & Steele, 2001). In their 2013 study, Mann et al. (2013) found that older adults with chewing and swallowing difficulties tended to have an insufficient intake of fibre, potassium, calcium, magnesium, vitamins D, E and K and other nutrients and were on average 44.9 percent below their recommended nutrient intakes (Mann et al., 2013).

2.8.1.5 Dysphagia

Age-related changes in swallowing physiology and function (such as reduced muscle mass and strength) and underlying disease are thought to give rise to dysphagia in older adults (Sura, Madhavan, Carnaby, & Crary, 2012). Dysphagia refers to disorders or difficulty with swallowing, and is characterised by abnormality in the transfer of bolus from the mouth to the stomach (Sura et al., 2012).

Swallowing disorders are prevalent within the ageing population and increase with age (Sura et al., 2012). In a study by Serra-Prat et al (2011), dysphagia was present in 27 percent of independently living older people, and became more common with age where prevalence was 17 percent in those aged 70-79 compared to 33 percent in those aged 80+ years (Serra-Prat et al., 2011).

A study by Lee et al. (1999) found approximately 30 percent of older hospitalised patients had dysphagia on admission, however only 7.1 percent of patients had a history of swallowing impairment prior to hospitalisation (A. Lee, Sitoh, Lieu, Phua, & Chin, 1999). In a single US tertiary hospital, dysphagia referral rates among the elderly increased by 20 percent from 2002-2007. Over 70 percent of referrals were for those over 60 years old, of which 42 percent were for those aged 80+ years (Leder & Suiter, 2009).

Age-related adverse health conditions experienced by older adults can also impact swallowing function. It was found dysphagia is more common in those with neurological disease (such as stroke and dementia), cancers of the head, neck and oesophagus, progressive diseases (such as Parkinson's disease) and metabolic deficits (Sura et al., 2012)

Dysphagia is associated with increased mortality and morbidity (Miller & Patterson, 2014; Sura et al., 2012). Severe dysphagia poses the immediate risk of choking and possible death, while lesser forms are associated with a range of other negative factors including increased risk of undernourishment, development of aspiration pneumonia and longer length of hospital stay (Leder & Suiter, 2009; A. Lee et al., 1999; Miller & Patterson, 2014; Sura et al., 2012).

Dysphagia also has significant social and psychological impacts. Some individuals report fear of choking when eating alone and consequently avoid, reduce or alter their oral intake. Others avoid eating in social settings due to anxiety or embarrassment related to being dysphagic (Martino, Beaton, & Diamant, 2010; Miller & Patterson, 2014).

Prompt screening is key to identifying and managing those at risk of or currently presenting with dysphagia to prevent further complications. In a setting where dysphagia was routinely screened for, there was lower incidence of pneumonia and reduced length of stay in hospital (Hinchey et al., 2005). Many dysphagia screening tools are available, but only three are validated which include the SWAL-QOL, the MD Anderson Dysphagia Inventory (MDADI) and the Eating Assessment Tool (EAT-10) (Belafsky et al., 2008; Miller & Patterson, 2014). Unfortunately, the SWAL-QOL (a 44 item tool which involves both patient and clinician input) is slow and complicated to complete, and the MDADI is specific for dysphagic patients with head or neck cancers limiting its use within the general population (Belafsky et al., 2008; Miller & Patterson, 2014).

The EAT-10 is a self-administered, symptom-specific measurement for dysphagia. It consists of ten questions, each of which is scored out of four (with zero being no problem and four being a severe problem). Those who score three or greater are considered to be at risk of dysphagia. The tool is simple and quick to use, and has shown to be reliable, consistent and valid in identifying dysphagia in a range of individuals, including older adults (Belafsky et al., 2008; Miller & Patterson, 2014). This makes the EAT-10 a more suitable screening tool in a clinical setting.

2.8.1.6 Cognition in Old Age

As individuals age, many suffer from a decline in cognitive function and experience

mental health issues which can affect autonomy, independence and quality of life. The signs and symptoms of cognitive impairment can include memory loss, language difficulties, impaired judgement, confusion, changes in mood and personality and impairment in executive function (Petersen, 2004; Ragdale, 2014). These signs and symptoms are exacerbated in advanced cognitive impaired states such as severe dementia (Petersen, 2004).

Dementia, defined as significant memory impairment and loss of intellectual functions, affects 48,182 New Zealanders (one percent of the country's total population), and sharply rises with age (Deloitte Access Economics, 2012). In Australasia, dementia affected 6.4 percent of people aged 60 and older in 2009 (Deloitte Access Economics, 2012). Those with dementia or Alzheimer's disease (a type of dementia) are more likely to be at risk of or already malnourished due to refusal or forgetting to consume meals, inability to perform tasks such as shopping, cooking or eating meals or have poor or erratic eating patterns (Gonzalez-Gross, Marcos, & Pietrzik, 2001; Keller et al., 2008). As evidenced by a Swedish study of community living older adults, those with moderate or severe cognitive ability were more likely to be malnourished (11.3 %) than have normal nutrition status (3.6 %) (Fagerström, Palmqvist, Carlsson, & Hellström, 2011). Nutrition education programmes for caregivers looking after those with cognitive impairment seem to be the best way to improve nutrition status, as those with cognitive impairment may be unable to nutritionally support themselves (Keller et al., 2008).

Various tools have been developed which can screen for cognitive impairment and identify patients in an impaired cognitive state (Mitchell, 2009; Nasreddine et al., 2005). The Mini Mental State Examination (MMSE) is most commonly used to detect dementia in older adults (Mitchell, 2009). It scores individuals out of a possible 30, where scores of 26 and below indicate cognitive impairment. However, it fails to accurately detect mild cognitive impairment (MCI) as many individuals score above 26 even with MCI (Nasreddine et al., 2005). MCI precedes more advanced impaired cognitive states such as dementia and is likely to give rise to them (Solfrizzi et al., 2004). Detection and management early in the disease process can lead to improved prognosis and reduced morbidity. For this reason, tools that detect MCI may have better clinical utility (Nasreddine et al., 2005).

The Montreal Cognitive Assessment (MoCA) was developed to detect MCI or early stages of dementia. It assesses several cognitive domains including; attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations and orientation. In a validated study it was found to be reliable and have excellent sensitivity to identify those with MCI (Nasreddine et al., 2005). In the study by Nasreddine et al (2005), the sensitivity of MMSE to detect MCI was 18 percent, whereas the MoCA detected 90 percent of MCI subjects. The specificity and sensitivity to detect Alzheimer's disease by the MoCA was 87 percent and 100 percent respectively. The MoCA is simple to use and can be performed within 10 minutes, making it suitable to administer in a clinical setting (Nasreddine et al., 2005).

2.8.2 Social Factors and Nutrition Risk

2.8.2.1 Marital Status and Living Situation

Eating is a social activity, and those who eat with others have enhanced nutrient intake and diet quality (American Dietetic Association, 2005). It was found older adults would consume 23 percent more food when dining with family or friends and had wider dietary variety (American Dietetic Association, 2005). A study by Schafer et al (1999) found food interactions (e.g. eating or cooking together) within a family to be associated with a more healthful diet (such as a lower fat intake for men eating with their partners). This may be a result of sharing nutrition information and encouragement of better eating habits from food-related interaction between marital partners (Schafer, Schafer, Dunbar, & Keith, 1999).

Unfortunately, many older adults live on their own. In 2013, 44 percent of older New Zealanders (aged 65+ years) lived alone, with slightly more older women (69 %) than men (31 %)(Koopman-Boyden & Moosa, 2014). Females have a higher life expectancy and live longer than men, which may explain the disproportionate number of older women living alone (Koopman-Boyden & Moosa, 2014; Statistics New Zealand, 2015).

Loneliness can have a negative effect on food intake and is associated with increased nutritional risk. It may lead to decreased food intake through decreased motivation to eat, forgetfulness in consuming meals, or lack of skill in shopping and preparing

balanced meals (American Dietetic Association, 2005; Ministry of Health, 2010; Schafer et al., 1999). In an NZ study in community living older adults 82 percent of participants lived alone. It was found that participants who lived alone and reported feelings of loneliness were at higher nutrition risk (C. Wham et al., 2011). In a study of hospitalised older adults in Australia, those who lived alone were 1.47 times more likely to be 'not well nourished' than those who lived with company (Visvanathan et al., 2003).

This illustrates that social support and living situation influence nutritional outcomes for older adults and explains why the NZ dietary guidelines for older people includes 'take opportunities to eat with others' (page 6) as a key guideline (Ministry of Health, 2010).

2.8.2.2 Income

Income can impact food choices and the ability to purchase food which can influence nutritional status. Limited money or low income mean older people are forced to choose foods they may not like because they are cheaper, it can also impact affordability of suitable transport to access groceries or visit food stores and restaurants (Locher et al., 2005). Wylie et al. (1999) found that older adults with insufficient money were less likely to purchase foods such as chicken, fish or fruit (Wylie, Copeman, & Kirk, 1999), which is important because older adults have higher requirements for protein (found in such foods as chicken and fish) for maintaining muscle mass and strength at old age (Ministry of Health, 2010).

Older adults with limited budget may consequently skip or have smaller meals, resulting in inadequate food intake (Guthrie & Lin, 2002; Wylie et al., 1999). Several studies have found lower-income adults had significantly lower energy intake and ate smaller number of total servings of all food groups, including grains, fruits, vegetables, meat and dairy products compared to high-income counterparts (Bowman, 2007; Guthrie & Lin, 2002), which has nutritional risk implications.

2.8.2.3 Education Level

It is thought that educated older adults may make better informed decisions about the nutritional quality of their diet and be more aware of the effects of diet upon their

health (Locher et al., 2005). Having nutrition related knowledge may result in better decisions regarding food, and in having better practical food skills (Hughes, Bennett, & Hetherington, 2004; Locher et al., 2005). In a study by Hugh et al (2004), older men with good cooking skills (those who could cook several dishes and had a grasp on several cooking techniques) reported better physical health and consumed more vegetables than men with poorer cooking skills (Hughes et al., 2004).

It is likely those who lack education may have limited food choices and inability to improve their dietary behaviour and therefore be at nutritional risk (Caraher, Dixon, Lang, & Carr-Hill, 1999). In a study by Saeidlou et al. (2011), 82.4 percent of older adults who were illiterate were malnourished compared to 17.6 percent of literate older adults (Saeidlou, Merdol, Mikaili, & Bektaş, 2011).

2.8.2.4 Support Services

To support older adults living independently within their homes, home support services funded through the government or privately are available to assist with ADLs and quality of life (Ministry of Health, 2011). As noted previously, many older adults in NZ have disabilities and experience a decline in functional status (Ministry of Health, 2013). In a study by Wham et al. (2011), 67 percent of older adults aged 80 to 85 years living independently had some level of disability which resulted in a need for assistance with daily tasks such as housework, shopping, meal preparation and personal cleaning and dressing. Those with higher disability scores which indicated need for assistance with ADLs were at greater nutrition risk (C. Wham et al., 2011).

Support services, such as Meals on Wheels (MoW), have shown to improve nutritional status (Ministry of Health, 2011). In an intervention study by Kretser et al (2003), there was an improvement in nutrition status among the majority of patients who received MoW support with greater improvement in those receiving 21 weekly meals compared to participants receiving only 5 meals per week over a 6 month duration (Kretser, Voss, Kerr, Cavadini, & Friedmann, 2003). Older adults who live independently but struggle with daily tasks are at greater nutrition risk and therefore may benefit from support service input.

2.8.2.5 Assessing Nutrition Risk Status

Change in nutritional status in older adults is not often recognised until more severe physical and biochemical signs are present, and so malnutrition is thought to be under-recognised and under-treated in older adults (Goldstraw, 1998; Guigoz, 2006; The Dietitians Association of Australia, 2009). Screening tools provide an effective method for identifying those at risk of malnutrition or those who are malnourished (Green & Watson, 2006; The Dietitians Association of Australia, 2009).

