Factors Associated with Dysphagia Risk among Residents in Aged Care

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Mariam Hanosh

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Abstract

Background: Dysphagia is commonly associated with the ageing process and can lead to decreased food intake with associated health problems.

Aim: This study aimed to determine factors associated with-dysphagia risk among older adults in residential aged care (RAC).

Methods: Residents aged ≥ 65 years and, with severe cognitive or functional decline, or undertaking palliative care were excluded. Pacemaker wearers were excluded from completing the body composition analysis assessment. This cross-sectional study included 91 older adults across three RAC facilities in Auckland. Demographic data were collected from the RAC clinical files. Validated questionnaires were completed during personal interviews. These included: Strength, Assistance with walking, Rising from a chair, Climbing stairs, and experiencing Falls (SARC-F), Mini Nutritional Assessment Short-Form (MNA-SF), Eating Assessment Tool (EAT-10), Geriatric Depression Scale (GDS) and the 12-item short form survey to assess health-related quality of life (SF-12). Physical measures included weight, grip strength, gait speed and body composition.

Results: Findings showed the odds of being at dysphagia risk increased in those at risk of sarcopenia OR= 4.7, 95% CI 1.8, 12; malnutrition OR=10, 95% CI 1.2, 82, and depression OR= 5.0 95% CI 1.9, 13. Adjusting for age, sex and number of medications, sarcopenia risk, malnutrition and depression remained associated with dysphagia risk. Adjusting for age, sex, number of medications and all health variables (SARC-F, MNA, and GDS); depression risk was the only remaining significant association with being at dysphagia risk .

Conclusion: This study highlights the need to identify and address malnutrition, sarcopenia, and depression to minimise the cyclic impact these conditions have one each other and older adults in RAC.

Acknowledgements

To my supervisors Professor Carol Wham and Dr Wendy O'Brien, I have been extremely privileged to work under your guidance and expertise. Thank you for all the hours you have invested in me, for your patience, empathy, and words of encouragement throughout this marathon, and for getting me to the finish line.

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List of Abbreviations

Abbreviation	Definition
ADL	Activities of daily living
AOA	Anorexia of ageing
ASHA	American speech and hearing association
BIA	Bio-electrical impedance analysis
BMI	Body mass index
CI	Confidence interval
DHB	District health board
DXA	Dual energy X-ray absorptiometry
EAT-10	10-Item Eating Assessment Tool
EGWSOP	European working group on sarcopenia in older people
EPOA	Enduring power of attorney
ESPEN	European society for clinical nutrition and metabolism
FFM	Fat free mass
FFMI	Fat free mass index
GDS	Geriatric depression scale
GP	General practitioner
HE	Health expectancy
HEHP	High energy, high protein
IBM	International business machines corporation
ILE	Independent life expectancy
LE	Life expectancy
MCS	Mental component summary
MNA	Mini nutritional assessment
MNA-SF	Mini nutritional assessment -short form
MUST	Malnutrition universal screening tool
NZANS	New Zealand adult nutrition survey
OD	Oropharyngeal dysphagia
OECD	Organization for economic cooperation and development
OR	Odds ratio
PCS	Physical component summary
QOL	Quality of life
RAC	Residential aged care
SARC-F	Strength, assistance with walking, rising from a chair, climbing stairs, and falls
SF-12	12 item short form survey
SNAQ	Simplified nutritional appetite questionnaire
SPSS	Statistical package for the social sciences

UK	United Kingdom

Abbreviation	Definition
US	United States
USA	United States of America
VFS	Videofluoroscopic swallow study
V-VST	Volume-viscosity swallow test

Chapter 1: Introduction

1.1 Background and Justification

New Zealand's demographic is changing as the older adult population (aged 65+ years) is increasing. Older adults accounted for 16% of the total New Zealand population in 2020, this proportion is forecasted to more than double approximately 50 years down the line (by 2073) increasing to 34% (Statistics New Zealand, 2020). Out of the older adult population, the more frail and dependent ≥85-year group is the fastest growing (Ashley-Jones, 2009; Hill et al., 2016). Our developing society is the key driver for our steadily increasing lifespan through efforts to improving food, health and housing security as well as the development of therapeutic and preventative medicines (Kirkwood, 2017).

This positive outcome of increased life expectancy (LE) fails to address the quality of these extra years lived. Health expectancy (how many years we live in good health) is rising at a much slower rate than LE, so more years will be lived in ill health, approximately a decade (Ministry of Health, 2017). As a result of ill health, carrying out activities of daily living (ADL) may become challenging and unsafe to do so independently and will therefore require additional support. Almost half of total district health board (DHB) spending goes towards supporting older adults, mostly to fund residential aged care (RAC) services (Ministry of Health, 2016b). The increasing older adult population will require an equivalent increase in support services and the budget to fund them.

Efforts towards improving the health of older adults can relieve some pressure from healthcare providers and enable older adults to have the opportunity to safely and independently age in place within the community. The current reality, however, is RAC facilities are forecasted to have 12,000 - 20,000 additional older adults in New Zealand who will require placement by 2026 (Thornton, 2010) on top of the current 33,000. To remain safely residing within the community, older adults must be capable of carrying out basic ADL such as toileting, bathing, dressing and eating (Verlaan et al., 2017). These ADL require

energy and some physical function to carry out, therefore adequate nutrition is imperative to facilitate this by providing the fuel and building blocks the human body requires.

Alongside consuming enough energy required to carry out ADLs, protein intake is also necessary as it provides the amino acid building blocks that form muscles and contribute to muscle mass and strength. Inadequate protein intake in older people is associated with increased frailty, decreased immune function, poorer healing, and longer recuperation from illness (Chernoff, 2004). Protein requirements for people aged over 70 years are 25% higher than for younger adults (NHMRC, 2006), however as calorie intake generally decreases with age (De Groot et al., 2000; Wakimoto & Block, 2001) and meeting those increased protein recommendations may be challenging. Chronic insufficient protein intake can lead to changes in body composition over time, such as decreased muscle mass (Hickson, 2006); muscle strength, and function (Cruz-Jentoft et al., 2010).

The primary cause of nutrition deficit in older adults is reduced intake (De Groot et al., 2000; Wakimoto & Block, 2001). According to the 2008/09 New Zealand Adult Nutrition Survey, energy consumption fell by 260 kcal in females and 312 kcal in males as they progressed from 51-70 years to 71+ years of age (University of Otago and Ministry of Health, 2011). Reduced food intake in older age can be a result of many factors, one of those being dysphagia (difficulty when swallowing) (Morris, 2006).
Dysphagia risk is prevalent among older adults in various settings, more so in hospital patients and RAC residents. A New Zealand cross-sectional study investigated dysphagia risk in two Auckland hospitals of newly admitted older adults and found that 33% of the participants were at risk of dysphagia (Popman, Richter, Allen, & Wham, 2018). Another study in New Zealand found that participants recently admitted to RAC were 32% likely to have dysphagia, over nine times more likely compared to those living in the community (Wham et al., 2017). Dysphagia has been observed to further increase among a malnourished, older population. Chatindiara et al. (2020), reported that across newly admitted RAC residents, dysphagia risk was found to affect 38% of participants, further increasing to 56% in those identified as malnourished and 83% in those identified as frail.

Early identification of dysphagia is key to preventing its progression, therefore a quick, affordable and non-invasive bedside screening tool such as the Eating Assessment Tool (EAT-10) can be an ideal screening method. This tool can be used to determine the initial dysphagia risk as well as monitor severity in response to treatment. It is an excellent tool that can support adequate management of OD (Belafsky et al., 2008).

Dysphagia is part of a cyclic relationship with co-morbidities including malnutrition and sarcopenia (see Figure 1).

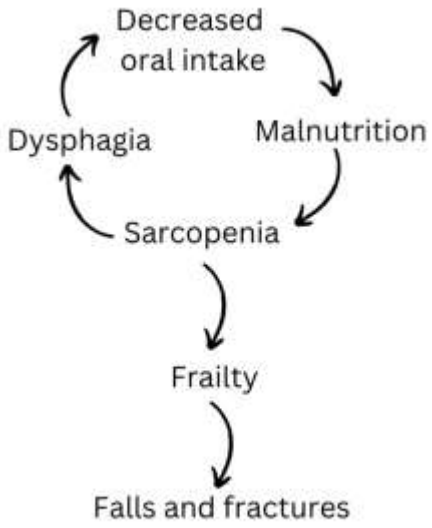

Figure 1. Dysphagia, malnutrition and sarcopenia cycle

An association between dysphagia and malnutrition has been well documented (Madhavan et al., & Carnaby, 2016; Mann et al., 2013; Serra-Prat et al., 2012; Serra-Prat et al., 2011; Takeuchi et al., 2014; Wakabayashi & Matsushima, 2016; Wham et al., 2017). Decreased oral intake can be a result of dysphagia due to the discomfort, pain and stress associated with the safety of swallowing (Khan et al., 2014) as well as the reduced acceptability of texture-modified dysphagic diets (Ullrich & Crichton, 2015).

Failing to meet nutritional requirements for a prolonged period of time can lead to malnutrition. Malnutrition is disproportionately prevalent in the older population (Watson et al., 2010; Wham et al., 2011); studies indicate that 25% of the global older population is

malnourished and 46% are at risk (Kaiser et al., 2010). Similarly, New Zealand research assessed the malnutrition risk of older people across district health board community, hospital and residential care settings and reports that 23% of older adults were malnourished and 35% at high risk of malnutrition (Wham et al., 2017). Further analysis indicated that those living in RAC had the highest malnutrition risk compared to hospital and community settings (Wham et al., 2017). A separate New Zealand study that screened for malnutrition among a sample of 257 older adults within the community found that 12% were malnourished or at risk of malnutrition, the odds increasing with age (Chatindiara et al., 2020).

Malnutrition is not only a result of dysphagia, but also a cause, as insufficient nutrition can result in muscular atrophy, including swallow muscles, therefore reducing the effectiveness of the swallow (Baijens et al., 2016; Cabré et al., 2014), leading to reduced food intake, and further exacerbating malnutrition (Wham et al., 2017). A chronic malnourished state gradually causes muscle wasting due to insufficient protein intake to maintain muscles, and insufficient energy intake resulting in muscle breakdown for energy use (Carbone et al., 2012).

Muscle protein degradation can lead to sarcopenia, a syndrome that describes the generalised and progressive decline of muscle mass, strength, and function (Cruz-Jentoft et al., 2010; Fielding et al., 2011; Morley et al., 2011; Rolland et al., 2008).

The association between sarcopenia and dysphagia has been documented. Sarcopenia is a generalised and progressive decline of muscle mass, strength, and function (Cruz-Jentoft et al., 2010; Fielding et al., 2011; Morley et al., 2011; Rolland et al., 2008); and frailty occurs from age-related decrease in several physiological systems, cumulatively rendering an individual more susceptible to sudden changes in health status brought on by minor stressor events (Clegg et al., 2015). A 2016 study investigated the link between sarcopenia and dysphagia in hospitalized older adults, finding sarcopenia to be an independent factor for dysphagia incidence (Maeda & Akagi, 2016a). Loss in muscle strength and function can make carrying out even simple daily tasks such as dressing and toileting difficult, and can potentially lead to falls, fractures and an increased risk of frailty and mortality (Bahat et al.,

2019; Hathaway et al., 2015; Hathaway et al., 2014; Madhavan et al., 2016; Melgaard et al., 2017). Frailty is better than chronological age in predicting all-cause mortality (Song et al., 2010), however with early assessments, identification and intervention of dysphagia and sarcopenia, the progression of frailty can be prevented, delayed or reversed (Chatindiara et al., 2020).

Dysphagia in itself can be an acutely life-threatening condition by increasing aspiration risk (potentially resulting in choking and aspiration pneumonia), while also chronically increasing the risk of developing co-morbidities such as malnutrition, sarcopenia and frailty. The development of these conditions can be highly detrimental to the physical and mental health of older adults, resulting in loss of independence and quality of life. By identifying and understanding the factors associated with incidence of dysphagia, targeted interventions can then be developed and act as a 'spanner in the works' in the dysphagia, malnutrition, and sarcopenia cycle and improve the quality of the golden years.

1.2 Researcher Contributions

Contributor	Roles
Professor Carol Wham	Main Supervisor
Dr Wendy O'Brien	Main Supervisor
Dr Hajar Mazahery	Statistician
Amy Richter	Research Assistant
Brittany Malcolm	Research Assistant
Phillipa Darroch	Research Assistant
Jessica Jellicoe	Research Assistant

1.3 Aim and Objectives

1.3.1 Aim

To investigate factors associated with dysphagia risk among older adults living in residential aged care.

1.3.2 Objectives

1. Investigate the association between dysphagia risk and demographic factors.

2. Investigate the association between dysphagia risk, health conditions and malnutrition status.

1.4 Thesis structure

This thesis is divided into four chapters. Chapter 1 provides an overview including the research problem and significance of the study. Chapter 2 provides a critical review of the literature and current knowledge around the context of dysphagia in older age. Chapter 3 includes the research manuscript consisting of an abstract, introduction, methodology, results, discussion, and conclusion and has been formatted according to the Dysphagia journal's format and structure guidelines. Chapter 4 provides the research summary, strengths, limitations and recommendations for future research and practices.

Chapter 2: Literature Review

2.1 Ageing in New Zealand

New Zealand's population is ageing, as people are living longer than ever before. Our developing society is the key driver for our steadily increasing lifespan through efforts to improving food, health and housing security as well as the development of therapeutic and preventative medicines (Kirkwood, 2017). Whilst this increase in lifespan is a massive human achievement, it brings challenges to both individuals and society; people may be living for longer, but these extra years of life are not always of good health and quality (Ministry of Health, 2017).

The 65+ year old 'older adult' population is extremely diverse, ranging in health and ability (Hickson, 2006) and can be categorised into two sub-groups (Baltes & Smith, 2003): those between 65- 84 years which we can refer to as the 'young old', and those 85+ years which can be referred to as the 'oldest old'.

The older adult population in New Zealand was 790,000 in the year 2020, accounting for 16% of the total population. This proportion is forecasted to increase by up to 91% and 181% within the following 28 and 53 years, respectively. This means the older adult population is estimated to make up 34% of the population in New Zealand by 2073, more than doubling the current percentage of older adults (Statistics New Zealand, 2020). The World Health Organisation also predicts that by 2050 the number of older adults will double, contributing to 20% of the global population (United Nations, 2019; World Health Organisation, 2016). Out of the older adult population, the more frail and dependent ≥85-year group, the oldest old, is the fastest growing (Ashley-Jones, 2009; Hill et al., 2016).

Looking at life expectancy (LE) alone is not enough to paint a clear picture of health; independent life expectancy (ILE) and health expectancy (HE) should also be considered. Where LE is how many years we live, ILE is the expected number of years we will live

without functional limitations requiring assistance, and HE is how many years we live in good health (Ministry of Health, 2015).

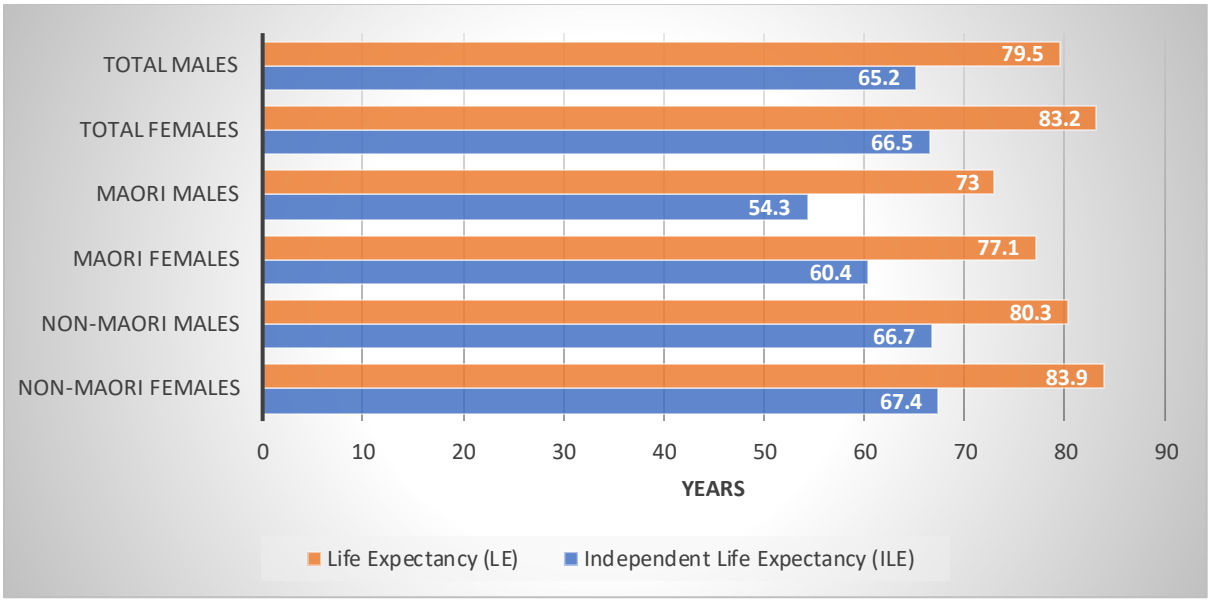

Figure 2. The life expectancy (LE) and independent life expectancy (ILE) of New Zealanders, compared by sex and ethnicity (Māori vs non-Māori) (Ministry of Health, 2015)

Male New Zealanders born in 2013 have a LE of 79.5 years and ILE of 65.2 years (82% of their life), and New Zealand females having a LE of 83.2 years, and ILE of 66.5 years (79.8% of their life) with ethnic inequity affecting Māori, most significantly Māori males.

Collaboration between communities, health professionals, service providers and policymakers is crucial to facilitating positive health outcomes for all older adults. The World Health Organisation Constitution reinforces that "governments have a responsibility for the health of their peoples which can be fulfilled only by the provision of adequate health and social measures" (World Health Organization, 1946). New Zealand's Ministry of Health developed the Positive Ageing Strategy to support and provide older adults (Māori as a priority population) with the opportunity to live healthy, connected, and dignified lives in their later years while remaining independent and in their own homes for as long as possible (Dalziel, 2001). This is vital as the majority of older adults live independently in communities (Kerse et al., 2016), and by enabling older adults to age in place, the pressure on residential age care facilities can be reduced.

As the most current ILE for New Zealand males and females is 65.2 and 66.5 years, respectively, it suggests that some level of support is likely required for activities of daily living (ADL) in their lifetime (Ministry of Health, 2015). Older adults need to be able to carry out basic ADL, including bathing, toileting, dressing and eating to safely remain residing independently within the community (Verlaan et al., 2017). Older adults who require daily support with ADL and health care may decide with their family and doctor or multidisciplinary team to move to a residential aged care facility (RAC).

By 2026, it is forecasted that 12,000 – 20,000 extra older adults will need residential aged care within New Zealand (Thornton, 2010). Each year, about 33,000 RAC residents are cared for by 670 RAC facilities with 37,000 beds available. In comparison to other OECD nations, New Zealand has a comparatively high per capita usage of RAC for older adults (Central Regian Technical Advisory Services Limited, 2019). The average age of admittance to a RAC has risen to 86 years old in 2008, from 82 years old twenty years prior, so residents are now frailer than in the past and have a higher rate of dependency (Boyd et al., 2011).

The current proportion of older adults within the total New Zealand population is about 16%, yet they are the highest consumers of health and disability expenditure, making use of 42% of the district health board (DHB) expenses (Ministry of Health, 2016a). Over half (60%) of this is utilised for RAC support services (Ministry of Health, 2016b), spending approximately $1.1 billion per year on RAC facilities (Central Region Technical Advisory Services Limited, 2019). DHB spending will continue to grow as more individuals reach older age unless the health of older adults improves (Ministry of Health, 2016a). This is also evident in the United States where the older adult population consumes the greatest proportion of healthcare services despite accounting for just 14% of their population (Porter Starr et al., 2015). RAC funding will be unsustainable if the demand for facilities increases at the same rate as the forecasted rise in the older adult population (Ovseiko, 2007). It is, therefore, crucial to focus interventions on prevention and early management by collaborating and utilising the resources available to improve population health outcomes for older adults (Ministry of Health, 2017). Efforts to do so have been reflected through a rise in HE along with LE, however, HE is rising at a much slower rate than LE meaning that

more years will be lived in ill health, approximately a decade (Ministry of Health, 2017). Although health decline with age is inevitable, the rate and severity of it is highly determined by lifestyle factors during younger adulthood and in older age, such as diet and physical activity, both of which directly affect body composition and function.

2.2 Body Composition Changes with Age

The body is composed of fat mass and fat-free mass (FFM – muscle and bone). The proportions of these components within the body change over the lifespan and differs between people of the same age due to genetics and lifestyle factors. Body composition values provide some insight into a person's functional and overall health, and ability to carry out ADL (Gill et al., 1995; Roubenoff, 2003). Generally, lean mass and bone mineral density decrease with age, whilst body fat percentage increases (Atlantis et al., 2008). Fat mass approximately doubles between the ages of 20 and 60 with more fat infiltrating muscle tissue (WHO, 2002) which can weaken muscle contractions (Biltz et al., 2020). There is agreement that body fat mass then stabilises and/or starts to decrease around the ages of 50-75 (Baumgartner et al., 1995; Kyle et al., 2001; Silver et al., 1993) whilst FFM decreases (Gallagher et al., 2000; Goodpaster et al., 2006; Kyle et al., 2001; Newman et al., 2003), beginning at a younger age than fat mass loss, around the age of 40–50 years (Baumgartner et al., 1995; Kyle et al., 2001).