Nutrition risk needs to be addressed by nutrition therapy, it is then important those at nutrition risk are identified correctly. Identification with screening tools and treatment administered by health professionals at early stages of nutritional risk is effective in producing better health outcomes (Kondrup, Allison, Elia, Vellas, & Plauth, 2003; Saunders et al., 2010). Early treatment and management can prevent progression to a more severe malnourished state (Saunders et al., 2010).

To detect those with compromised nutritional status, several validated tools have been developed and are widely used in clinical setting. The Mini Nutritional Assessment (MNA) is the most extensively evaluated screening tool which has been validated in older adults (Guigoz, 2006; Vellas et al., 1999).

The MNA is composed of simple measurements and brief questions that include assessments in four domains; anthropometry, lifestyle, dietary and self-perception of health and nutrition. Scores which are summed from the questionnaire distinguish those with adequate nutritional status ($MNA \geq 24$), those at risk of malnutrition ($MNA 17-23.5$) and those who are undernourished ($MNA < 17$) (Vellas et al., 1999). Low scores on the MNA are predictive of adverse outcomes in hospitalised patients including longer length of hospital stay and a threefold increase in mortality (Guigoz, 2006).

The MNA has a high sensitivity of 96 percent and specificity of 98 percent to detect undernutrition. Sensitivity refers to the ability to detect undernutrition in those who actually are undernourished, and specificity is the ability to give a negative result in those who actually are not undernourished. This ensures the nutritional health of individuals is identified correctly. The test is also simple, reliable and reproducible (results obtained are consistent with use by different investigators) (Guigoz, 2006).

Although it meets the desired features of an effective screening tool, it takes around 10-15 minutes to administer (Vellas et al., 1999). This can be considered lengthy and potentially impractical to undertake routinely in busy clinical wards, which is partly why a shorter form, the MNA-Short Form (MNA-SF), was developed (Rubenstein, Harker, Salva, Guigoz, & Vellas, 2001).

The MNA-SF consists of six items and includes questions on decline in food intake, weight loss, mobility, psychological stress and acute disease, neuropsychological problems and body mass index (BMI) (or alternatively calf circumference) measurement (Kaiser et al., 2009; Rubenstein et al., 2001). In older patients who cannot stand or be weighed, calf circumference can alternatively be measured instead of BMI, which means those who are bedridden can still be assessed. Scores are summed and indicate either that the individual is 'malnourished' (0-7 points), 'at risk of malnutrition' (8-11 points) or has 'normal nutritional status' (12-14 points). The MNA-SF can be administered in less than five minutes yet still retains the validity and accuracy of the full MNA. It has a sensitivity of 97.9 and specificity of 100 percent in assessing nutritional status (Kaiser et al., 2009; Rubenstein et al., 2001).

The MNA-SF is highly correlated to the full MNA (Kaiser et al., 2009). In their validation study Kaiser et al (2009), cross-referenced the MNA-SF against the full MNA. It was found that 79.9 percent of cases were classified correctly. The study used twelve data sets containing information on 2032 older adults from Asia, Australia, Africa and Europe from varied clinical and community settings. This provides evidence that the MNA-SF is an effective and efficient stand-alone nutritional screening tool for older adults for use in a range of settings and among different ethnic groups (Kaiser et al., 2009).

Summary

Nutrition plays a key role in successful ageing. However, a myriad of factors influence nutritional status and unfortunately many hospitalised older adults are at risk of malnutrition or are malnourished. Utilizing screening tools such as the MNA-SF provide an effective and efficient assessment of nutritional health, which easily identify those that require nutrition therapy.

National studies that have assessed nutritional status of hospitalised older adults are at least a decade old, and since then *The NZ Positive Ageing Strategy* has been implemented which may have influenced the health of older adults. The nutritional status of older adults described in past studies may therefore be out dated. There is a need and an opportunity to add to this research and to look at an updated prevalence of nutritional risk and any current risk factors associated with it in the demographic of older adults.

Chapter 3: Methods

3.1 Aims and Objectives

3.1.1 Aim

The aim of the study was to investigate the prevalence of nutritional risk and potential associated risk factors including dysphagia risk, muscle mass and hand grip strength, of young- older adults (65-84 years old) admitted within five days to the AT&R wards of WDHB hospitals.

3.1.2 Objectives

1. To investigate nutrition risk prevalence using the Mini Nutritional Assessment – Short Form (MNA-SF) Tool
2. To investigate dysphagia risk prevalence using the Eating Assessment Tool -10 (EAT-10) Questionnaire
3. To assess muscle mass using bioelectrical impedance analysis in hospitalised older adults aged 65-84 years (or 55 to <85 years if of Māori or Pacific ethnicity)
4. To determine muscle strength using hand grip dynamometer in this population group
5. To explore associations between nutrition risk prevalence and relevant physiological and socio-demographic risk factors in this population group

3.2 Study Design

This research is a collaboration project between Massey University and WDHB and is a cross-sectional, observational study as part of a multicentre prospective study in which a non-randomised convenience sample was collected between June and September 2015 (12 weeks).

3.3 Setting

The study was conducted in the AT&R wards, which included Muriwai ward at Waitakere Hospital and wards 14 and 15 at North shore Hospital. Both these hospitals

are located in Auckland, NZ and are under the management of WDHB. The AT&R wards incorporate geriatric medicine and rehabilitation services for older adults with the aim of improving both physical and mental functioning of patients (Ministry of Health, 2002). The care and rehabilitation process for older people are provided by a group of health professionals, including doctors, nurses, occupation therapists, physiotherapists, social workers, speech and language therapists, dietitians and needs assessors (Waitemata District Health Board, 2015). The AT&R wards at North Shore Hospital have 68 beds and Waitakere Hospital has 47.

Referral to the AT&R services are done in-house from acute wards (e.g. medical and surgical specialists) or from the District and Gerontology Nursing Services from the community (Waitemata District Health Board, 2015).

The patient entry criteria to be accepted into the AT&R are as follows (as per the WDHB AT&R Service website) (Waitemata District Health Board, 2015);

- Entrants are generally over 65 years of age, or are 50-65 years with age related conditions
- Those that require a period of rehabilitation, particularly frail elderly who are at risk of losing their independence or having difficulty managing at home
- Those that need multidisciplinary specialist assessment and treatment for conditions or impairments related to age and frailty
- Those that need specialist reassessment and treatment of multiple or chronic conditions or disabilities
- Those that will require ongoing assessment for safety and community support at home including follow-up by Home Health services

3.4 Ethics

3.4.1 Ethics Approval

Ethics approval was obtained from the Health and Disability Ethics Committee: Northern A, Application 14/NTA/70. Study title: Multidimensional Nutritional Analysis of Waitemata DHB Elderly Population (Appendix A).

3.4.2 Consent

Participation in the study was undertaken on a voluntary basis after potential participants were screened and given information about the research. Initial contact and invitation into the study was done in person on the AT&R wards and participants were given an Information Sheet (Appendix B). The information given to participant included: reason for study, participant selection, outline of study procedure, risks and benefits, the rights of the participant, confidentiality and researcher contact details.

Before the interview, the researcher checked the participants understanding of the information and written consent was gained via signature on the Consent Form (Appendix C). Participants were informed they could decline invitation to participate in the study, decline answering any specific questions and could withdraw at any stage during the study. They were also assured this would not affect their on-going care. Permission was also sought to view medical files.

3.4.3 Adverse Effects

Participants were informed they were unlikely to experience any adverse effects from participating in the study. If participants felt concerned or uncomfortable at any stage, they could decline certain questions or assessments or withdraw all together. If required, a health professional would be sought.

Participants were informed that the questionnaire and assessments may identify a nutrition or health problem. Where the participants were identified as being 'at risk of malnutrition' or 'malnourished' a Dietitian was informed for assessment and management. Similarly, those identified as 'at risk of swallowing difficulties' were referred to the speech and language therapist.

3.4.4 Confidentiality

Participants were assured all effort would be made to ensure personal information would be kept private and not divulged to anyone, except to health professionals in direct care of the participant. All participant questionnaires and related forms were kept in a filing cabinet in the AT&R ward at North Shore Hospital and any electronic

data entered into a computer or USB were protected by a password known only by the researcher. Participants were informed in the event the results of the study were to be published that only de-identified information would be used, ensuring that no participants could be identified personally.

3.5 Recruitment of Participants

Participants were recruited between June and September 2015 (12 weeks). Patients admitted within five days into the AT&R wards of North Shore and Waitakere Hospitals were invited into the study (non-randomised). The inclusion and exclusion criteria was used to screen participant eligibility, and patient medical notes and health professional recommendation (e.g. participants care nurse or Geriatrician), was used to determine patient suitability into the study. The following inclusion and exclusion criteria were used:

3.5.1 Inclusion criteria:

- Aged 65-84 years (or aged 55-84 years if of Māori or Pacific ethnicity)
- Newly admitted to the AT&R ward within five days
- Ability to comprehend study requirements and give consent

3.5.2 Exclusion criteria:

- Age less than 65 years (or aged less than 55 years if or Māori or Pacific ethnicity)
- Inability to understand study requirements or give informed consent
- Anyone with psychiatric illness affecting nutrition e.g. Anorexia nervosa
- Anyone with malabsorption syndromes or metabolic syndromes affecting digestion

Those that met inclusion and exclusion criteria but weren't suitable, e.g. were too ill, felt participation burden was too great, or assumed not to give reliable responses were not invited to participate.

The age criteria for Māori and Pacific people is lower than that of non- Māori/Pacific to increase recruitment numbers due to their lower life expectancy and health disparities compared to non- Māori/Pacific.

An enrolment log of all participants screened and registered was kept on a computer or USB which was protected by a password known only by the researcher.

3.6 Data Collection

The study involved a personal interview with a questionnaire (Appendix D) and two physical assessments to identify nutritional and non-nutritional factors that may influence nutritional status.

The time limit given to complete the entire assessment was 30 to 90 minutes per participant. Data was collected on patient background information, nutrition risk assessment (using the MNA-SF)(Appendix E), dysphagia risk assessment (using EAT-10)(Appendix F), muscle mass (using Bioelectrical Impedance Analysis scales) and muscle strength (using a JAMAR hand grip dynamometer).

At the end of each interview, participation was noted in the participant's medical files and a referral to an appropriate health professional was made if required. Within three days prior to participant discharge from hospital, a cognitive screening was done by either the researcher or Geriatrician using the MoCA (Appendix G).

3.6.1 Questionnaire

The questionnaire was developed in the previous year with 47 items and included validated screening tools. The initial questionnaire was reviewed by nutrition and research professionals and revisions were made based on their recommendations. Additionally, the questionnaire was further revised and finalized based on pilot group feedback. The same final questionnaire was used in this study (as both studies assessed nutrition risk status) albeit with two additional assessments and one extra question (Appendix D).

In this study, the extra assessments included muscle mass analysis and hand grip strength measurements, and the extra question 'have you previously had any dietetic input?'.

3.6.2 Participant Characteristics

The first page of the questionnaire comprised of personal and anthropometric information which included participant date of admission into hospital, full name, National Health Index number, date of birth, age, gender, weight, height, BMI, hand grip strength of dominant hand and muscle mass measurements (in kg's and percentage).

The data was either collected from participant medical files or the participants themselves. Demi-span and calf circumferences were only conducted if participant height or weight were unavailable.