Muscle weakness is consistently reported as an independent risk factor for high mortality in older adults (Laukkanen et al., 1995; Metter et al., 2002; Newman et al., 2006; Rantanen et al., 2000; Rantanen et al., 2003). A loss in muscle mass is usually reflected by a loss in weight, studies report a positive relationship between weight loss and ageing (Chapman et al., 2002; Thomas, 2007), however muscle mass loss associated with ageing can often occur in the absence of body mass index (BMI) and body weight changes, buffered by the increase in body fat (Lührmann et al., 2009; St-Onge & Gallagher, 2010) therefore additional assessments may be necessary such as hand-grip strength or body composition analysis.

Adult dietary energy guidelines in New Zealand are based on age and sex, with the aim of maintaining a BMI of 22 kg/m2, the midpoint of the healthy weight range for all adults (Capra, 2006). BMI is a measure of weight adjusted for height (Markowitz, 2018). In older age, having a BMI that falls within the overweight category range (25-29.9 kg/m2) is associated with optimal survival (Diehr et al., 2008; Grabowski & Ellis, 2001; Stevens et al., 1998) and therefore has been suggested that desirable weight range for older adults to be set higher for improved health outcomes (Rejeski et al., 2010). A meta-analysis of 32 studies published between 1990 and 2013 that investigated causes of mortality among community based older adults found that mortality risk increased at a BMI of lower than 23.0 kg/m^2 (Winter et al., 2014). A slightly higher BMI promotes survival partly because there are more nutritional reserves to draw on to mitigate illnesses (Chatindiara et al., 2020).

2.3 Nutrition and ageing

Nutrition plays an indispensable role in good health throughout the lifecycle, largely by providing the building blocks needed for the body to build and repair itself as well as extra to break down for energy. Nutritional needs change throughout the life course, differing from adulthood to older age. Requirements for energy decrease in older age, whilst protein needs increase (Elmadfa & Meyer, 2008; Ministry of Health, 2013a; Porter Starr et al., 2015). Failing to meet nutrition requirements over time can lead to compromised health and ability; good nutrition can prevent the occurrence or reduce the rate and severity of a multitude of health complications associated with malnutrition, such as dysphagia and sarcopenia (age-related loss of muscle mass/strength).

The main culprit for undernutrition is reduced food intake. It is well established that calorie intake decreases with age (De Groot et al., 2000; Wakimoto & Block, 2001); according to the 2008/09 Adult Nutrition Survey conducted in New Zealand, energy consumption fell by 260 kcal in females and 312 kcal in males as they progressed from 51-70 years to 71+ years of age (University of Otago and Ministry of Health, 2011). This reduction in energy intake is partly a result of the reduction in energy expenditure associated with ageing, as well as other psychosocial, physiological and physical influences (Ministry of Health, 2013b) associated with anorexia of ageing (appetite loss). If energy expenditure exceeds energy

consumption, fat and muscle loss will result indicated by body weight loss (MacIntosh et al., 2000).

Sufficient protein intake is vital, as is utilised by the body for building and repairing lean structures such as muscles, and can be catabolised for energy when other dietary sources of energy are scarce. Protein requirements for people aged over 70 years are 25% higher than for younger adults (NHMRC, 2006); chronic inadequate protein intake in older adults is associated with increased frailty, decreased immune function, poorer healing, and longer recuperation from illness (Chernoff, 2004). Higher dietary protein intakes have been associated with the preservation of skeletal muscle mass and reduced effects of age-related sarcopenia (Chernoff, 2004; Millward, Layman et al., 2008).

The Food and nutrition guidelines for healthy older people background paper proposes a recommended protein intake of 0.75-0.94 g protein per kg body weight for women and 0.84-1.07 g/kg protein for men over the age of 50 years, with the higher end recommended for those over 70 years (Ministry of Health, 2013). This translates to 60 – 75.2 g protein per day for an 80 kg older woman (equivalent to 5-6 chicken drumsticks) and 67.2- 85.6 g protein per day for an 80 kg older man (equivalent to 5.5 – 7 chicken drumsticks). The 2008/09 New Zealand Adult Nutrition Survey (2008/09 NZANS) reports that older adults aged 65-74 were meeting these protein recommendations, however, overall nutrition intake was decreasing with age, despite recommendations increasing. It is however argued that older people might need higher amounts of protein for optimal preservation of lean body mass, body functions and health as well as further stimulating muscle protein formation; the increased availability of dietary protein leads to an increased concentration of amino acids in plasma which directly relates to the stimulation of muscle protein synthesis (Deutz & Wolfe, 2013). Higher daily protein intakes of 1.2–1.5 g/kg body weight has been suggested, which translates to 96-120 g protein/day for an 80 kg person (equivalent to 8-10 chicken drumsticks) (Roberts et al., 2019). According to the 2008/09 NZANS, even the lower end of this higher recommendation was not met by older adults. Older adults have a lower rate of anabolism than younger adults, therefore the higher protein recommendations may be more beneficial to overcome anabolic resistance (Bauer et al., 2013). Insufficient protein intake in older people can exacerbate the naturally occurring changes that come with

ageing, such as decreased muscle mass (Hickson, 2006); muscle strength, and function (Cruz-Jentoft et al., 2010) (further exacerbated by a lack of resistance activities and exercises) (Rom et al., 2012)

Older people may feel apprehensive about eating due to a multitude of factors conspiring against adequate oral intake; such as psychosocial factors (isolation, depression and loneliness), physiological (chemosensory decline, appetite decline and dysphagia), and physical factors (oral health).

2.4 Psychosocial factors affecting nutrition intake in older people

The transition from living in the community to RAC housing can be a difficult ordeal for older people. Institutionalised residents may feel isolated from family and friends leading to depression and loneliness. Around 49,000 people in New Zealand aged 65 and over say they feel lonely most of the time (Ministry of Social Development, 2018), with a similar phenomenon prevalent in Australia and the United Kingdom: 7-17% of older adults said that they often experience social isolation and up to 31% say they sometimes do (Gardner et al., 1999; Hawthorne, 2008; Owen, 2007; Steed et al., 2007).

Prevalence and risk of social isolation in older adults have been suggested to be higher in those living in RAC compared to older adults living in the community (Jang et al., 2014; Parmenter et al., 2012; Prieto-Flores et al., 2011; Savikko et al., 2005; Slettebø, 2008; Wenger & Burholt, 2004). Studies show that around 56% of older adults residing in nursing homes in Norway and Sweden experience chronic loneliness (Drageset et al., 2011; Nyqvist et al., 2013). The high prevalence of loneliness and social isolation among older adults is a cause for concern as social isolation has been strongly associated with reduced well-being in older adults (Cacioppo et al., 2011; Nicholson, 2012) and acknowledged being detrimental to physical and mental health (Heinrich & Gullone, 2006).

Factors associated with loneliness in older adults aged 60+ were investigated in Spain among RAC residents vs those in the community and it was found that depression and

functional dependence were associated with loneliness in both groups (Prieto-Flores et al., 2011). Loneliness can be a direct cause of depression, however, pre-existing depression may lead to loneliness by causing a person to become less motivated, and choose to socially isolate, further exacerbating depression. It is therefore important to simultaneously screen for and address both depression and loneliness for the best outcome.

Previous studies further expand on the interlinked relationship between loneliness and depression. A meta-analysis that assessed 88 studies with a total of 40,068 participants sought to determine the effect of loneliness on depression and concluded that loneliness had a moderately significant effect on depression (Erzen & Çikrikci, 2018). In Spain, research was conducted on 3535 community-dwelling adults aged 50 years and over, to investigate the role of social networks on the relationship between loneliness and depression in the older Spanish population; results showed that among those who were lonely, having a small social network influenced being depressed, and of those who were depressed, having a small social network influenced loneliness. On the other hand, among those who were not depressed, marital status had a stronger influence on loneliness than social networks (Domènech-Abella et al., 2017). This research suggests that partnered older adults rely primarily on their partner to keep loneliness and depression at bay, whereas those not living with a partner such as widowed older adults depend on a social network such as friends and family, in order to achieve social connectedness and reduce the risk/ severity of loneliness and depression.

Older adult widows and widowers have been found more likely to be at malnutrition risk than those who were married, divorced/separated or never married (Wham et al., 2011). The increased nutrition risk for widows and widowers may suggest that loss and grief as well as a shift in routine (i.e. no longer preparing and sharing food with a partner) may have a bigger influence on decreased food intake compared to those non-widowers.

Depression is increasingly recognised as a major health issue for older people (Chapman & Perry, 2008) and is a significant psychosocial factor that decreases appetite and oral intake. One of the reasons is due to changes in the brain's flavour and reward centres, as discovered by functional magnetic resonance imaging in depressed older adults (Lavretsky

et al., 2007). As a result of depression, older people may not be motivated to perform basic physical tasks, including cooking and eating (Donini et al., 2003; González-Gross et al., 2001) which can gradually result in malnutrition.

Social connectedness plays an important role in the nutrition of older adults. Eating is socially facilitated; people eat more when dining in a group compared to eating alone. This phenomenon was first observed by John de Castro (De Castro & De Castro, 1989) who analysed food diaries of 63 adults, to find that meals eaten with others contained more carbohydrate, fat, protein, and total calories and had larger satiety ratios than meals eaten alone. He proposed the number of people present was positively correlated with meal size. This theory was tested by manipulating group size and meal duration, finding that the amount of food eaten is correlated to meal-time duration rather than group size (Pliner et al., 2006). Not only does increased intake provide more energy but also nutritional diversity and quality, and subsequent positive health outcomes (Bernstein et al., 2002; Donini et al., 2003).

2.5 Physiological and physical factors affecting nutrition intake in older people

Concurrent use of multiple medications is common in older age and can cause a further decline in chemosensory function than with the ageing process alone (Duffy et al., 1995; Schiffman, 1997), and subsequent appetite decline. Although appetite naturally declines with the ageing process, it is further exacerbated by polypharmacy (the use of five or more medications per day by the same individual) (Elmadfa & Meyer, 2008; Masnoon et al., 2017).

Early satiation (feeling fuller sooner) and prolonged satiety (feeling fuller for longer) can occur as part of the ageing process and affect the amount of food eaten. The stomach wall stretches to accommodate the food entering it (fundal compliance), however in older age the stretch capacity reduces, sending earlier and stronger signals of fullness to the brain during a meal which influences earlier satiation and an earlier halt of an eating event (Morley, 2001). Gastric emptying is also slower with ageing, so food stays in the stomach for

longer (Malafarina et al., 2013) and therefore increasing the period of satiety, delaying when a person will next get hungry.

On the occasion of a good appetite, nutrition can then transfer from the plate to the mouth for mechanical processing (Orchardson & Cadden, 1998). Adequate masticatory muscle strength and good dentition (well-fitting dentures and adequate saliva flow) are vital for facilitating this journey along (Phillips, 2003). Saliva plays a vital role in the oral processing of food by preparing food for mastication and swallowing by forming a food bolus and acting as a transport mechanism of ingested food (Mandel, 1987; Pedersen et al., 2002), as well as stimulating taste receptors (Pedersen et al., 2002). Insufficient saliva production is a common consequence of the ageing process and the use of some medication, resulting in dry mouth (xerostomia) (Marcott et al., 2020). As well as contributing to poor dentition, xerostomia poses an additional challenge to oral intake by affecting swallowing as a result of insufficient saliva production (Saunders & Friedman, 2007). Swallowing difficulties or dysphagia can become increasingly prevalent in older age; 7-40% of older adults living in RAC report difficulty swallowing (Namasivayam & Steele, 2015), which further exacerbates the decline in the frequency and amount of food eaten, thus further limiting nutrition intake (Takeuchi et al., 2014).

2.6 Dysphagia

Dysphagia is a symptom that is defined as difficulty in the propagation of a food bolus from the mouth to stomach (L. Baijens et al., 2016; Payne & Morley, 2017). The difficulty may be related to the transfer of the bolus from the mouth to the oesophagus and/or from the oesophagus to the stomach, hence dysphagia may develop due to oropharyngeal and/or oesophageal problems (Bahat et al., 2019; Rofes et al., 2010). Dysphagia can lead to an increased risk of aspiration pneumonia, malnutrition, frailty, falls, hospitalisations and mortality. Data analysis from 9.44 million adults found that 4% of the US adult population reported swallowing difficulty, a mean age of 52.1 years. Results show that strokes account for the highest rate of dysphagia (~400,000), followed by neurological disease (~300,000),

head and neck cancers (200,000) and in fourth place, advancing age (~100,000) (Bhattacharyya, 2014).

Older adults have been noted to regard swallowing difficulty as a normal part of ageing; 23.4% of older adults within an independent living facility in the United States believed this (Chen et al., 2009). Those afflicted therefore may be less likely to report it to a health professional or family, and self-treat by changing their swallow technique (taking smaller mouthfuls or double swallows) or avoiding troublesome foods and fluids from their diet (Chen et al., 2009; Omari et al., 2014). Thin fluids such as water can be a safety risk for those afflicted with dysphagia as they can enter the airway before airway closure has been engaged (Clavé et al., 2006; Logemann, 1988). On the other hand, solid foods such as fruits, vegetables, nuts, and meat may require greater swallow muscle force to propel a bolus through the oropharynx . A decline in tongue and/or pharyngeal muscle strength increases the likelihood of food residues remaining behind, posing a risk of aspiration (Clavé et al., 2006; Clavé et al., 2012; Huckabee & Steele, 2006; Steele & Huckabee, 2007).

Food restriction further exacerbates dysphagia (Namasivayam et al., 2016) and can trigger associated consequences (including aspiration pneumonia, malnutrition, frailty, falls, hospitalisations and mortality) (Madhavan et al., 2016). Depression and other cognitive disorders such as dementia are also risk factors for reduced food intake, therefore may mask the recognition of dysphagia in older adults and result in a delayed diagnosis (Schindler & Kelly, 2002) which is not ideal as early detection and timely treatment are key for successful outcomes. Older adults with weight loss alongside dysphagia have an increased risk of mortality (Wirth et al., 2018).

To identify more older adults at risk of dysphagia, more of them need to be assessed. Older adults have been known to not report swallowing difficulties when they arise and attempt to self-manage (Chen et al., 2009; Omari et al., 2014), therefore the more older adults screened, the more silent cases afflicted with swallowing difficulties can be identified and safely managed alongside professional supervision. A quick, affordable and non-invasive bedside screening tool to identify dysphagia is therefore ideal as it can be accessible to more people and used to screen older adults upon RAC and hospital admissions. The

American Speech-Language-Hearing Association (ASHA) also describes screening tools as rapid and minimally invasive methods of examining: dysphagia risk, swallow safety, requirement for further swallow examinations and the requirement for oral nutrition support (Jiang et al., 2016; Perry & Love, 2001).

The sensitivity and specificity of two bedside dysphagia screening tools have been assessed: Eating Assessment Tool (EAT-10) and Volume-Viscosity Swallowing Test (V-VST) against Videofluoroscopic swallow study (VFS), which is used as the standard reference (Rofes et al., 2014).

VFS uses X-ray imaging to examine how the mouth and throat muscles work and is considered a gold standard for diagnosing dysphagia as it shows the entire swallow process (Horner & Massey, 1988; Ramsey et al., 2003; Smith et al., 2000). The Eating Assessment Tool (EAT-10) is a self-administered, symptom-specific, ten-item questionnaire, each item is completed by selecting an answer, noting the corresponding score (0-4) and calculating the score sum of all ten questions to provide an EAT-10 score. The maximum score is 40 but a score of 3 and above is indicative of a potential swallowing problem. This tool can be used to determine initial dysphagia risk, as well as monitor severity in response to treatment (Belafsky et al., 2008). The V-VST is an effort test looks for clinical indicators of reduced swallow efficacy (impaired labial seal, piecemeal deglutition, and residue), as well as impaired safety of swallow (cough, voice changes, and oxygen desaturation) (Rofes et al., 2014).

Comparative results from Rofes et al. (2014), found the EAT-10 screening tool to have 89% sensitivity and 82% specificity whilst the V-VST showed 94% sensitivity and 88% specificity in the identification of OD. V-VST further showed 79% sensitivity and 75% specificity for impaired efficacy, 87% sensitivity and 81% specificity for impaired safety, and 91% sensitivity and 28% specificity for aspirations. The author concludes that clinical methods for screening (EAT-10) and assessment (V-VST) of OD "offer excellent psychometric proprieties that allow adequate management of OD" and that their accessibility to at-risk populations can improve the identification of dysphagia and decrease the risk of aspiration pneumonia and malnutrition (Rofes et al., 2014). Fibreoptic endoscopic evaluation of swallowing (FEES)

is also considered a gold standard for swallowing assessments, alongside VFS (Speyer et al., 2010). A FEES assessment entails inserting a fibreoptic laryngoscope trans nasally into the hypopharynx, larynx, and proximal trachea (Hiss & Postma, 2003). Fees may be a preferred method for some patients due to its mobility and lack of ionising radiation however has been expressed to be the most invasive method for evaluating dysphagia (Adachi, Umezaki, & Kikuchi, 2017). After FEES, VFS could be helpful to provide complete visualisation and make sure an aspiration event is not missed during FEES.

For a more specific and sensitive bedside assessment, a combination of EAT-10 and V-VST can be used alongside each other to identify dysphagia in older adults. The V-VST does however take more time and training to perform, therefore for a more rapid and less invasive assessment, EAT-10 on its own is an effective and more suitable bedside screening tool for identifying dysphagia risk.

The risk of developing dysphagia is common in RAC. A New Zealand cross-sectional study investigated dysphagia risk in two Auckland hospitals of newly admitted adults of 'advanced age' and found that 33% of the participants were at risk of dysphagia (Popman et al., 2018). Dysphagia prevalence in New Zealand RAC was assessed, and found that participants recently admitted to RAC were 32.1% likely to have dysphagia, over 9 times more likely compared to those living in the community (Wham et al., 2017). A cross-sectional study that further assessed this data found that across newly admitted RAC residents, dysphagia risk was found to affect 37.9% of participants, further increasing to 56.1% in those identified as malnourished and 83.3% in those identified as frail (Chatindiara et al., 2020).

2.7 Malnutrition

A link between dysphagia and malnutrition has been well supported (Madhavan et al., 2016; Mann et al., 2013; Serra-Prat et al., 2012; Serra-Prat et al., 2011; Takeuchi et al., 2014; Wakabayashi & Matsushima, 2016; Wham et al., 2017). The term "malnutrition" means "bad nutrition" referring to over-nutrition, under-nutrition, or nutrient imbalances (Elia,

2017), however in this context of older adults the form of malnutrition described is under-nutrition (National Institutes of Health, 2018; Nowson, 2007; Söderström et al., 2017). The European Society for Clinical Nutrition and Metabolism's (ESPEN) criteria for diagnosing malnutrition is based on either: a BMI of <18.5 kg/m^2 OR unintentional weight loss of either >10% in an indefinite amount of time or >5% in three months AND a reduced BMI or FFMI (fat-free mass index) (Cederholm et al., 2015).

Malnutrition is disproportionately prevalent in the older population (Watson et al., 2010; Wham et al., 2011). Prevalence studies indicate that 25% of the global older population is malnourished and 46% are at risk (Kaiser et al., 2010). A similar pattern is observed in New Zealand; data was collected from 167 older adults across district health board community, hospital and residential care settings in New Zealand; findings showed that 23% of participants were malnourished and 35% at high risk of malnutrition (Wham et al., 2017). Further data analysis shows that those living in a RAC had the highest malnutrition risk compared to hospital and community settings. The combined results from 257 older adults from the same dataset were further analysed, reporting that within the community 12% were malnourished or at risk of malnutrition, odds increasing with age (Chatindiara et al., 2020). International research follows suit; a meta-analysis across 249 international papers relating to malnutrition found that within a RAC setting, malnutrition rates have been reported to be 40-70% (Hickman & Tapsell, 2009).

Malnutrition, although consistently present in the older population, increases with age whilst also becoming more difficult to treat (Lee et al., 2015; Lee et al., 2013; Porter Starr et al., 2015; yet it is largely under-recognised and under-diagnosed resulting in a chronic decline in nutritional status (Hickson, 2006). It is important to detect and manage malnutrition early to avoid or reduce the risk of its related consequences (dysphagia, sarcopenia, frailty, falls, hospitalisations and mortality) (Lee et al., 2015). Early screening of malnutrition, such as upon admission to hospitals and RAC will increase the likelihood of detection and timely treatment prior to irreversible decline and mortality (Hickman & Tapsell, 2009; Lee et al., 2015; Meijers et al., 2014; Visvanathan, 2009).

Several malnutrition screening tools have been developed and validated for use within a RAC setting; malnutrition can be screened for by using several validated tools: the Mini Nutritional Assessment (MNA)**,** Mini Nutritional Assessment- Short Form (MNA-SF; a shortened version of the MNA), Malnutrition Universal Screening Tool (MUST), Simplified Nutritional Appetite Questionnaire (SNAQ) and the Simple Nutrition Screening Tool (Watterson et al., 2009). These tools utilise qualitative and quantitative information to calculate risk, using BMI, weight change, as well as nutritional risk factors (Porter Starr et al., 2015). The MNA-SF is recommended for use within a RAC setting as it is more suitable to administer to institutionalised older adults (Chatindiara et al., 2018; Porter Starr et al., 2015). The MNA-SF includes consideration of other issues associated with older age including cognitive impairment, depression, mobility, acute disease or psychological stress, weight loss, and food intake (Kaiser et al., 2009).