In the event that height could not being recorded, or could not be recorded safely, a demi-span (half-arm span) was conducted as per the MNA-SF user guide. A mark was drawn on the midpoint of the sternal notch with a pen. The participant was then asked to hold out their left arm in a horizontal position and in line with shoulders. With the arm held out flat and straight, the distance from the mark on the sternal notch to the web of the middle and ring finger was measured to the nearest 0.5 cm with a measuring tape. Height was then calculated from the following formulae:

Females

$$\text{Height (cm)} = (1.35 \times \text{demispan in cm}) + 60.1$$

Males

$$\text{Height (cm)} = (1.40 \times \text{demispan in cm}) + 57.8$$

In the event a BMI could not be calculated, a calf circumference measurement was conducted as per the MNA-SF user guide. The calf circumference measurement was taken with the participant seated with the left leg hanging loosely uncovered. The widest measurement was taken to the nearest 0.1 cm. Additional measurements above and below the point were also taken to ensure the widest point was recorded. For bed-bound participants, their calf circumference was measured with the left knee bent at a 90° with the person lied in a supine position. Measurement of the widest part was taken with the tape snug but not tight around the tissue, additional measurements were taken to ensure the widest part was recorded to the nearest 0.1 cm.

3.6.3 Demographic Characteristics

The second page of the questionnaire consisted of five demographic questions; ethnicity, marital status, living situation, income and education. Possible answers were provided for each question.

For ethnicity, there were 4 possible answers: 'New Zealand European', 'New Zealand Māori', 'Pacific Island' or 'Other (please specify)'. The answer 'Other' was open to what the participant identified as their ethnicity that were not any of the previous three options and was noted specifically in the space provided. For marital status, participants could choose from 'Married/partnered', 'Widowed', 'Divorced/Separated' or 'Never Married'. For living situation, there were 3 possible answers; 'Living alone', 'Living with Spouse' or 'Living with Others'. If participants were living with others, the 'comments' section was filled in to specify who they lived with. For income, there were two possible answers; 'Pension only income' or 'Pension plus other income'. Space was left to describe what other income participants received if they wished to disclose such information. For education, participants could choose from 'Primary', 'Secondary' or 'Tertiary' level as their highest level of education attained.

3.6.4 Health Characteristics

The third and fourth pages of the questionnaire looked at the participant's key comorbidities, other health issues, prescribed regular medication, regular over-the-counter medications, nutrition supplement use and dental status.

Information on participant's key comorbidities, other health issues and regular prescribed medication were gained from the participant's medical file and online health database, named Concerto. Regular prescribed medication prior to hospital admission was noted rather than current in-ward medication, as this was better reflection of medication use when participant was in the community.

The other health questions (regular over-the-counter medications, nutrition supplement use and dental status) were answered by the participant themselves. The possible answers for dental status were 'Dentate', 'Edentulous' or 'Dental Appliance'.

3.6.5 Support Services

The fifth page of the questionnaire looked at the support services the participant was receiving prior to hospital admission. Questions included; 'Do you received any regular subsidised support service?', 'Do you usually need help with daily tasks like shopping, cleaning, cooking?', and 'Have you previously had any dietetic input?' All questions had a 'Yes' and 'No' response and any specific details from the participants were noted.

3.6.6 Nutritional Status Assessment with the Mini Nutritional Assessment-Short Form (MNA-SF)

The sixth page of the questionnaire contained the MNA-SF, which was used to identify participants nutrition status and classify them as having a 'normal nutrition status', being 'at risk of malnutrition' or 'malnourished'.

The MNA-SF consisted of six questions;

1. Has food declined over the past 3 months due to loss of appetite, digestive problems, chewing or swallowing difficulties? (severe decrease, moderate decrease, no decrease)
2. Had weight loss during the last 3 months (weight loss greater than 3 kg, does not know, weight loss between 1-3 kg, no weight loss)
3. Mobility status (bed or chair bound, able to get out of bed/chair but does not go out, goes out)
4. Has suffered psychological stress or acute disease in the past 3 months (yes, no)
5. Has neurological problems (severe dementia or depression, mild dementia, no psychological problems)
6. BMI (less than 19, 19 to 21, 21 to 23, 23 or greater) or alternatively calf circumference was used if BMI was unavailable (less than 31 cm, 31 cm and above)

Each of the responses correlated to specific points which were then added up together to produce a total score, the scores then identified participants as either having 'normal nutritional status' (12 -14 points), being 'at risk of malnutrition' (8 – 11 points) or being 'malnourished' (0 – 7 points). As mentioned previously, should the participant score

zero to eleven points, the appropriate health professionals e.g. nurse or dietitian were notified.

3.6.7 Dysphagia Status Assessment with the Eating Assessment Tool (EAT-10)

The seventh page of the questionnaire contained the EAT-10 tool, which was used to identify participants who are at risk of dysphagia.

The EAT-10 assessment consisted of 10 questions:

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

Participants were asked to rate each statement on a continuum of zero to four, with zero being no problem and four being a severe problem. Points for each question (0 to 4) were summed for a final score. Those that scored less than three points were deemed 'not at risk of swallowing difficulties', alternatively those that scored three or more points were deemed 'at risk of swallowing difficulties'. As mentioned previously, should the participant score three or more points the appropriate health professionals e.g. nurse or speech and language therapist were notified.

3.6.8 Cognitive Status Assessment with the Montreal Cognitive Assessment (MoCA)

The MoCA was conducted to determine the cognitive status of participants. It assessed several cognitive domains including; attention and concentration, executive functions, memory, language, visuoconstructional skills, conceptual thinking, calculations and

orientation. The MoCA was conducted within three days of participant discharge from hospital to give a more reflective cognitive state, as upon admission the participants cognitive state may have been falsely lowered due to confusion, stress or other factors. The total possible score is 30 points, a score of 26 or above was considered normal.

3.6.9 Participant Reliability and Understanding

The last page of the questionnaire contained final two questions which were filled out by the researcher. It rated the reliability of the participant's responses and their understanding of questions, a score was selected from one to five (where one was 'very poor' and five was 'very good'). Participant responses were compared with their medical files and discussed with relevant health professionals, often their nurse, in order to ensure the information was accurate. All effort was made to attain accurate information or increase participants understanding of questions, often by use of family members, language translators or other health professionals.

Comments were noted if the researcher felt the participant's responses were unreliable or understanding of questions was poor.

3.6.10 Hand Grip Strength Assessment with a Hand Dynamometer

Participants hand grip strength was assessed by Jamar Hydraulic Hand Dynamometer, model #5030J1 (Sammons Preston brand). The procedure for assessing hand grip strength was as per the instruction manual and the standards testing position approved by the American Society of Hand Therapists (Innes, 1991).

Participants were assessed sitting upright in a chair with their feet flat on the floor. Before formally assessing the patient the adjustable handle on the dynamometer was set to the desired spacing, and the red peak-hold needle set to zero.

As per the American Society of Hand Therapists testing position, participants had 'shoulders adducted and neutrally rotated, elbow flexed at 90 degrees, forearm in a neutral position, and wrist between 0 and 30 degrees extension and between 0 and 15 degree ulnar deviation.' The dynamometer was presented vertically and in line with the forearm. The participant's arm was not supported by the researcher or armrest. They

were then instructed to squeeze the handle of the dynamometer as hard as they could, then to relax. Scores of three successive trials of the participant's dominant hand were recorded and an average calculated.

The dynamometer was then recovered from the participant, cleaned and stored in its case.

3.6.11 Muscle Mass Assessment with Bioelectrical Impedance Analysis

Participant's body composition was assessed by the InBody 230 (GE Healthcare) bioelectrical impedance analyser (BIA). Before formally assessing the participant, the BIA scales were set upright to participant bedside. The lower knob on the BIA scales was tightened to prevent folding over, and all four foot plate screws were levelled for so that the scales stood balanced in all four corners as indicated by the air bubble level indicator on the device. The power cable and printer were then plugged into the BIA scales and turned on. The device was then loaded. **Figure 3** shows the setup of the BIA scales taken from the InBody 230 User Manual (Biospace.).

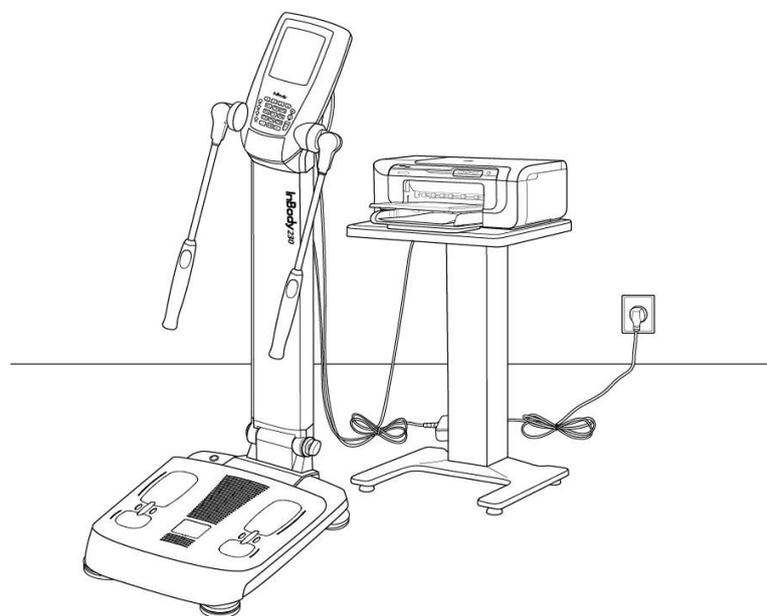


Figure 3. InBody 230 BIA scales and printer set up (InBody 230 User Manual)(Biospace.)

Participants were then asked to remove any heavy clothing or accessories and to stand on the scales with bare foot in contact with the metal electrodes on the foot plate. Heels were positioned on the rear sole electrode and the sole of the foot on the front sole electrode surface. While the participant stood upright on the BIA scales, their personal data such as age (years), gender and height (cm) were input into the system by the researcher. The participant was then told to continue to stand at attention without movement so that the device could calculate weight (kg). After data input was completed, participants were then asked to lift the hand electrodes at a comfortable height to them while placing their thumb on the electrode pad on top of the handle pressing lightly, with the rest of the hand covering the palm electrodes. **Figure 4** illustrates correct posture and position for assessment taken from InBody 230 User Manual (Biospace.).

The device then analysed the participant's body composition, which displayed the result on the information window and printed copy. The muscle mass weight (kg) and percentage (%) was noted from 'SMM' (information window) or 'Muscle Mass' (printed form). The participant then safely got off the scales and returned to their bed or chair.

The BIA scales were then safety shut down, unplugged, cleaned, folded and stored away.



Figure 4. Correct form and position of participant on the BIA scales (InBody 230 User Manual)(Biospace.)

3.7 Data Handling and Statistical Analysis

All participant information was gathered on the study questionnaire, then transferred into Microsoft Excel. All data was then imported, coded and statistically analysed in SPSS version 21 (IBM Corporation, 2012). Descriptive statistics were used to analyse participant demographic data, anthropometric data, medication, social situation, nutrition status, dental status, dysphagia status and cognitive data. Kolmogorov-Smirnov and Shapiro-Wilk tests were conducted to determine normality of data. If data were normally distributed, it was expressed as mean \pm standard deviation (SD), and not-normally distributed data were expressed as median [25th, 75th percentiles]. Categorical data was reported as counts and percentages. For data expressed as mean (SD), comparisons between two groups were done using independent sample t-tests and ANOVA for comparisons between more than two groups. For categorical data expressed as counts, comparisons between groups were done using Pearson Chi-square test. In the instance the assumption for Chi-Square test was violated (expected counts less than five exceeding zero percent) a Fisher's Exact test was conducted. A p-value of <0.05 was considered statistically significant.

Chapter 4: Results

4.1 Participant Characteristics

A total of 104 AT&R ward patients aged 65 to <85 years were screened for eligibility into the study. Seven participants were excluded from the study due to inability to give reasonable informed consent (n =3), or medical staff recommendation against patient participation in the study due to poor health (n =4). Of the 97 eligible patients, eight declined to participate due to personal reasons (undisclosed). A final sample of 89 AT&R ward patients from both Waitakere and North Shore Hospitals made up the participants in the study. Participant personal and demographic characteristics are shown in **Table 3** below.

The mean age of participants was 78.1 ± 5.9 years with half the participants aged between 80 and 84 years (49.4 %). Two participants were aged less than 65 years of Māori ethnicity (55 years and older).