As dysphagia is an independent risk factor of malnutrition, by identifying and addressing risk factors of dysphagia, malnutrition risk also can be reduced (Bahat et al., 2019). Malnutrition is not only a result of dysphagia but also a cause. Insufficient nutrition can result in muscle atrophy including swallow muscles reducing the effectiveness of the swallow (Baijens et al., 2016; Cabré et al., 2014), therefore leading to reduced food intake, further exacerbating malnutrition (Wham et al., 2017). Malnutrition has a larger effect on type II muscle fibre atrophy, those which makeup swallow muscles and therefore can lead to swallowing difficulties (Robbins et al., 1995; Sakai & Sakuma, 2017).

Swallowing difficulties have been associated with poorer tongue strength in a RAC (Nicosia et al., 2000). Tongue strength has also been positively associated with hand grip strength in 78 healthy community-dwelling adults (Butler et al., 2011) therefore using a hand dynameter to measure grip strength may be an effective, affordable and non-invasive supplementary tool used for early identification of potential swallow problems.

2.8 Sarcopenia

Muscular atrophy can partly be due to malnutrition. Sarcopenia is a syndrome which describes the generalised and progressive decline of muscle mass, strength, and function (Cruz-Jentoft et al., 2010; Fielding et al., 2011; Morley et al., 2011; Rolland et al., 2008). Sarcopenia is a result of both biological and environmental factors (British Nutrition Foundation 2009).

Muscle mass naturally drops by 1-2% every year from the age of 50 (Rolland et al., 2008), with up to 3 kg of lean mass lost per decade also from the age of 50 (Dwyer, 1993). This drop is often seen in women post-menopause, but is more gradual in men (Rolland et al., 2008). The link between sarcopenia and dysphagia was investigated in hospitalized older adults, finding sarcopenia to be an independent factor for dysphagia incidence (Maeda & Akagi, 2016a). A systematic review and meta-analysis of cross-sectional, case control and cohort studies which investigated the association between sarcopenia and dysphagia also found sarcopenia to be positively associated with dysphagia (Zhao et al., 2018).

2.9 Frailty and falls

If sarcopenia and dysphagia worsen, they become major contributors to the onset of frailty (Bahat et al., 2019; Hathaway et al., 2015; Hathaway et al., 2014; Madhavan et al., 2016; Melgaard et al., 2017). A 'phenotype' to describe frailty comprising of five markers: unintentional weight loss, self-reported exhaustion, weakness, slow walking speed, and low physical activity has been described (Fried et al., 2001). Frailty would be considered present if three out of five markers were relevant to an individual. A study on 1138 older adults aged 60 years and over found an association between frailty and dysphagia, independent of age, sex, medication, number of chronic diseases and nutrition status (Pilotto et al., 2019).

Frail older adults are likely to have an increased risk of falls (Kojima, 2015), hospitalisation, trouble independently undertaking ADL (Butler et al., 2011; González-Fernández et al., 2014; Kawashima et al., 2004) and face an increased risk of mortality (Fried et al., 2001). Every year, around 30% of older adults in the community will suffer at least one fall, 5% of which will result in a fracture and/or hospital admission (Fairfax et al., 2015) with 75% of trauma admissions being a result of falls, hip fractures being the most common (Tha et al., 2009). Frailty is better than chronological age in predicting all-cause mortality (Song et al., 2010), however with early assessment, identification and intervention, the progression of frailty can be prevented, delayed or reversed (Chatindiara et al., 2020).

2.10 Summary

New Zealanders are living for longer however these extra years of life are usually met with health challenges that affect functionality and capacity to carry out ALD rendering someone unfit to safely live without assistance. The number of people requiring a bed in RAC is estimated to continue rising alongside health and disability expenditure. Physical and functional decline is a guaranteed effect of time on the body, however, the rate and severity of this decline can be manipulated by lifestyle choices directly affecting body composition and overall functional health and ability.

Nutritional intake is a major determinant of physical health in older age, primarily by providing energy to cover a person's total daily energy expenditure requirements, and protein to build and repair muscles and tissues. Energy intake, however, appears to fall by approximately 300 calories in older adulthood and may fail to meet requirements resulting in muscle and weight loss. The primary reason for failing to meet nutrition requirements in older adults is inadequate oral intake. This decline in eating is a product of a multitude of physical, physiological, and psychosocial factors.

Loneliness is a common phenomenon in older age within New Zealand and globally. Many older adults can be isolated from family and friends, leading to depression and loneliness, and contributing to poor appetite and lack of motivation to prepare food and eat. The

decline of chemosensory function (smell and taste) is another contributor to appetite decline in older age, further exacerbated by polypharmacy. Physiological changes in the stomach are common in older age can decrease intake even further by triggering early satiety and prolonging satiation. Eating may also be physically challenging and uncomfortable potentially due to poor dentition and/or swallowing difficulties (dysphagia). Dysphagia not only decreases oral intake but can also lead to an increased risk of aspiration pneumonia, malnutrition, frailty, falls, hospitalisations, and mortality.

Dysphagia can silently manifest until it becomes problematic before it is identified and managed. Older adults have been noted to regard swallowing difficulty as a normal part of ageing and therefore may be less likely to report it to a health professional or family and self-manage by avoiding troublesome foods. Food restriction however further exacerbates dysphagia. Early identification is key to preventing the progression of dysphagia, therefore a quick, affordable and non-invasive bedside screening tool such as the Eating Assessment Tool (EAT-10) is an ideal screening method.

New Zealand studies show that dysphagia in older adults is prevalent, with odds significantly increasing in those with malnutrition or frail. Dysphagia and malnutrition have a cause-and-effect bi-directional relationship which can result in a vicious cycle when not intervened, further leading to sarcopenia, frailty, falls, hospitalisations and mortality. Frail older adults are likely to have an increased risk of falls, hospitalisation, and trouble independently undertaking ADL, therefore, becoming dependent on assistance and care to live.

Factors Associated with Dysphagia Risk among Residents in Aged Care

Chapter 3: Research Manuscript

Formatted according to the journal Dysphagia author guidelines.

3.1 Abstract

Dysphagia is commonly associated with the ageing process and can lead to decreased food intake with associated health problems. This study aimed to determine factors associated with dysphagia risk among older adults in residential aged care (RAC). This cross-sectional study included 91 older adults aged ≥ 65 years, across three RAC facilities in Auckland. Those with severe cognitive or functional decline, undertaking palliative care were excluded. Demographic data was collected from the RAC clinical files. Validated questionnaires were completed during personal interviews conducted by trained researchers. These included: Strength, Assistance with walking, Rising from a chair, Climbing stairs, and experiencing Falls (SARC-F), Mini Nutritional Assessment Short-Form (MNA-SF), Eating Assessment Tool (EAT-10), Geriatric Depression Scale (GDS) and the 12-item short form survey to assess health-related quality of life (SF-12). Physical measures taken included weight, grip strength, gait speed and body composition. Findings showed the odds of having dysphagia increased in those at risk of sarcopenia OR= 4.7, 95% CI 1.8, 12; malnutrition OR=10, 95% CI 1.2, 82, and depression OR= 5.0 95% CI 1.9, 13. Adjusting for age, sex and number of medications, sarcopenia risk, malnutrition and depression remained associated with dysphagia risk Adjusting for age, sex, number of medications and all health variables (SARC-F, MNA, and GDS); depression risk was the only remaining significant association with dysphagia risk. This study highlights the need to identify and address malnutrition, sarcopenia, and depressive symptoms to minimise dysphagia risk in older adults in RAC.

3.2 Introduction

Dysphagia is defined as difficulty in the propagation of a food bolus from the mouth to the stomach (Baijens et al., 2016; Payne & Morley, 2017). Swallowing difficulties can originate from neurological conditions (Seifpanahi et al., 2022) i.e. Parkinson's disease (Barbiera et al., 2022) and stroke (Singh & Hamdy, 2006), or because of muscle deterioration caused by sarcopenia (Maeda et al., 2017). The latter loss of muscle mass with ageing can be part of anorexia of ageing which is defined as appetite loss observed with ageing, associated with a reduction in food intake (Chapman, 2004). A decrease in food intake may be the gateway to an aggressive cycle of co-morbidities, including dysphagia, malnutrition (Bauer et al., 2006) and sarcopenia (Muscaritoli et al., 2010).

The risk of dysphagia is higher in residential aged care (RAC) compared to the general population. In New Zealand, a cross-sectional study of 174 older adults, mean age of 85.5 years, found the risk of dysphagia was evident in 38% of the residents within the first week of admission to RAC (Chatindiara et al, 2020). Many residents of aged care facilities are of advanced age, and many have multiple medical conditions, which can increase the risk of dysphagia.

Dysphagia can have detrimental effects on both the physical and mental well-being of older adults (Engel et al., 2011), and quality of life (Ekberg et al., 2002), while also increasing pressure on district health board (DHB) spending (Ministry of Health, 2016a) and care facilities (Thornton, 2010*)*. In New Zealand, the older adult population make use of about 42% of DHB expenses (Ministry of Health, 2016a) with over half (60%) utilised for RAC support services (Ministry of Health, 2016b). By 2026, it is forecasted that 12,000 - 20,000 extra older adults will need RAC placement within New Zealand (Thornton, 2010). RAC funding will be unsustainable if the demand for placement increases at the same rate as the forecasted rise in the older adult population (Ovseiko, 2007). To paint a clearer picture of how dysphagia occurs in this population, this study aimed to investigate factors associated with dysphagia among older adults living in RAC.

3.3 Materials and Methods

3.3.1 Study Design and Recruitment

This cross-sectional study was carried out within three RAC facilities in Auckland, New Zealand. All participants who met the inclusion criteria were invited to participate in the study. Participants (n=91) were ≥ 65 years, receiving hospital or rest home level care and informed consent was provided by the participants or where necessary their EPOA. Participants in palliative care were excluded, as were those whom the clinical manager assessed to be physically or cognitively unfit to participate. Residents with pacemakers were excluded from completing the body composition analysis (BIA) assessment. Eligible participants were guided through the participant information sheet and consent forms. This study was approved by New Zealand Health and Disability Ethics Committee 20/NTB/120/AM01.

3.3.2 Data Collection

Demographic data were obtained from the RAC's clinical notes and included: age, gender, ethnicity, highest level of education, marital status, length of stay, level of care, number of prescribed medications, comorbidities and fall history. Physical measures and questionnaire administration were conducted face-to-face with the participants by trained researchers. Physical measures and administration of the questionnaire items were undertaken in the order most convenient for the participant.

3.3.3. Physical measures

Height was measured using a portable stadiometer (SECA, model 213, Germany) to the nearest 0.1 cm. Participants were asked to remove their shoes stand with their heels touching the vertical surface and looking straight ahead. The headpiece was brought down by the researcher to touch the crown of the head. Alternatively, for participants unable to

stand upright, ulna length was measured to the nearest 0.5 cm and height was estimated using validated equations (Barbosa et al., 2012). Weight was measured to the nearest 0.1 kg using a calibrated digital scale (SECA GMBH & Co., model 813, Germany). Participants unable to stand were weighed on a calibrated chair hoist and weight was recorded to the nearest 0.1 kg.

Hand grip strength was measured three times per hand to the nearest 1 kg by squeezing a hand dynamometer (Jamar, model 5030J1, USA) with maximum force, whilst seated with elbows at a 90-degree angle. The researcher assisted by holding it in place while the participant squeezed. The highest of six scores was compared against the EGWSOP criteria to determine muscle strength: < 27 kg for men and <16 kg for women are indicative of low muscle strength (Dodds et al., 2014).

Physical function was assessed with a 2.4m gait speed walking test. Two pieces of tape were placed 2.4 meters apart from each other on a flat walking surface, with two cones placed 0.6 m away from either side of the two pieces of tape. Participants were asked to walk at their normal pace from cone to cone, using any prescribed walking aids. The researcher began the timer as the participant reached the first tape and stopped the timer at the second tape. This was repeated three times (with a rest in between as needed) and time was recorded to 0.1 seconds and converted into velocity (m/s). The fastest time was converted into a 4m gait speed and compared against the EWGSOP criteria to determine physical function: velocity <0.8 m/s was indicative of poor function. High fall-risk residents unable to participate in this test were allocated a velocity score below 0.8 m/s, indicating poor physical functioning.

Body composition was measured using a portable bioelectrical impedance assessment (BIA) scale (InBodyS10, Inbody Co, Ltd., Korea). Participants were in a reclined seat or laying in a supine position for this measurement. Those with pacemakers, cardioverter-defibrillator implants or dressings covering electrode sites were excluded from undertaking this assessment. Appendicular muscle mass/height^2 was compared against the EGWSOP criteria to determine low muscle mass: <7 kg/m^2 for men and <5.5 kg/m^2 for women.

3.3.4 Questionnaires

Questionnaires were administered orally by the researchers and participants' responses were recorded on a tablet.

SARC-F was used to assess the risk of sarcopenia. This is a five-item sarcopenia screening questionnaire, including an assessment of Strength, Assistance with walking, Rising from a chair, Climbing stairs, and experiencing Falls. Each item has a score of 0-2 points, and a total score ≥4 out of a possible total of 10 is indicative of sarcopenia risk requiring further investigation.

The Mini Nutritional Assessment Short-Form (MNA-SF) is a validated six-item questionnaire for assessing malnutrition risk in older adults by considering diet, weight change, BMI, and stress in the last three months (Ranhoff et al., 2005). Nutrition status is allocated based on the cumulative score: 0-7 (Malnourished), 8-11 (at risk of becoming malnourishment) 12-14 (not at risk of malnourishment/ normal nutrition status) (Kaiser et al., 2009).

The Eating Assessment Tool (EAT-10) is a self-administered, symptom-specific, ten-item questionnaire. Scores for each question range from 0-4; a sum score from all ten questions provides an EAT-10 score where ≥ 3 is considered at risk of dysphagia (Belafsky et al., 2008).

The Geriatric Depressions Scale (GDS) is a self-administered 15-item questionnaire validated for assessing depression risk in older adults. A score of either zero or one can be obtained for each questionnaire item. Depressive symptom severity is allocated based on the cumulative score: 0-4 (none to normal depressive symptoms), 5-9 (mild depression) 10-15 (moderate to severe depression) (Yesavage & Sheikh, 1986).

The 12-Item Short Form Survey (SF-12) is a validated assessment tool that measures the physical and mental quality of life (QOL) in older adults (Fleishman et al., 2010). The scale presents two summary scores: physical component summary (PCS) and mental component summary (MCS). Scores above 50 are indicative of no disability, 40-50 indicate mild

disability, 30-40 indicate moderate disability, and below 40 indicate severe disability (Andrews, 2002).

3.3.5 Statistical analysis

Statistical analyses were performed using IBM SPSS version 27.0 (IBM Corp; Armonk, NY, USA). We investigated the relationship between potential variables and dysphagia risk using cross-tabulation for categorical variables (demographic data and medical conditions), independent sample t-test for normally distributed data (BMI) and Mann-Whitney U test for not normally distributed data (EAT-10, SARC-F, SF-12, MNA and GDS scores). The association of health variables that showed significant association with dysphagia at cross-tabulation level (sarcopenia, malnutrition, and depression) with dysphagia were further assessed employing binary logistic regression analysis (univariable and multivariable, models 1 and 2). As maximum grip strength in combination with gait speed is a measure of sarcopenia, and gait speed was not associated with dysphagia, only SARC-F (as a measure of sarcopenia) was included in the models. At univariate level, each independent health variable was included separately in the model, at multivariate model 1, age, sex and number of medications were added to the model (to control the model for these variables), and at multivariate model 2, all health variables together as well as age, sex and number of medications were included in the model (to investigate the predictive values of health variables when other health conditions were controlled for). To avoid the violation of multicollinearity and incomplete information from the predictors (due to many variables with many categories) and because there was a strong relationship between number of comorbidities and number of medications, we included number of medications in the regression. Imbalanced data with binary outcome variables are associated with biases in the estimated probability of an event. We investigated the models to determine if all the assumptions were met and which model had a better model fit (assessing -2 log likelihood). We also added interaction terms into the models to investigate for interaction effects between variables, but no significant results were observed. Associations were described using adjusted odds ratios (OR) and 95% confidence intervals (CI).

3.4 Results

The study population comprised 91 participants (69% female) with a mean age of 86 ±7.9 years, (range 78–94 years). Thirty-two (35%) participants had an EAT-10 score of ≥ 3, indicating dysphagia risk (Figure 1). Table 1 presents the demographic characteristics of the study population. This population had an average of 5.9±3.1 comorbidities and were taking an average of 7.9±3.4 different medications.

Dysphagia risk was associated with a higher number of co-morbidities (t (85) = 2.85, P=0.003), higher number of medications (t (83) = 1.82, P=0.04), higher SARC-F (U = 458, P=<0.001) and GDS (U = 485, P=<0.001) scores, and a lower score on maximum grip strength (t (89) = -2.6, P=0.01) and the MNA-SF (U = 491, P=<0.001).

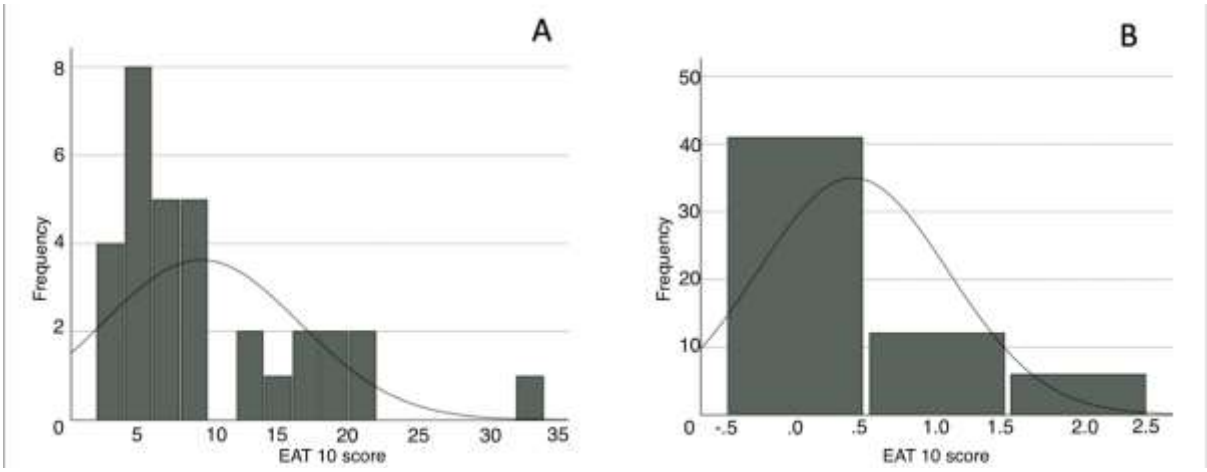

Figure 3. Distribution of EAT10 scores (dysphagia) by risk of developing dysphagia (A, dysphagia risk and B, no dysphagia risk)

Table 1. Characteristics of the study population by dysphagia risk

	Total (n=91)	At risk of dysphagia (n= 32)	Not at risk of dysphagia (n=59)	P-value*
Demographics variables				
Age, years	86±7.9	88±7.4	86±8.0	0.47
Sex, n (%)				0.38
Female	63 (69)	24 (75)	39 (66)	
Male	28 (31)	8 (25)	20 (34)	
Length of stay, months	31±30	40±43	25±18	0.05
Number of comorbidities	5.9±3.1	7.1±3.2	5.3±2.6	0.003
Number of regular medications	7.9±3.4	9.0±3.5	7.7±3.1	0.04
Health variables				
BMI	25±5.6	24±5.6	26±5.9	0.11
Percent body fat		34±13	38±9.9	0.13
Fat free mass, kg		39±7.7	41±8.6	0.40
EAT10 [1]	1.0 [0.0, 5.0]	7.0 [4.0, 14]	0.0 [0.0, 1.0]	<0.001
SARC-F [1]	5.0 [2.0, 7.0]	7.0 [4.0, 8.0]	3.0 [1.0, 5.0]	<0.001
Maximum grip strength, kg		11±8.5	15±7.8	0.01
Gait speed, m/s		2.2±1.0	19±0.8	0.31
SF-12 [1]	25 [13, 27]	25 [23, 28]	26 [23, 28]	0.75
MNA [1]	10 [8.0, 11]	8.0 [6.0, 10]	10 [9.0, 12]	<0.001
GDS [1]	4.0 [2.0, 7.0]	6.0 [2.0, 9.0]	3.0 [1.0, 5.0]	<0.001

Abbreviations: OR, odds ratio; CI, confidence interval; MNA-SF, mini nutritional assessment- short form; SARC-F, strength, assistance with walking, rising from a chair, climbing stairs, and falls; GDS, geriatric depression scale

Values are reported as mean±SD, unless otherwise stated.

[1] Median [25th, 75th percentiles]

*Chi-square test for categorical variables, independent sample t-test for normally distributed data and Mann-Whitney U test for not normally distributed data). Significant at P<0.05

Univariate analysis, as presented in Table 2, found the odds of having dysphagia increased for those who were at risk of sarcopenia (51 vs. 18%, OR=4.7, 95% CI 1.8, 12), at risk of malnutrition (41 vs. 6%, OR=10, 95% CI 1.3, 82), and depression (60 vs. 23%, OR=5.0, 95% CI 1.9, 13) compared to those who were not at risk.

When the analysis was adjusted for covariates (age, sex and number of medications) as presented in Table 2, model 1: the odds ratio of having dysphagia increased for those who were at risk of sarcopenia (OR= 4.1, CI 1.5, 12, malnutrition (OR= 11, CI 1.3, 94, and depression (OR= 6.5, CI 2.2, 19).