There were slightly more women (n=48) than men (n=41) in the study. Most participants were 'New Zealand European', making up half (50.6 %) the proportion of participants with 'Other' making up the second largest percentage (39.3 %). 'Other' identified themselves as Sri Lankan, Scottish, Dutch, Italian or English. There were four 'New Zealand Māori' and five 'Pacific Island' participants in the study.

Around half the participants were married or partnered with slightly more men (63.4 %) than women (43.8 %) in relationships. Around 30 percent of participants were widowed, 11 percent were separated and around seven percent never married. Fifty eight percent of participants lived with either their spouse or others such as family members and 41.6 percent lived alone.

Sixty seven percent stated their primary source of income was the pension and 32.6 percent had other income in addition to their pension. Most participants had secondary level education (70.8 %), 19.1 percent had tertiary and 10.1 percent had primary level education as their highest level of education.

Table 3.*Participant Characteristics*

	Total (n= 89)	Men (n= 41)	Women (n=48)
Total (%)	100.0	46.0	54.0
Age (years) ‡	78.1 ± 5.9	77.5 ± 5.5	78.6 ± 6.2
Age Range (years)	59.5-84.9	65.3-84.8	59.5-84.9
Age Categories*			
55-64	2(2.2)	0(0.0)	2(4.2)
65-69	8(9.0)	5(12.2)	3(6.3)
70-74	16(18.0)	8(19.5)	8(16.7)
75-79	19(21.3)	10(24.4)	9(18.8)
80-84	44(49.4)	18(43.9)	26(54.2)
Ethnicity*			
New Zealand European	45(50.6)	19(46.3)	26(54.2)
New Zealand Māori	4(4.5)	2(4.9)	2(4.2)
Pacific Islander	5(5.6)	3(7.3)	2(4.2)
Other	35(39.3)	17(41.5)	18(37.5)
Marital Status*			
Married/Partnered	47(52.8)	26(63.4)	21(43.8)
Widowed	26(29.2)	13(31.7)	13(27.1)
Divorced/Separated	10(11.2)	2(4.9)	8(16.7)
Never Married	6(6.7)	0(0.0)	6(12.5)
Living Arrangement*			
Living alone	37(41.6)	16(39.0)	21(43.8)
Living with spouse only	33(37.1)	18(43.9)	15(31.3)
Living with others	19(21.3)	7(17.1)	12(25.0)
Income*			
Pension only income	60(67.4)	23(56.1)	37(77.1)
Pension plus other income	29(32.6)	18(43.9)	11(22.9)

Education*

Primary	9(10.1)	4(9.8)	5(10.4)
Secondary	63(70.8)	26(63.4)	37(77.1)
Tertiary	17(19.1)	11(26.8)	6(12.5)

* Values are expressed as count (percentage)

‡ Values are expressed as mean \pm standard deviation

4.2 Participant Anthropometric, Muscle Mass and Grip Strength Measures

The anthropometric, muscle mass and grip strength measures of participants are presented in **Table 4** below.

The mean weight of participants in the study was 70.9 ± 15.6 kg. Men were significantly heavier (76.5 ± 14.0 kg vs. 66.1 ± 15.3 kg, $p = 0.001$), as well as significantly taller (171.1 ± 7.6 cm vs. 153.1 ± 32.5 cm, $p = 0.001$) than women.

BMI was recorded for all participants, with the mean being 26.1 kg/m^2 . The mean BMI did not differ significantly between men (26.7 kg/m^2) and women (25.4 kg/m^2 , $p = 0.40$). It was found 4.5 percent of participants had a BMI of $<18.5 \text{ kg/m}^2$ (underweight), 35.9 percent had BMI of $18.50\text{-}24.99 \text{ kg/m}^2$ (normal weight) and 59.6 percent had BMI of $\geq 25 \text{ kg/m}^2$ (overweight/obese). More men and women were 'overweight/obese' than 'normal' or 'underweight'.

Muscle mass measurement was collected for only nine participants, due to participants either declining or too frail to stand on their own on the BIA scales. The mean muscle mass was 27.5 ± 3.9 kgs, with men having a significantly higher muscle mass than women (29.1 ± 2.0 kgs vs. 21.7 ± 3.3 kgs respectively, $p = 0.004$). The mean muscle mass percentage was 38.9 ± 7.0 percent. The mean muscle mass percentage did not differ significantly between men and women (40.0 ± 6.6 % vs 35.2 ± 9.7 % respectively, $p = 0.427$).

Hand grip strength was recorded for 77 participants, the remaining 12 participants either declined or were not able to be measured due to arm being in a cast, injured or with a disability (e.g. arthritis). The mean hand grip strength of participants' dominant hand was 17 ± 8.0 kgs. Men had a significantly higher mean grip strength (20 ± 9.0 kgs) than women (13 ± 6.0 kgs, $p = <0.001$).

Table 4.*Participant Anthropometric, Muscle Mass and Grip Strength Measures*

	Total	Men	Women	p-value [†]
Weight (kg) ‡ (n=89)	70.9 ± 15.6	76.5 ± 14.0	66.1 ± 15.3	0.001 [†]
Height (cm) ‡ (n=89)	161.4 ± 25.9	171.1 ± 7.6	153.1 ± 32.5	0.001 [†]
BMI (kg/m ²)(n=89) ‡	26.1 ± 5.6	26.7 ± 5.9	25.7 ± 5.3	0.400
Underweight* (<18.50)	4(4.5)	1(2.4)	3(6.3)	0.810 [§]
Normal* (18.50-24.99)	32(35.9)	15(36.6)	17(35.4)	
Overweight/Obese* (≥25.00)	53(59.6)	25(61.0)	28(58.3)	
Muscle Mass Composition ‡ (n=9)				
Muscle Mass (kg)	27.5 ± 3.9	29.1 ± 2.0	21.7 ± 3.3	0.004 [†]
Muscle Mass (%)	38.9 ± 7.0	40.0 ± 6.6	35.2 ± 9.7	0.427
Grip Strength (n=77) ‡				
Dominant Hand (kg)	17 ± 8.0	20 ± 9.0	13 ± 6.0	<0.001 [†]

* Values are expressed as count (percentage)

‡ Values are expressed as mean ± standard deviation

Independent t-test was used to determine significant differences between men and women for scale data

§ Chi-square test was used to determine significant differences between men and women for categorical data

† A p-value of <0.05 was considered statistically significant

4.3 Health and Medications

4.3.1 Health Conditions

The ten most commonly noted health conditions among the participants were hypertension (n=57, 64.0 %), ischaemic heart disease (n=24, 27.0 %), type II diabetes mellitus (n=21, 24.0 %), atrial fibrillation (n=20, 22.5 %), dyslipidaemia (n=18, 20.2 %),

osteoporosis (n=16, 18 %), recurrent falls (n=15, 16.9 %), osteoarthritis (n=14, 15.7 %), chronic obstructive pulmonary disease (n=12, 13.5 %) and gout (n=11, 12.4 %).

4.3.2 Prescription Medications

As presented in **Table 5**, most participants were taking five or more prescription medications (75.3 %), 24.7 percent were taking less than five and 3.4 percent none. Prescribed medications taken by the participants ranged from none to 17 with a mean of 6.75 ± 3.6 . The five most commonly prescribed medications were; Paracetamol (n=37, 43.0 %), Aspirin (n=34, 39.5 %), Omeprazole (n=32, 37.2 %), Metoprolol (n=30, 34.9 %) and Atorvastatin (n=25, 29.1 %).

Table 5.

Regular Prescribed Medications

	Total (n= 89)	Men (n= 41)	Women (n= 48)	p-value
Less than five medications	22 (24.7)	10 (24.4)	12 (25.0)	0.95
Five or more medications	67 (75.3)	31 (75.6)	36 (75.0)	

Values are expressed as count (percentage)

Chi-square test was used to determine significant differences between men and women

4.3.3 Over-the-Counter Medications

Thirteen (14.6 %) participants were taking over-the-counter medications. These included medication for joint care (e.g. Glucosamine)(n= 7, 53.8 %), pain relief (e.g. Panadol)(n= 2, 15.4 %), nasal spray (e.g. Otrivine nasal)(n=1, 7.7 %), inducing good sleep cycle (melatonin)(n=1, 7.7 %) and others such as 'Rescue Remedy' (n=1, 7.7 %) and 'Bee Pollen' (n=1, 7.7 %).

4.3.4 Over-the-Counter Nutritional Supplements

Half the participants (n=45, 50.6 %) were taking nutritional supplements. These included Vitamin D tablets (n=19, 42.2 %), Multi-vitamins (n=8, 17.8 %), Iron tablets

(n=3, 6.7 %), nutrient dense drinks/powders (e.g. Complian, Fortisip) (n=3, 6.7 %), Fish Oil (n=3, 6.7 %), Vitamin-C (n=3, 6.7 %), Prebiotics (n=2, 4.4 %), Folic Acid (n=1, 2.2 %), Metamucil (n=1, 2.2 %), Potassium supplement (n=1, 2.2 %) and Selenium supplement (n=1, 2.2 %).

4.4 Dental Characteristics and Dysphagia Status (EAT-10)

4.4.1 Dental Characteristics

Eighty six participants responded to questionnaire items related to dental status and three declined. As shown in **Table 6**, nearly half the participants had dental appliance (45.3 %). More women had dental appliance (55.6 %) than were dentate (15.6 %) or edentulous (28.9 %). More men were edentulous (39.0 %), than have dental appliance (34.1 %) or be dentate (26.8 %). No significant differences were observed between men and women in regards to dental status ($p = 0.08$).

Table 6.

Dental Status of Study Participants

	Total (n =86)	Men (n =41)	Women (n =45)	p-value
Dentate	18(20.9)	11(26.8)	7(15.6)	0.08
Dental Appliance	39(45.3)	14(34.1)	25(55.6)	
Edentulous	29(33.7)	16(39.0)	13(28.9)	

Values are expressed as count (percentage)

Chi-square test was used to determine significant differences between men and women

4.4.2. Dysphagia Risk Status (EAT-10)

Eighty seven participants completed the dysphagia risk assessment and two declined. Participants were categorized depending on points totalled from the questions, with <3 indicating 'not at risk of dysphagia' and points ≥ 3 indicating 'at risk of dysphagia'.

As shown in **Table 7**, the majority of the participants (72.4 %) were not at risk and 24 (27.6 %) participants were at risk of dysphagia. No significant differences were observed between men and women in regards to dysphagia risk status (p =0.18).

Table 7.

Dysphagia Risk Status

	Total (n= 87)	Men (n= 41)	Women (n= 46)	p-value
Not at risk of dysphagia (<3 points)	63(72.4)	27(65.9)	36(78.3)	0.18
At risk of dysphagia (≥ 3 points)	24(27.6)	14(34.1)	10(21.7)	

Values are expressed as count (percentage)

Chi-square test was used to determine significant differences between men and women

4.5 Support Services

As presented in **Table 8**, 46 percent of participants were receiving regular support services, with significantly more women (56.3 %) receiving support service than men (34.1 %, p= 0.04). Support services included aid with cleaning, showering, personal cares and food preparation, frequency of help ranged from one hour daily to one hour fortnightly. Sixty six percent of participants stated requiring daily help, with more women (75.0 %) than men (65.1 %) needing help.

Around 34 percent of participants had previously seen a dietitian; reason for visit included diabetes management and oral nutrition support for weight gain or weight loss. Slightly more men (36.6 %) than women (31.3 %) had seen a dietitian. No statistically significant difference was observed between gender and requiring daily aid (p =0.06) or previous dietetic input (p =0.60).

Table 8.

Differences between men and women who answered 'yes' to Support Service Use and Previous Dietetic Input

	Total (n =89)	Men (n =41)	Women (n =48)	p-value
Receiving Support Service	41 (46)	14 (34.1)	27 (56.3)	0.040 [†]
Requiring Daily Aid	59 (66.3)	23 (56.1)	36 (75.0)	0.060
Previously seen a Dietitian	30 (33.7)	15 (36.6)	15 (31.3)	0.600

Values are expressed as count (percentage)

Chi-square test was used to determine significant differences between men and women

[†] A p-value of <0.05 was considered statistically significant

4.6 Participant Cognition

4.6.1 Montreal Cognitive Assessment (MoCA)

Participant cognitive status was assessed using the MoCA within three days of discharge from hospital. The maximum MoCA score is 30; and a cut off score of 26 or over is indicative of normal cognitive function. MoCA assessments were conducted in 63 (70.8 %) participants. The remaining 26 participants either declined or were discharged prior to assessment. **Table 9** shows majority of participants were considered to have 'below normal cognitive function' with 82.5 percent having a total MoCA score of <26. No statistically significant differences were observed between gender and cognitive status (p =0.35).

Table 9.*Cognitive Status*

	Total (n =63)	Men (n =31)	Women (n =32)	p-value
Normal Cognitive Function (26-30)	11 (17.5)	4 (12.9)	7 (21.9)	0.35
Below Normal Cognitive Function (<26)	52 (82.5)	27 (87.1)	25 (78.1)	

Values are expressed as count (percentage)

Chi-square test was used to determine significant differences between men and women

4.6.2 Participant Understanding of Questionnaire Items

Participants were assessed by the researcher for their reliability of responses and understanding of the questionnaire items.

Overall the majority of the participants (n=78) were thought to understand the questionnaire items and provide reliable responses with 11 participants providing uncertain responses. Responses were compared against medical notes or discussed with the participants nurse or family members to provide for greater accuracy.

Questions were asked in a simpler manner a second time if participants initially did not understand and language translators or other health professionals and family members were utilized if present at time of assessment.

4.7 Nutrition Risk Status (MNA-SF)

The median MNA-SF score was 9 [7, 12], with the lowest score being zero and the maximum score being 14. Twenty-seven percent of participants were categorized as 'malnourished' (score between 0-7 points), 43.8 percent were considered 'at risk of malnutrition' (score between 8-11 points) and 29.2 percent had 'normal' nutrition status (score between 12-14 points). No statistically significant differences were observed in nutrition risk status between men and women (p =0.60).

Table 10.*MNA-SF Scores of Study Participants*

	Total (n =89)	Men (n =41)	Women (n =48)	p-value
Malnourished (0-7)	24(27.0)	11(26.8)	13(27.1)	0.60
At risk of malnutrition (8-11)	39(43.8)	20(48.7)	19(39.6)	
Normal nutrition status (12-14)	26(29.2)	10(24.4)	16(33.3)	

Values are expressed as count (percentage)

Chi-square test was used to determine significant differences between men and women

Table 11 below shows the participant responses to the MNA-SF questionnaire items. All 89 participants completed the MNA-SF. Overall, half of the participants (51.7 %) reported having no decrease in food intake over the past three months due to loss of appetite, digestive problems, chewing or swallowing difficulties; 32.9 percent experienced no weight loss in the last 3 months; 66.3 percent had good mobility and went out; 50.6 percent had suffered psychological stress or acute disease within the past three months; 70.8 percent had no psychological problems (i.e. dementia or depression) and 67.4 percent had BMI of 23 or greater.

More participants categorized as ‘malnourished’ reported severe decrease in food intake over the past three months due to loss of appetite, digestive problems, chewing or swallowing difficulties (45.8 %), >3 kg weight loss in the last three months (62.5 %), be bed or chair bound (20.8 %), had suffered psychological or acute disease in the past three months (95.8 %), had mild dementia or depression (41.7 %) and have BMI of <21 (33.4 %) than those ‘at risk of malnutrition’ or with ‘normal’ nutrition status.

Table 11.*MNA-SF Participant Item Responses*

	Total	Malnourished	At Risk	Normal
Total n (%)	89 (100)	24 (27.0)	39 (43.8)	26 (29.2)
1. Food Intake;				
Severe decrease	14 (15.7)	11 (45.8)	3 (7.7)	0 (0.0)
Moderate decrease	29 (32.6)	10 (41.7)	17 (43.6)	2 (7.7)
No decrease	46 (51.7)	3 (12.5)	19 (48.7)	24 (92.3)
2. Weight loss in 3 months;				
Greater than 3 kg	27 (30.3)	15 (62.5)	12 (30.8)	0 (0.0)
Does not know	23 (25.8)	7 (29.2)	13 (33.3)	3 (11.5)
Between 1 to 3 kg	10 (11.2)	2 (8.3)	6 (15.4)	2 (7.7)
No weight loss	29 (32.9)	0 (0.0)	8 (20.5)	21 (80.8)
3. Mobility;				
Bed or chair bound	9 (10.1)	5 (20.8)	4 (10.3)	0 (0.0)
Able to get out of bed/chair but does not go out	21 (23.6)	9 (37.5)	8 (20.5)	4 (15.4)
Goes out	59 (66.3)	10 (41.7)	27 (69.2)	22 (84.6)
4. Suffered psychological stress or acute or disease within 3 months;				
Yes	45 (50.6)	23 (95.8)	18 (46.2)	4 (15.4)
No	44 (49.4)	1 (4.2)	21 (53.8)	22 (84.6)
5. Neurological problems;				
Severe dementia or depression	9 (10.1)	7 (29.2)	2 (5.1)	0 (0.0)

Mild depression or dementia	17 (19.1)	10 (41.7)	4 (10.3)	3 (11.5)
No psychological problems	63 (70.8)	7 (29.2)	33 (84.6)	23 (88.5)

6. BMI;

Less than 19	7 (7.9)	4 (16.7)	3 (7.7)	0 (0.0)
19 to less than 21	8 (9.0)	4 (16.7)	3 (7.7)	1 (3.8)
21 to less than 23	14 (15.7)	3 (12.5)	9 (23.1)	2 (7.7)
23 or greater	60 (67.4)	13 (54.2)	24 (61.5)	23 (88.5)

Values are expressed as count (percentage)

4.8 Nutrition Risk Associations

Table 12 below shows the participants demographic, health, anthropometric and social characteristics by nutrition risk status using the MNA-SF scores. There were no statistically significant associations for any of these characteristics by nutrition risk status i.e. $p > 0.05$ except for dysphagia risk status and previous dietetic input.

Half of the participants in all nutrition risk status categories were married or partnered. Those that were 'malnourished' and had 'normal' nutrition status were likely to live alone (37.5 % and 57.7 % respectively). Participants that were 'at risk of malnutrition' were likely to be living with a spouse (38.5 %).

Two-thirds of participants were receiving pension only income and had secondary level education as their highest level of education.

Participants that were 'malnourished' were likely to be underweight and be taking ≥ 5 prescribe medications.

Those that were 'malnourished' had muscle mass of 25.05 ± 8.1 kgs and muscle mass percentage of 39.0 ± 4.3 percent, participants that were 'at risk of malnutrition' had muscle mass of 27.35 ± 2.2 kgs and muscle mass percentage of 46.2 ± 0.6 percent, and participants that had 'normal' nutrition status had muscle mass of 28.5 ± 3.0 kgs and muscle mass percentage of 36.0 ± 7.5 percent.

Those that were ‘malnourished’ had dominant hand grip strength of 15 ± 6.0 kg’s, participants that were ‘at risk of malnutrition’ had dominant hand grip strength of 18 ± 8.0 kg’s and those that had ‘normal’ nutrition status had dominant hand grip strength of 16 ± 10.0 kg’s.

More participants that were ‘malnourished’ were edentulous (41.7 %). More participants that were ‘at risk of malnutrition’ and had ‘normal’ nutrition status had dental appliance in regards to their dental status (48.7 % and 46.2 % respective).

Table 12.

Associations between nutrition risk prevalence and relevant physiological and socio-demographic risk factors

	Malnourished (n =24)	At Risk (n =39)	Normal (n =26)	p-value
Marital Status*;				0.940
Married/Partnered	12 (50.0)	21 (53.8)	14 (53.8)	
Widowed	8 (33.3)	12 (30.8)	6 (23.1)	
Divorced/separated	3 (12.5)	4 (10.4)	3 (11.5)	
Never married	1 (4.2)	2 (5.1)	3 (11.5)	
Living Situation*;				0.100
Living alone	9 (37.5)	13 (33.3)	15 (57.7)	
Living with spouse only	8 (33.3)	15 (38.5)	10 (38.5)	
Living with others	7 (29.2)	11 (28.2)	1 (3.8)	
Income*;				0.600
Pension only income	17 (70.8)	24 (61.5)	19 (73.1)	
Pension plus other income	7 (29.2)	15 (38.5)	7 (26.9)	
Education*;				0.900
Primary	1(4.2)	5(12.8)	3(11.5)	
Secondary	18(75.0)	27(69.2)	18(69.2)	

Tertiary	5(20.8)	7(17.9)	5(19.2)	
BMI*;				0.150
Underweight (<18.50)	3(12.5)	1(2.6)	0(0.0)	
Normal (18.50-24.99)	10(41.7)	15(38.5)	7(26.9)	
Overweight/obese (≥25.00)	11(45.8)	23(59.0)	19(73.1)	
Muscle Mass Composition*;				
Muscle Mass (kg)	25.0 ± 8.1	27.4 ± 2.2	28.5 ± 3.0	0.643 [§]
Muscle Mass (%)	39.0 ± 4.3	46.2 ± 0.6	36.0 ± 7.5	0.236 [§]
Dominant Hand Grip Strength (kg)†	15 ± 6.0	18 ± 8.0	16 ± 10.0	0.312 [§]
Regular prescribed medication*;				0.440
Less than 5 medications	4 (16.7)	12 (30.8)	6 (23.1)	
Five or more medications	20 (83.3)	27 (69.2)	20 (76.9)	
Using Nutrition Supplements*;				0.970
Taking regular supplements	11 (45.8)	19 (48.7)	15 (57.7)	
Not taking regular supplements	13 (54.2)	20 (51.3)	11 (42.3)	
Dental Status*;				0.520
Dentate	5(20.8)	7(17.9)	6(23.1)	
Edentulous	10(41.7)	13(33.3)	6(32.1)	
Dental appliance	8(33.3)	19(48.7)	12(46.2)	
Dysphagia*;				0.002 [†]
Not at risk of swallowing difficulties	10(45.5)	33(84.6)	20(76.9)	

At risk of swallowing difficulties	12(54.5)	6(15.4)	6(23.1)	
Cognition State*;				0.230
Normal (MoCA \geq 26)	2 (12.5)	3 (11.1)	6 (30.0)	
Below (MoCA <26)	14 (87.5)	24 (88.9)	14 (70.0)	
Support Service use*;				
Receiving support service	11(45.8)	20(51.3)	10(38.5)	0.597
Not receiving support service	13(54.2)	19(48.7)	16(61.5)	
Need daily help	18(75.0)	27(69.2)	14(53.8)	0.251
Not needing daily help	6(25.0)	12(30.8)	12(46.2)	
Previous dietetic input*;				0.030 [†]
Received dietetic aid	12(50.0)	14(35.9)	4(15.4)	
Not received dietetic aid	12(50.0)	25(64.1)	22(84.6)	

* Values are expressed as count (percentage)

Chi-square test was used to determine significant associations between nutritional risk factor groups and physiological and socio-demographic risk factors

‡ Values are expressed as mean \pm standard deviation

§ One-way ANOVA was used to determine significant difference between nutrition status for parametric data

† A p-value of <0.05 was considered statistically significant

4.8.1 Association between Dysphagia Risk and Nutrition Risk Status

Participants who were 'malnourished' had a higher risk of having dysphagia risk (54.5 %) as determined by the EAT-10 versus 15.4 percent of those 'at risk of malnutrition' and 23.1 percent of those with 'normal' nutrition status (p= 0.002) (depicted in **Figure 5**).