When the analysis was adjusted for covariates (age, sex and number of medications, SARC-F, MNA-SF, and GDS) as presented in Table 2, model 2, the odds ratio of having dysphagia increased for those who were at risk of depression (OR= 6.6, 1.8, 25).

Table 2. Factors associated with dysphagia risk

	At risk of dysphagia, 32 (35)	Not at risk of dysphagia, 59 (65)	Univariate* OR [95% CI]	Multivariate* OR [95% CI]	
				Model 1[1]	Model 2[2]
SARC-F					
Not at risk of sarcopenia	8 (18)	36 (82)	Reference category	Reference category	Reference category
At risk of sarcopenia	23 (51)	22 (49)	4.7 [1.8, 12]	4.1 [1.5, 12]	0.4 [0.1, 1.4]
MNA-SF					
Not at risk of malnourishment	1 (6)	15 (94)	Reference category	Reference category	Reference category
At risk of malnourishment/malnourished	30 (41)	44 (59)	10 [1.3, 82]	11 [1.3, 94]	9.1 [0.9, 92]
GDS					
Not at risk of depression	13 (23)	43 (77)	Reference category	Reference category	Reference category
At risk of depression	18 (60)	12 (40)	5.0 [1.9, 13]	6.5 [2.2, 19]	6.6 [1.8, 25]

Abbreviations: OR, odds ratio; CI, confidence interval; MNA-SF, mini nutritional assessment- short form; SARC-F, strength, assistance with walking, rising from a chair, climbing stairs, and falls; GDS, geriatric depression scale

*Binary logistic regression analysis.

[1]Adjusted for age, sex and number of regular medications

[2]All health variables (SARC-F, MNA, and GDS) included in the model and adjusted for age, sex and number of regular medications.

3.5 Discussion

This study found the risk of dysphagia was evident among 35% of the RAC participants using EAT-10. A similar prevalence was discovered in another New Zealand study among 174 residents across three RAC facilities (mean age 85.5 years); 38% were found to be at risk of dysphagia (Chatindiara et al., 2020). In Australia, 29% of 458 participants (mean age 84.3 years) had a positive dysphagia diagnosis in a retrospective audit of four RAC facilities in Melbourne (Birchall et al., 2022). In aged care facilities, the risk of dysphagia is increased by a higher prevalence of conditions that can cause dysphagia, such as stroke and the use of certain medications that can affect swallowing function (Aslam & Vaezi, 2013). In addition, some residents may have limited mobility or cognitive impairment, which can make it more difficult for them to eat and drink safely.

After adjusting for age, sex, and number of medications, we found dysphagia risk among the participants in this study was associated with malnutrition, sarcopenia, and depression. There were 41% of residents in this study either malnourished or at malnutrition risk who were at risk of dysphagia.

Malnutrition is a well-established risk factor for dysphagia (Madhavan et al., 2016; Mann et al., 2013; Serra-Prat et al., 2012; Serra-Prat et al., 2011; Takeuchi et al., 2014; Wakabayashi & Matsushima, 2016; Wham et al., 2017). Previously, among 174 older adults at RAC admission, 56% of residents who were malnourished or at risk of malnutrition using the MNA-SF were at dysphagia risk (Chatindiara et al., 2020). A lower malnutrition prevalence was identified among 6349 older residents (70% women, mean age 84.5 years) from Dutch nursing homes, finding 10% were malnourished and 12% had swallowing problems (Huppertz et al., 2018). Although malnutrition and dysphagia prevalence was lower in this study, the association between dysphagia and malnutrition still presents; almost one out of five (17.2%) of those with swallowing problems were malnourished (Huppertz et al., 2018). In Finland, an investigation among 2114 aged care residents (mean age, 82 years) found 29% of participants were malnourished, 60% were at risk of malnutrition and 27.7% and 10.4% had swallowing difficulties, respectively (Suominen et al., 2005). In the New Zealand hospital setting among 234 older adults at admission (mean age 83.6 years) dysphagia risk

was found to be a significant predictor of malnutrition risk (Chatindiara et al., 2018). A further study suggests patients with dysphagia may experience malnutrition issues due to their limited food intake making it challenging to maintain sufficient nutrition (da Silva et al., 2020).

The present study found 51% of residents at sarcopenia risk (using SARC-F) were also at risk of dysphagia. Sarcopenia as an independent risk factor for dysphagia has previously been reported among 236 community-living older adults in Korea where the likelihood of having dysphagia was observed to be almost three times as likely in those with sarcopenia (Cha et al., 2019). Similarly, sarcopenia was found to be an independent predictor of dysphagia among 224 older adults admitted to acute phase wards in a medical centre in, Japan (Maeda & Akagi, 2016a), as well as among 512 older adult clinic patients (aged 60+) admitted to a geriatric outpatient clinic of a tertiary centre in Turkey (Fırat Ozer et al., 2021). Across a range of hospital, community and RAC settings, a systematic review that comprised 2033 participants aged 65+ years also found sarcopenia to be positively associated with dysphagia (Zhao et al., 2018). In Japan, a study that assessed dysphagia using the modified water swallowing test among 399 nursing home residents found a reduction in skeletal muscle index (kg/m^2) was a significant risk factor for reduced swallowing function (Murakami et al., 2015). Much evidence reveals the association between dysphagia and sarcopenia.

The relationship between dysphagia and sarcopenia is part of a bi-directional cycle that also includes malnutrition (Chatindiara et al., 2018). Factors associated with anorexia of ageing can limit dietary quantity and quality (Oda et al., 2021), diminishing nutrition status and therefore leading to malnutrition (Griffin et al., 2012). Malnutrition leads to loss of muscle mass and strength which in turn results in sarcopenia and negatively affects dysphagia (Maeda & Akagi, 2016b; Poisson et al., 2016; Wakabayashi et al., 2019).

Dysphagia, poor oral intake, malnutrition and sarcopenia are in a positive feedback loop (see Figure 1.), where the effector amplifies the deviation from homeostasis (Abdel-Sater, 2011). If dysphagia is prolonged, sarcopenia can progress due to malnutrition (Maeda & Akagi, 2014, 2016b, 2017). If the cycle is allowed to continue, positive feedback will aggravate all the conditions involved, making the cycle more vicious and will require

external inputs to brake (Niell, 2006), such as intervention to interrupt this cycle (Rhoades & Bell, 2012). The key to managing this is prevention or early intervention (Oda et al., 2021). Prior to treatment, screening for malnutrition and sarcopenia first is essential, in order to detect risk followed by a more comprehensive assessment to determine whether these conditions are present, as suggested by the Australian and New Zealand Society for Geriatric Medicine (Visvanathan, 2009). Rapid assessment tools for malnutrition and sarcopenia include the MNA-SF and gait assessment, respectively, which should be followed up with more in-depth assessments such as dietary and body composition assessments if risk is detected (Visvanathan, 2009). Sarcopenia diagnosis also requires conformation of low appendicular skeletal muscle mass (< 7.36 kg/m2 for men and < 5.81kg/m2 for women) which can be measured using bioelectrical impedance (BIA) or dual-energy X-ray absorptiometry (DXA) (Yu et al., 2014).

Our study found a relationship between dysphagia and depression; 60% of those at risk of depression also had dysphagia. The association remained significant after adjusting for age, sex, number of medications and all health variables.

Dysphagia has been found to be a cause and effect of depression. A study in the UK, Spain, Germany and France of 100 nursing home and clinic residents with subjective dysphagia complaints found dysphagia to induce depression; with over half of the participants reported that dysphagia triggered feelings of isolation, anxiety and panic at mealtimes as well as embarrassment, loss of self-esteem, and reduced quality of life (Ekberg et al., 2002). A community study in Korea, found, using EAT-10, dysphagia was significantly associated with depression among older adults (Ko et al., 2022). Findings showed participants with dysphagia may experience depression due to food constraints and discomfort during meals, making it challenging for them to eat on their own. (Ko et al., 2022). Depression may therefore be ameliorated by making it easier for older adults to eat independently and ensuring food preferences are met.

Depression and loneliness often come hand-in-hand, influencing one another (Domènech-Abella et al., 2017; Erzen & Çikrikci, 2018; Prieto-Flores et al., 2011), and if left untreated, can affect dysphagia and its precursors such as malnutrition. Interventions involving digital

technology and group activities have been proven to be effective in reducing factors related to and including depression in RAC (Kahlbaugh et al., 2011; Tsai et al., 2010).

The main limitation of this study is the low external validity due to the small sample size, and participants residing in Auckland RAC within RAC villages run by the same organisation. Other limitations include the cross-sectional nature of the study unable to accurately determine cause and effect relationships between the variables, as well as potential confounding influences of the COVID-19 lockdown.. Depression was significantly associated with dysphagia, however as Auckland was in and out of COVID-19 lockdown, visitation restrictions within the RAC may have confounded our results. The questionnaires in this study were validated for use among the older adult population, however, the reliability of the survey responses is called into question as some participants were cognitively impaired; for example, the validity of the GDS decreased for cognitively impaired participants (Li et al., 2015), and EAT-10 scores significantly varied from the gold standard in a study where participants' cognitive impairment was not considered (Möller, Safa, & Östberg, 2016).

3.6 Conclusion

We found significant associations between dysphagia and depression, malnutrition, and sarcopenia. Our findings support regular dysphagia and associated co-morbidities screening to facilitate early intervention. further investigation among a larger sample size and among other residential care settings is warranted.

Chapter 4: Conclusion and Recommendations

4.1 Conclusion

This research provides insight into factors associated with dysphagia in older adults living in RAC. Dysphagia is defined as difficulty in the propagation of a food bolus from the mouth, through the oesophagus and into the stomach (Baijens et al., 2016; Payne & Morley, 2017). Swallowing difficulties can originate due to neurological conditions (i.e. Parkinson's disease and strokes), or chronically as a result of result of sarcopenia causing swallow muscle deterioration, associated with the ageing process (Robbins et al., 1995; Sakai & Sakuma, 2017). Dysphagia is a relatively newly recognised geriatric condition (Baijens et al., 2016; Payne & Morley, 2017) and therefore limited research is available on its manifestation in older adults.

This chapter will summarise the key findings of the study in relation to the aim as well as the contributions this study adds to the field. It will also review the limitations and propose recommendations for clinical practice as well as opportunities for future research.

This study aimed to investigate factors associated with dysphagia risk among older adults living in residential aged care. We investigated the association between dysphagia risk and demographic factors, nutrition status, and mental and physical health factors. We collected demographic information from the resident's clinical notes; physical measures including height, weight, hand grip strength, gait speed and body composition were collected using digital scales, a portable stadiometer, hand grip dynamometer, 2.4m gait speed walking test and portable bioelectrical impedance assessment (BIA) scales (InBodyS10, Inbody Co, Ltd., Korea) respectively. Sarcopenia, malnutrition, dysphagia, depression and quality of life was assessed using validated questionnaires: SARC-F (Strength, Assistance with walking, Rising from a chair, Climbing stairs, and experiencing Falls), The Mini Nutritional Assessment Short-Form (MNA-SF), The Eating Assessment Tool (EAT-10), The GDS (geriatric depressions scale) and the 12-Item Short Form Survey (SF-12), respectively.