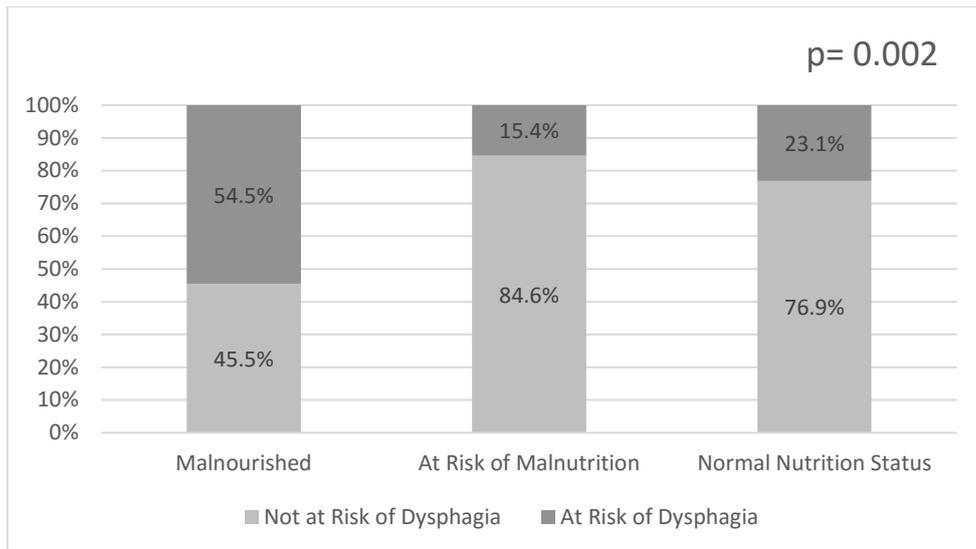


Figure 5: Dysphagia Risk Status and Nutrition Risk Status

4.8.2 Association between Previous Dietetic Input and Nutrition Risk Status

Participants with poorer nutrition status were more likely to have had previous dietetic input compared to participants with normal nutrition status. Fifty percent of participants that were ‘malnourished’ had previously received dietetic input versus only 35.9 percent of those ‘at risk of malnutrition’ and 15.4 percent with ‘normal’ nutrition status ($p= 0.03$) (depicted in **Figure 6**).

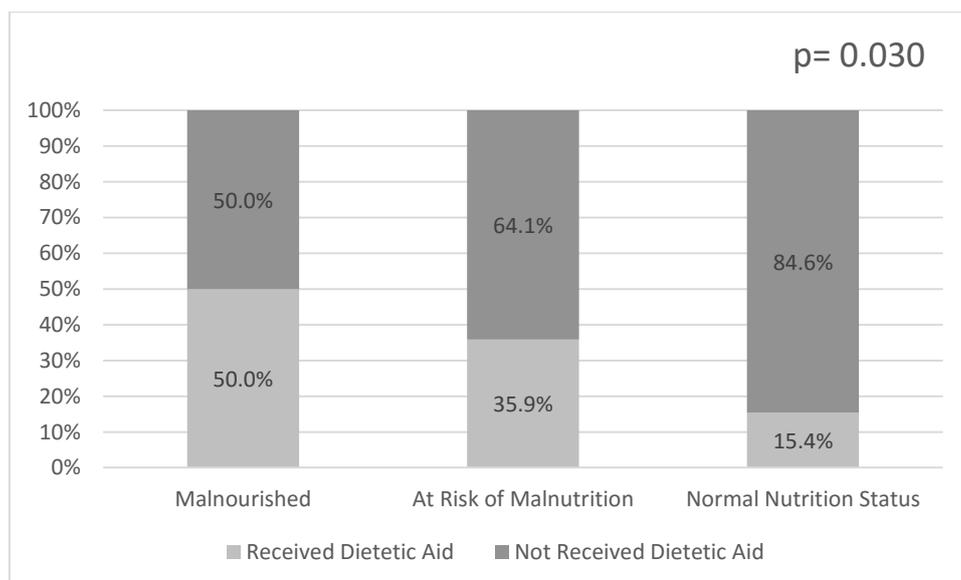


Figure 6: Previous Dietetic Input and Nutrition Risk Status

Chapter 5: Discussion

The purpose of this study was to investigate the prevalence of nutrition risk in older adults between the ages of 65 years to <85 years (and 55 to <85 if of Māori or Pacific ethnicity) admitted to the rehabilitation wards of Waitemata DHB hospitals. The present study also aimed to identify the participant's dysphagia risk, muscle mass and hand grip strength, as well as other relevant physiological and socio-demographic associations with nutrition risk.

5.1 Nutrition Risk Prevalence

Overall, 70.8 percent of the study participants had poor nutrition status (were either malnourished or at risk of malnutrition) upon admission into the AT&R wards. Risk of malnutrition was evident in nearly half (43.8 %) of older adults, while 27 percent were malnourished upon admission to hospital.

These findings are consistent with similar national and international studies. A study in the AT&R wards at Middlemore Hospital identified 68 percent of hospitalised older adults at nutrition risk using the MNA screening tool (24 percent of subjects were malnourished and 44 percent were at risk of malnutrition) (van Lill, 2002). Similarly, in the Bay of Plenty, 73 percent of hospitalised older participants were considered at risk of malnutrition or malnourished using the MNA (Goldstraw, 1998). Furthermore, using tricep skinfold thicknesses, mid-upper arm circumference, serum albumin and pre-albumin (serum proteins) as parameters, a study in Christchurch Hospital found 42 percent of older adults admitted with a fractured hip were significantly malnourished (Hanger et al., 1999). However, given serum proteins are influenced by inflammation (Bruun, Bosaeus, Bergstad, & Nygaard, 1999) these results may have been confounded especially in those who recently experienced a fracture. However, collectively these studies indicate that being at risk of malnutrition or malnourished is not uncommon in older adults, in support of findings in the present study.

Overall prevalence and proportion of severe malnutrition increases with age (Pirlich et al., 2006). Therefore old age may partly explain the high prevalence of nutrition risk in the present study. A hospital malnutrition study in Brazil which included 4000 patients

aged 18 to 90 years of age showed a higher prevalence of malnutrition in those ≥ 60 years (52.8 %) compared to those < 60 years of age (44.7 %, $p < 0.05$) (Waitzberg, Caiaffa, & MI, 2001). In the hospital malnutrition study by Pirlich et al (2006) conducted in Germany, 43 percent of those aged ≥ 70 years were classified as malnourished compared to only 7.8 percent of younger patients aged less than 30 years (Pirlich et al., 2006).

Disease state or illness among the participants, which increases with age (Ministry of Health, 2002; Wang et al., 2006), may also contribute to the high prevalence of nutrition risk. Disease is often associated with loss of appetite, nutrient loss, malabsorption and altered metabolism (often increased requirements) (Ministry of Health, 2010; Norman, Pichard, Lochs, & Pirlich, 2008). These factors contribute to decreased food intake and eventually malnutrition. Patients who are malnourished often have impaired immune response, increased infection risk and a delay in wound healing (Correia & Waitzberg, 2003; Saunders et al., 2010). Therefore a vicious cycle is created, where malnutrition results in slower recovery, increased length of hospital stay and increased treatment costs (Barker, Gout, & Crowe, 2011; Correia & Waitzberg, 2003). As found by Correia et al (2003), patients in various Brazilian hospitals who were malnourished had a 1.6 times higher incidence of complications which included respiratory and cardiac failure, cardiac arrest and wound dehiscence compared to those who were well nourished (Correia & Waitzberg, 2003). In the present study all participants had some form of long standing illness such as ischaemic heart disease, osteoporosis, osteoarthritis and chronic obstructive pulmonary disease and 75.3 percent of participants were taking ≥ 5 prescription medications illustrating poor health. The study by Margett et al (2003) in the UK, found participants in the high and medium risk of malnutrition groups were more likely to report poor health and longstanding illness than those with low risk of malnutrition (80.9 %, 90.1 % and 67.8 % respectively) (Margetts, Thompson, Elia, & Jackson, 2003) which suggests that malnutrition and nutrition risk can be influenced by disease states and poor health. It is likely that old age and poor health may have influenced the high prevalence of malnutrition and nutrition risk found in participants newly admitted to hospital in the present study.

Nutrition risk and malnutrition prevalence in hospitalised older adults has remained an ongoing issue for over a decade. Even with the development of the *Positive Ageing*

Strategy in 2001 and the implementation of its goals by many DHBs, positive changes in the nutritional health of older adults do not appear evident in the present study, where we found nutrition risk comparable to other New Zealand studies dating back as far as 1998 (Goldstraw, 1998; Hanger et al., 1999; van Lill, 2002). Although many key achievements, such as improved provision of access to residential care for older people, fall prevention programmes, better assessment tools, support for older people living in their own homes, and a focus on health and wellbeing programmes have been reported (Office for Senior Citizens, 2015), suboptimal nutritional health remains a problem. The evidence from the present study suggests a greater focus to support the nutritional health in hospitalised older adults is needed.

5.2 Nutrition Risk Factors

As seen from the MNA-SF results in our study, more participants in the 'at risk of malnutrition' group reported a moderate decrease in food intake in the past three months due to loss of appetite, digestive problems, chewing or swallowing difficulties (43.6 %) compared to those with 'normal' nutrition status (7.7 %). Those with decreased or low food intake may very likely not be meeting their nutritional requirements for their physical and physiological functioning (Ministry of Health, 2010). Weight loss can result from individuals not meeting their energy requirements and can be attributed to reduced food intake or presence of disease, which is likely to be inevitable in hospitalised patients (Barker et al., 2011; Hickson, 2006; Ministry of Health, 2010). Weight loss of five percent in three months or ten percent in six months is indicative of increased risk of malnutrition (Hickson, 2006). Individuals with decreased or low food intake can be expected to be at risk of malnutrition or even malnourished (Arikbuka, Yucecan, & Karaagaoglu, 2013; Hickson, 2006; Keller, 2007; Mann et al., 2013). Nearly half (45.8 %) of participants in this study who were 'malnourished' had a decrease in food intake. A third (30.8 %) of those 'at risk of malnutrition' and two-thirds (62.5 %) of those that were 'malnourished' reported unintentional weight loss of greater than 3 kg's during the last three months. This is consistent with similar NZ studies (Goldstraw, 1998; Watson, Zhang, & Wilkinson, 2010). Weight loss is also known to increase risk of morbidity and contributes to frailty and poor quality of life (Kretser et al., 2003).

There were more participants 'malnourished' and 'at risk of malnutrition' who reported needing daily help with activities of daily living (ADL's) (75 % and 69.2 % respectively) than those with 'normal' nutrition status (53.8 %). This finding is similar to other studies. Hengstermann et al (2008), found good nutritional status correlated with the ability to perform ADL's ($r = 0.307, p < 0.001$). Impaired nutritional status can give rise to a decrease in functional status which can impair the ability to perform ADL's (Hengstermann, Nieczaj, Steinhagen-Thiessen, & Schulz, 2008). The finding that a high number of participants with impaired nutritional status reporting needing daily help with ADL's is then not unexpected. Additionally, those who cannot perform food related ADL's and/or instrumental activities of daily living (IADL) are at an increased risk of malnutrition. Older adults who have limited functional health may struggle with self-feeding, food procurement and meal preparation (Sharkey, 2002) which can further exacerbate poor nutritional status (S. Lee, Frongillo, EA., 2001). This can give rise to a vicious cycle whereby impaired nutritional status negatively affects the ability to perform ADL's and IADL's which then further exacerbates poor nutritional status (Ministry of Health, 2010).

In this study more participants in the 'malnourished' group had previous dietetic input (50 %), than those in the 'at risk of malnutrition' group (35.9 %), or the 'normal' nutrition status group (15.4 %, $p = 0.03$). This finding may be somewhat expected because malnourished individuals are typical dietetic patients (American Dietetic Association, 2005; Tappenden et al., 2013). Malnutrition is a nutritional issue and dietitians are trained nutrition professionals that implement complete nutritional assessments, diagnosis, evidence-based interventions and outcome evaluations for nutritional problems (American Dietetic Association, 2005; Tappenden et al., 2013). The findings may suggest that those with nutritional issues would be more likely to be seen by a dietitian, and for those with no nutritional issue (i.e. those with 'normal' nutrition status) to have the least dietetic input. Even though the highest amount of participants previously seen by a dietitian were in the malnourished group, 50 percent of those who were 'malnourished' and 64.1 percent of those 'at risk of malnutrition' still had not previously had dietetic input – which suggests many patients with malnutrition or at risk of malnutrition are not being recognised or referred while having malnutrition and therefore untreated. Agarwal et al (2012), whom investigated nutrition care practices in hospital wards as part of the Australasian Nutrition Care Day Survey, found 90 wards

(24 %) did not conduct nutrition risk screening or routine weighing for their patients (Agarwal et al., 2012) indicating that many individuals go unrecognised and untreated with malnutrition or being at risk of malnutrition. Although nutrition care practices were not investigated in this study, inadequate screening or monitoring practices may explain the low but slightly increasing number of patients receiving dietetic aid as patients may not be seen before their symptoms of malnutrition become severely noticeable (e.g. significant weight loss, poor oral intake).

5.3 Dysphagia Risk Status and Prevalence

Nearly a third (27.6 %) of participants in this study were at risk of dysphagia. There were more participants who were both 'malnourished' and 'at risk of dysphagia' (54.5 %) than those 'at risk of malnutrition' (15.4 %) or with 'normal' nutrition status (23.1 %, $p= 0.002$). Previous literature supports an association between increase dysphagia risk and malnutrition (Ercilla et al., 2012; Hickson, 2006; A. Lee et al., 1999; Mann et al., 2013; Martino et al., 2010; Serra-Prat et al., 2011; Wakabayashi & Matsushima, 2015).

Dysphagia is an ageing concern (Ercilla et al., 2012; Hickson, 2006; Miller & Patterson, 2014; Serra-Prat et al., 2011; Sura et al., 2012; Wakabayashi & Matsushima, 2015). Older adults experience changes to the swallowing process brought on by physiological changes with advancing age, including reductions in muscle mass, muscle strength and tissue elasticity, leading to slower bolus transit times from mouth to the stomach (Miller & Patterson, 2014). This may predispose older adults to increased risk of developing dysphagia, and as a consequence, nutritional issues such as decreased food intake leading up to malnutrition (Miller & Patterson, 2014). Furthermore, malnutrition in turn can contribute to dysphagia via deglutitive muscles undergoing atrophy from reduced food intake. This can compromise the integrity of the swallow and initiate a viscous cycle further decreasing intake and exacerbating poor swallow function (Hudson, Daubert, & Mills, 2000)

Lee et al (1999) in their prospective study in an acute geriatric medicine unit in Singapore, noted dysphagia referral rates among the elderly have increased by 20 percent from 2002-2007, where over 70 percent of referrals were for those over 60 years of age (A. Lee et al., 1999). In Serra-Prat et al's (2011) study which investigated

dysphagia in independently living older persons in Spain, found dysphagia was more prevalent with increasing age (36.4 % in 80 year olds, compared to 21.7 % in 70-79 year olds) . The study also found malnutrition or being at risk of malnutrition was independently associated with impaired efficacy of swallow (Serra-Prat et al., 2011). The finding of ‘malnourished’ participants being at a higher risk for dysphagia risk in the present study is therefore not unexpected.

The three main swallowing issues, assessed from the EAT-10, were ‘swallowing solids takes extra effort’, ‘swallowing pills takes extra effort’ and ‘when I swallow food sticks to my throat’. Although not further investigated in this study, these unpleasant experiences would likely result in changes in eating habits, most notably in the form of food restriction (Mann et al., 2013; Martino et al., 2010; Miller & Patterson, 2014). A participant in Martino et al’s (2010) qualitative study in Canada, found fear of choking to be a psychological impact of dysphagia, for example, a participant reported refusal to drink prescribed fluids even when thirsty due to fear of choking (Martino et al., 2010). The extra effort in swallowing and poor nutritional intake is a potential explanation for a malnourished or at risk of malnutrition state in patients at higher risk of dysphagia. In the study by Mann et al (2013) investigating the association between chewing and swallowing difficulties and nutritional status in community-dwelling older adults in the US, found those with swallowing difficulties were deficient in fibre, calcium, magnesium, zinc, vitamins D, E and K and folate. These deficiencies were on average 44.9 percent below recommended dietary intakes (Mann et al., 2013).

5.4 Muscle Mass & Strength

Muscle mass percentage (39.0 ± 4.3 % for ‘malnourished’, 46.2 ± 0.6 % for ‘at risk of malnutrition’ and 36.0 ± 7.5 % for ‘normal’ nutrition status) in the present study are relatively lower than a previous NZ study (64.1 ± 8.9 % for those at high nutrition risk and 66.9 ± 7.3 % for those with low nutrition risk) assessing body composition and nutrition status in older adults (C. A. Wham, Teh, Robinson, & Kerse, 2011). There were a low number of BIA assessments completed in the present study, as only nine participants were suitable or willing to undergo BIA assessment. A smaller sample size may not accurately portray muscle mass of all hospitalised older adults and therefore results for muscle mass should be viewed with caution. In a study by Wham et al.

(2011), approximately 100 BIA assessments were completed, and found older adults who were 'at high nutrition risk' had a muscle mass percentage of 64.1 percent (C. A. Wham et al., 2011). This was more than 1.5 times the muscle mass percentage of older adults with similar nutrition risk status ('malnourished' and 'at risk of malnutrition') in the present study ($39.0 \pm 4.3\%$ and $46.2 \pm 0.6\%$ respectively). It should be noted that Wham et al (2011) had used the SCREEN II (Seniors in the community: risk evaluation for eating and nutrition, Version II) nutrition screening tool, whereas the present study had used the MNA-SF. Different nutrition screening tools between the study by Wham et al (2011) and the present study may in part explain the differences in muscle mass found between the two studies. The study by Wham et al (2011) was conducted in community living adults of advanced age, whereas the present study was conducted in hospitalised older adults. Different study participants (e.g. community vs. hospitalised older adults) may also partly explain why there were differences in muscle mass percentages between that study and the present study. Alley et al. (2010) found older adults who were hospitalised in the previous year had up to 0.33 kg lean mass loss compared to non-hospitalised participants. Presence of several major diseases and bed rest can impact body composition in hospitalised older adults (Alley et al., 2010; English & Paddon-Jones, 2010). Loss of muscle mass in older adults can be exacerbated with physical inactivity and bed rest due to a reduction in muscle protein synthesis and increased muscle catabolism secondary to injury or disease, which reduces both muscle mass and strength, this in turn can lead to problems with muscle tissue and functional capacity (English & Paddon-Jones, 2010).

Results for muscle strength in the present study for 'malnourished' (15 ± 6.0 kg), and 'at risk of malnutrition' (18 ± 8.0 kg) are similar to that of an Australian study of hospitalised participants with a mean age of 75 years, which found those who were severely malnourished had a mean hand grip strength of 14.0 ± 7.6 kg's, and those who were moderately malnourished had a mean hand grip strength of 17.1 ± 9.5 kg's. In the same Australian study, those who were well nourished had a mean hand grip strength of 27.2 ± 11.7 kg's (Flood, Chung, Parker, Kearns, & O'Sullivan, 2014). This indicates those with better nutritional status should have had higher muscle strength, but this was not the case in the present study. It was therefore interesting and surprising to find that hand grip strength in the participants in the present study was lower in those with

'normal' nutritional status (16 ± 10.0 kg's) compared to those 'at risk of malnutrition' (18 ± 8.0 kg's) and was similar to the hand grip strength of the those in the 'malnourished' group (15 ± 6.0 kg's). Differences in results between the present study and the study of Flood et al (2014) may in part be explained by the differences in the study populations and the use of different nutrition screening techniques. The study population in Flood et al's (2014) study included all patients aged 18 years onwards from the medical, surgical and rehabilitation wards which was different to the present study, where only participants aged 65 years and older and from the rehabilitation wards were included. Although, the study by Flood et al (2014) did have an older study group as the mean age of all participants was 75.1 years which is still comparable to the present study (78.1 years). Additionally, a different nutrition screening tool was used by them (the Patient Generated Subjective Global Assessment (PG-SGA)), whereas the present study used the MNA-SF. However the low hand grip strength in the 'normal' nutrition status group in the present study may potentially be explained by unequal numbers of men and women. In the present study women had a significantly lower hand grip strength than men (13 ± 6.0 and 20 ± 9.0 respectively, p -value <0.001). A higher number of women ($n= 16$) than men ($n=10$) in the 'normal' nutrition status group may have lowered the overall hand grip strength value and hence appeared lower than the 'at risk of malnutrition' group, which had near equal gender numbers. The results for handgrip strength should therefore be interpreted cautiously.

5.5 Strengths of the Study

The findings of the present study provide further insight of nutrition risk of older adults in NZ. Few studies have measured the prevalence of nutrition and dysphagia risk, muscle mass and muscle strength in a sample of hospitalised older adults. The present study provides updated information in this area and puts forth the notion that poor nutritional status is still a current concern that needs to be addressed.

A strength of the study was the use of validated screening tools (MNA-SF, EAT-10) to obtain accurate information. Furthermore, only two researchers were involved in the study who received robust training to appropriately conduct the assessments. Full

assessments with participants were only conducted by one researcher at a time. This reduced inter-individual variation.

The present study had a moderate sample size of 89 participants. This is comparable to other NZ studies that have looked at nutrition risk status of older adults in both community and hospital settings (Goldstraw, 1998; Hanger et al., 1999; van Lill, 2002; C. Wham et al., 2011; C. A. Wham et al., 2011).

5.6 Limitations of the Study

The observational cross-sectional study design had the inherent limitation of not being able to infer causation due to being carried out at one point in time. The findings observed are then merely associations. Nevertheless, it does provide current prevalence of nutritional risk in hospitalised older adults and provides insight into several nutrition risk factors.

Given the numbers excluded from the study, there may be an element of non-response bias on the estimated prevalence of malnutrition or risk of malnutrition on the rehabilitation wards. Seven participants were excluded from the study due to their poor health status. Evidence suggests that malnutrition and poor health status are linked (Correia & Waitzberg, 2003; Ministry of Health, 2010; Saunders et al., 2010), hence the prevalence of malnutrition or malnutrition risk among the study participants may be underestimated.

Muscle mass was assessed using standing BIA scales; although a useful tool in measuring muscle mass, the standing BIA scale limited our ability to collect accurate information on muscle mass or identify significant associations with nutrition risk status with low numbers of participant assessments completed. Many participants could not stand without assistance, as such, many declined assessment or could not be assessed with the standing BIA. In hindsight, a portable BIA machine would have been more practical in assessing participants that were bed-bound or could not stand unaided. Admittedly the researchers of the study only had access to a standing BIA scale at the time. It is advisable for future studies assessing body composition with a BIA in hospitalised older adults to use a portable device or if feasible, to use body imaging

techniques such as CT, MRI or DEXA for greater validity as these are considered gold standard for analysing body composition (Cruz-Jentoft et al., 2010).

The present study was unfortunately unable to gather accurate data or identify significant associations with muscle strength and nutrition risk status with imbalances of men and women in each nutrition risk group. Having more women in one group may have influenced combined muscle strength results as there was a significant difference in strength between genders. The results for hand grip muscle strength should be viewed with caution. Studies assessing hand grip strength in hospitalised older adults may need to ensure it can gather a large study sample so that imbalances in men and women in nutrition risk groups do not influence the results.

There were many assessments and questions declined by participants in the study, which may be due to patient fatigue as part of being in the AT&R ward. As participants were newly admitted into the rehabilitation wards, they may have been burdened by multiple assessments and treatments from health professionals e.g. gym sessions with the physiotherapist, doctor's orders, needing to go for scans, occupational therapy sessions etc. Additionally disease states and conditions may have caused fatigue in older hospitalised patients (Avlund, 2010). This may have led to them feeling overwhelmed with being seen by multiple health professionals whilst also taking part of the study. The study used four questionnaires (a general characteristics questionnaire, MNA-SF, EAT-10 and MoCA) and two physical assessments (hand grip strength and muscle mass by BIA assessment), less assessments or use of shorter questionnaires may increase participant compliance.

Finally, the MoCA may have misrepresented cognitive impairment. Participants in the present study who had impairments in vision (stated they could not see certain questions without their reading glasses) had partially completed MoCA assessments (as they declined answering certain questions). Similarly participants who were unable to write (e.g. due to arthritis in their hands) may have had lower MoCA scores, leading to inaccurate reflections of cognitive state. Oren et al (2015) in their study investigating the ability of the MoCA to assess cognitive status in the elderly found that the MoCA over represented cognitive impairment in a sample of cognitively-intact elderly, suggesting that a specific cut off score by age for the MoCA is required. In this study it is

also of note that 26 participants had either declined the MoCA assessment or were discharged prior to MoCA assessment. Additionally, there were seven patients who could not give consent and were excluded from the study. Therefore the MoCA scores may not be an accurate representation of the patient's cognitive status on the AT&R wards.

Chapter 6: Conclusion and Recommendations

6.1 Aim of the Research

This cross-sectional, observational study is one of few that measures the prevalence of nutrition risk and explores associations between nutrition risk prevalence and possible factors that can influence or can be influenced by nutrition status including dysphagia risk status, muscle mass composition, dominant hand grip strength, marital status, living situation, income, education, BMI, regular prescribed medication, use of nutritional supplements, dental status, cognitive state, support service use and previous dietetic input in hospitalised older adults in NZ. Nutrition risk and malnutrition has serious consequences including loss of muscle mass, loss of strength, impaired cognition, longer length of hospital stay, higher treatment costs and increased mortality (Correia & Waitzberg, 2003; Saunders et al., 2010). The nutritional health of older adults is complex and multi-factorial, understanding the range of factors that influence the nutritional health of older people will aid in the development of strategies and plans to prevent and treat the burden of malnutrition. With many similar national studies conducted over a decade ago by van Lill (2002), Goldstraw (1998) and Hanger et al (1999) there was a need for updated information, especially in light of the expected growth of the older population in NZ in the coming years (Statistics New Zealand, 2014c).

6.2 Main Findings and Recommendations

The study set out to investigate nutrition risk prevalence in hospitalised older adults newly admitted into the AT&R wards of WDHB using the Mini Nutritional Assessment – Short Form (MNA-SF) tool. It was alarming to find that in spite of the *Positive Ageing Strategy* released since 2001, that poor nutrition risk status (e.g. malnutrition and at nutrition risk) was still observed in two-thirds (70.8 %) of the participants and that malnutrition risk was not lower in the present study than studies done in the late 1990s and early 2000. Therefore the *Positive Ageing Strategy's* second goal to provide equitable, timely, affordable and accessible health services for older people (Office for Senior Citizens, 2015) does not seem to have been effective in reducing malnutrition risk.

The study determined the prevalence of dysphagia risk in the same study group. Using the Eating Assessment Tool-10 (EAT-10), it was found dysphagia risk was prevalent in a quarter of older adults (27.6 %), with no significant differences found between men and women ($p= 0.18$). Severe dysphagia poses the immediate risk of choking and possible death, while lesser forms are associated with a range of other negative factors including increased risk of undernourishment, development of aspiration pneumonia and longer length of hospital stay (Leder & Suiter, 2009; A. Lee et al., 1999; Miller & Patterson, 2014; Sura et al., 2012). The health care setting will need to put a greater focus on screening and management programmes for dysphagia as the population of older adult's increases.

Muscle mass and muscle strength were also determined in this study group. The muscle mass percentage for those who were 'malnourished' was 39.0 ± 4.3 percent, 46.2 ± 0.6 percent for those 'at risk of malnutrition' and 36.0 ± 7.5 percent for those with 'normal' nutrition status. Findings for muscle mass percentage should be interpreted cautiously however, since the standing BIA scale proved too much of a limitation in the demographic of older hospitalised adults, much of whom could not stand independently. It was interesting and unexpected to find that hand grip strength in the present study was lower in those with 'normal' nutritional status (16 ± 10.0 kgs) than those 'at risk of malnutrition' (18 ± 8.0 kgs) and was similar to the hand grip strength of those in the 'malnourished' group (15 ± 6.0 kgs). However, the validity of hand grip strength data was likely confounded by gender when assessed between nutrition groups, since there were more women in the 'normal' nutrition group and as expected women had lower hand grip strength than men, lowering the overall handgrip strength in the group. Nonetheless, research has shown that advancing age is met when physiological, functional and metabolic changes, all of which impact muscle mass and strength at old age (Frontera et al., 2000; Hickson, 2006; International Working Group on Sarcopenia, 2011; von Haehling et al., 2010). Monitoring of any changes to body weight, muscle mass or strength may prove to be effective health care practice.

The measurement of weight may be a more practical strategy in screening patients at risk of malnutrition, muscle mass loss and frailty in the health care setting, as sophisticated body composition measurements such as the DEXA, CT, MRI and BIA may be unrealistic to conduct routinely (too expensive and cumbersome)(von Haehling et al., 2010),

Patients with significant unintended weight loss can then be referred to a dietitian for more in depth assessment and implementation of weight gain strategies.

Future studies assessing body composition in hospitalised older adults may benefit from use of a portable BIA device that can measure body composition in bed-ridden or participants who cannot stand un-aided. Alternatively, body imaging techniques such as CT, MRI or DEXA may also be used for greater validity, if feasible (von Haehling et al., 2010). Studies assessing hand grip strength in hospitalised older adults may need to ensure it can gather a large study sample so that imbalances in men and women in nutrition risk groups do not influence the results.

This study also investigated associations between nutritional risk factors and relevant physiological or socio-demographic factors. Apart from previous dietetic input and dysphagia risk status, no other relevant physiological or socio-demographic risk factors (e.g. marital status, living situation, income, education, BMI, regular prescribed medication, use of nutritional supplements, dental status and support service use) was found to be associated with nutrition risk. Those that had poorer nutrition status (e.g. 'malnourished' or at risk of malnutrition') were more likely to have had previous dietetic input than those with 'normal' nutrition status. This finding is somewhat expected because malnutrition is a nutritional issue that is addressed by dietitians. It was however, surprising to find that a high number of those 'at risk of malnutrition' or 'malnourished' have yet not been seen by a dietitian, which indicates that older patients are not being seen before their symptoms of malnutrition become severely noticeable. Although there were more participants with poor nutrition risk status having previously received dietetic input, the majority of participants in both the 'malnourished' and 'at risk of malnutrition' groups had not received prior dietetic input, suggesting that many individuals with poor nutrition risk status go unrecognised or untreated.

A significant association was found between malnutrition and being at risk of dysphagia ($p=0.002$). Dysphagia is an ageing concern, as older adults experience age-associated physiological and nutritional decline, changes in deglutition may result as a consequence (Hickson, 2006; Hudson et al., 2000; Miller & Patterson, 2014; Sura et al., 2012). In addition, dysphagia poses increased risk of malnutrition which can develop

into a vicious cycle of exacerbated poor deglutition and severe poor nutritional status (Hudson et al., 2000; Miller & Patterson, 2014; Sura et al., 2012). As the population of older adults increases, screening and monitoring practices for dysphagia risk status needs to be implemented. It is essential dysphagia risk status is monitored so that patients at dysphagia risk can be identified and treatment be instigated by health professionals. Interventions can be put into place by using safe variations in food consistency and fluid viscosity to lead to better nutritional and health outcomes (Sura et al., 2012).

The findings highlight the need for nutritional screening and monitoring of hospitalised older adults. The importance of nutrition screening lies in the ability to identify those that are malnourished and those at risk of malnutrition, so that nutritional treatment can then be appropriately instigated for better health outcomes for hospitalised older adults. It is recommended that patients on admission to hospital be nutritionally screened and weighed. Routine screening and weighing (possibly weekly or fortnightly) in those who were not initially considered at risk of malnutrition is also advisable as nutrition risk may develop during the hospital stay. Nutrition screening tools, such as the MNA-SF, provide an effective and efficient method of nutritional screening which is practical in this setting. However, there is little value in assessing nutrition risk if screening is not followed by dietetic intervention. Health care facilities need to ensure appropriate protocols, such as ease of referrals to dietitian, are put in place to successfully reduce the health burden of malnutrition.

Future studies should aim to identify nutrition risk status in a larger sample of newly admitted hospitalised older adults to provide a more robust indication of nutrition risk prevalence and further explore the associations between nutrition risk prevalence and relevant physiological, and socio-demographic risk factors. Assessing nutrition risk prevalence in different ethnicities may also be of value, especially in light of the projected increase in ethnic diversity of the older population (Statistics New Zealand, 2010). Studies should also review nutrition screening and care practices in hospitals. Audit-like research will ensure hospitals are implementing best nutrition care practices for its patients and can identify any areas of improvement in the healthcare of older adults.

The present study contributes important insight into nutrition risk prevalence and its associated relationships in hospitalised older adults. This adds to the body of evidence that may help guide future nutrition interventions and policy in the healthcare setting. In the absence of nutrition risk surveillance, many patients can go undiagnosed and therefore untreated. Implementation and protocols around nutrition screening and treatment is therefore vital. Addressing the burden of poor nutritional health not only has beneficial health outcomes for the older patient but also economic benefits for the health care facility. Food and nutrition play an important role in old age and can contribute to maintaining independence, functional ability, chronic disease management and quality of life. With optimal nutrition status, older adults may be able to live a more fulfilling and enjoyable life away from the burdens of nutrition risk and malnutrition.

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Appendices

Appendix A. Ethics Approval

Appendix B. Patient Information Sheet

Appendix C. Consent Form

Appendix D. Study Questionnaire

Appendix E. Mini Nutritional Assessment – Short Form (MNA-SF)

Appendix F. Eating Assessment Tool – 10 (EAT-10)

Appendix G. Montreal Cognitive Assessment (MoCA)

Appendix A. Ethics Approval



Health and Disability Ethics Committees

Ministry of Health
C/- MEDSAFE, Level 6, Deloitte House
10 Brandon Street
PO Box 5013
Wellington
6011

0800 4 ETHICS
hdec@moh.govt.nz

30 June 2014

Dr Jacqueline Allen
PO Box 99743
Newmarket
Auckland
Auckland 1149

Dear Dr Allen

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

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

Conditions of HDEC approval

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

Standard conditions:

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

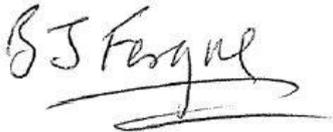
After HDEC review

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

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

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

Yours sincerely,

A handwritten signature in black ink, appearing to read 'B J Fergus', with a horizontal line underneath.

Dr Brian Fergus
Chairperson
Northern A Health and Disability Ethics Committee

Encl: appendix A: documents submitted
appendix B: statement of compliance and list of members

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.

Where can you go for more information about the study?

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

Amy Popman

Dietetic Student, Massey University
University

Phone: [REDACTED]

Email: [REDACTED]

Darshan Patel

Dietetic Student, Massey

Phone: [REDACTED]

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Dr Carol Wham, PhD, NZRD

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

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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 = New Zealand 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

19. Do you have any other health problems?

Yes	No
1	2

Other health problems	Comments:

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

Number of medications: _____

Medication	Comment (i.e. dose etc)

1	2
---	---

Comments:

25b. Have you previously had any dietetic input?

Yes	No
1	2

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

Interviewer to answer the following

How well do you rate:

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

Comments (required if answer is 1 or 2):

Appendix E. Mini Nutritional Assessment – Short Form (MNA-SF)

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 m²)

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

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 F. Eating Assessment Tool – 10 (EAT-10)

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	1	2	3	4
---	---	---	---	---

No problem				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