Out of the 91 participants assessed for dysphagia risk, 67% of them were at risk of dysphagia. Our findings indicated significant associations between dysphagia and demographic factors including number of comorbidities (p=0.003) and number of regular medications (p=0.04) as well as SARC-F (p=<0.001), MNA (p=<0.001) and GDS (p=<0.001). When we performed a multivariate analysis, adjusting for age sex and number of regular medications, SARC-F, MNA and GDS all remained significantly associated with dysphagia risk. When further adjusted for age, sex, number of regular medications as well as all health variables (SARC-F, MNA, and GDS) the only remaining significant factor associated with dysphagia was depression. A less significant, yet noteworthy factor was malnutrition.
Our results confirm the findings of previous studies which have also found significant associations between dysphagia and: Depression (Ko et al., 2022; Mello et al., 2022), malnutrition (Chatindiara et al., 2020; Eglseer et al., 2018; Sánchez et al., 2014), and sarcopenia (Cha et al., 2019; Maeda & Akagi, 2016a). Previous findings as well as our own reflect the theoretical framework of dysphagia manifestation in older adults, which appears to be linked with depression (exacerbating poor oral intake) as a part of a positive feedback comorbidity cycle leading to malnutrition, sarcopenia, and dysphagia.

Although this study did not investigate oral intake or anorexia of ageing, by looking at other studies we can infer that dysphagia in older adults as well as the associated factors that lead to it (malnutrition and sarcopenia) are results of inadequate oral intake, resulting from poor appetite (Engel et al., 2011; Wham et al., 2017). Depression has been known to decrease appetite and was the factor most significantly associated with dysphagia in our study. Older adults, particularly those residing in RAC may experience depression because of loneliness (Jang et al., 2014; Parmenter et al., 2012; Prieto-Flores et al., 2011; Savikko et al., 2005; Slettebø, 2008; Wenger & Burholt, 2004). As eating is socially facilitated, lack of mealtime companionship can decrease the amount of calories consumed (De Castro & De Castro, 1989; Pilner et al., 2006). Consistent inadequate oral intake will ultimately result in malnutrition and can escalate to sarcopenia, leading to diminished swallow muscles and the development of dysphagia, further reducing oral intake.

As dysphagia will likely manifest alongside malnutrition and sarcopenia, older adults may lose their independence and ability to carry out ADL and require placement in RAC. Older

adults should be able to age in place within their community for as long as possible, as this will enable less strain on the healthcare system as well as the individual. For this to be possible, independent life expectancy must increase. The most current data suggests male New Zealanders have an ILE of 65.2 years (82% of their life), and New Zealand females have a ILE of 66.5 years (79.8% of their life) (Ministry of Health, 2015). The addition of knowledge to the field can help further guide public health and clinical initiatives to prevent and manage dysphagia in older adults, to increase the ILE and allow older adults to remain in place within the community for longer.

4.2 Limitations

Although our cross-sectional study was able to identify associations between dysphagia and other health factors, it is unable to make causational inferences. This study also has low external validity due to the small sample size of 91, as well as participants residing in three Auckland RAC under the same organisation.

Depression was significantly associated with dysphagia, however as Auckland was in and out of COVID-19 lockdown, visitation restrictions within the RAC may have confounded our results.

4.3 Recommendations for clinical practice

This study has identified several opportunities for improving clinical practice.

Dysphagia in older adults will likely present alongside depression, malnutrition and sarcopenia as reinforced by the results of our study; treatment and management can be very challenging. We, therefore, recommend priority going towards prevention.

Older adults are commonly admitted to RAC due to loss of independence, therefore for best dysphagia prevention outcomes, we need to ensure older adults remain healthy and independent within the community. Loss of independence is a consequence of developing

age-related comorbidities such as malnutrition, sarcopenia, and dysphagia. We recommend all older adults have regular weight monitoring and screening for age-related malnutrition and dysphagia. Visits to the GP can be the ideal opportunity to do this. The average session with a GP is usually limited in time, therefore the use of validated questionnaires and techniques such as the ones used in this study to assess for depression, malnutrition and dysphagia using the of GDS, MNA-SF and EAT-10 tool may be appropriate. The EAT-10 tool can be used to determine initial dysphagia risk as well as monitor its severity in response to treatment (Belafsky et al., 2008). Dysphagia risk was a significant predictor of malnutrition risk at hospital admissions; as 88% of these admissions were from the community, the author suggests this may be a result of unrecognised community cases (Chatindiara et al., 2020). Community screening can increase dysphagia and malnutrition identification, while also supporting easier treatment and management of these diseases as community-residing adults likely have a higher level of strength and independence than hospital or RAC-residing adults.

We also recommend screening for malnutrition upon admission to RAC; having this information can increase mindfulness for nurses and care staff to be able to provide suitable and individualised care for residents.

Older adults identified as being at risk of depression can be closely monitored to ensure oral intake is adequate and that depression is not contributing to anorexia of ageing.

As depression in this population may be a symptom of loneliness, initiatives around increasing involvement of families may be beneficial, such as organising family-friendly meal- times within the RAC facility. Interventions involving digital technology and group activities have been proven to be effective in reducing factors related to and including depression in RAC (Kahlbaugh et al., 2011; Tsai et al., 2010).

Depression may also come from feeling unsatisfaction with their contribution to the world (Erikson & Erikson, 1998; Goodcase & Love, 2017), and therefore may benefit from having the opportunity to further contribute to the community. Appropriate opportunities could

include donating knitted clothes and toys to the maternity/paediatric wards or maintaining a community vegetable garden.

Food fortification can be an effective method for increasing nutritional intake for those identified as at risk of malnutrition by increasing the nutrition density of meals without increasing volume. High energy, high protein (HEHP) food and drink fortification with the addition of HEHP ingredients can be especially suitable for participants with small appetites, common in older people (Odlund Olin et al., 2003). Oral nutrition supplements can also be used alongside a regular or fortified diet between meals to provide extra nutrition.

Those identified as sarcopenic will also benefit from HEHP food fortification and/or oral nutrition supplements (ONS), as sarcopenia is likely a consequence of malnutrition. Alongside better nutritional intake, those with sarcopenia may benefit from resistance exercise which induces muscle anabolism as an adaptive response to the resistance, and in turn can increase muscle mass and strength, help reduce falls, maintain functioning for ADL and improves gait stability (Seguin et al., 2002). Regular physical activity is essential for healthy ageing (Nelson et al., 2007; Organization, 2002b)

4.4 Recommendations for future research

We recommend research and intervention development to address factors preceding anorexia of ageing (AOA) and poor oral intake (OI) in older adults, as this could be the key to avoiding the dysphagia cycle altogether in some people. Previous studies have suggested several factors to affect AOA and poor OI in older adults including poor dentition, polypharmacy, early satiation, prolonged satiety, and depression, and therefore we recommend further research in this area.

Our results show that depression had the strongest association with dysphagia and therefore we recommend special consideration to research focussed on reducing the rate and severity of depression in older adults.

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Appendices

Appendix A: Participant Information Sheet

Participant Information Sheet

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

Study title: Eating Well in Rest Home Care

Locality: Arvida Village

Ethics committee ref.: 20/NTB/120

Lead investigator: Professor Carol Wham

Phone: 09 213 6644

You are invited to take part in a study on understanding and improving food intake in residential care. Whether or not you take part is your choice. If you don't want to take part, you don't have to give a reason, and it won't affect the care you receive. If you do want to take part now, but change your mind later, you can pull out of the study at any time.

This Participant Information Sheet will help you decide if you'd like to take part. It sets out why we are doing the study, what your participation would involve, what the benefits and risks to you might be, and what would happen after the study ends. We will go through this information with you and answer any questions you may have. You do not have to decide today whether you will participate in this study. Before you decide you may want to talk about the study with other people. Feel free to do this.

If you agree to take part in this study, you will be asked to sign the Consent Form on the last page of this document. You will be given a copy of both the Participant Information Sheet and the Consent Form to keep. This document is 6 pages long, including the Consent Form. Please make sure you have read and understood all the pages.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of this study is to establish your nutrition, health and physical status as well as quality of life & psychological well-being, perceptions towards the food service and meal satisfaction.

Adequate nutrition in older people is an issue that rarely receives the attention it deserves. Depending on your nutrition status you may be invited to participate in a food-based intervention. The outcome of the research will help inform best practice for nutrition care by the Arvida Group and other aged care providers. This study is being undertaken by the department of Nutrition and Dietetics at Massey University in Albany and is led by Professor Carol Wham who can be contacted by calling 09 213 6644.

WHAT WILL MY PARTICIPATION IN THE STUDY INVOLVE?

If you agree to take part in the study a dietetic researcher will assess your nutrition status using a 6-item survey, the Mini Nutritional Assessment Short-form. Your demographic and health data will be obtained from the rest home clinical notes to record your medications, co-morbidities, weight, height (if available) and any recent falls or fractures.

You will be invited to complete four short surveys to assess your risk of swallowing difficulty (dysphagia), your health-related quality of life, any risk of depression and a Mealtime Satisfaction Survey.

The dietetic researcher will then undertake some physical measures including your hand grip strength using a hand dynamometer, and your usual walking speed by measuring how long it takes you to walk 2.4 meters (or 8 feet). Your muscle mass and fat mass will then be measured while you are lying down using portable bioelectrical impedance assessment (BIA) scales. The scales send a harmless electrical current up through your body to "read" the amount of fat body mass and lean body mass calculating your percentage of body fat.

Hand grip strength using a hand dynamometer

Muscle mass and fat mass measure using portable bioelectrical impedance assessment (BIA) scales.

WHAT ARE THE POSSIBLE BENEFITS AND RISKS OF THIS STUDY?

We do not envisage any risks or discomfort to yourself by taking part in the study. We anticipate the results will help inform best practice for Eating Well by the Arvida Group.

WHO PAYS FOR THE STUDY?

Participants will not incur any costs. Travel for the researchers and other costs will be met as part of a research grant by Massey University.

WHAT IF SOMETHING GOES WRONG?

If you were injured in this study, you would be eligible **to apply** for compensation from ACC just as you would be if you were injured in an accident at work or at home. This does not mean that your claim will automatically be accepted. You will have to lodge a claim with ACC, which may take some time to assess. If your claim is accepted, you will receive funding to assist in your recovery.

WHAT ARE MY RIGHTS?

Participation in this study is voluntary and you are free to decline to participate, or to withdraw from the research at any practicable time, without experiencing any disadvantage. You also have the right to access information collected as part of the study. All information collected will be de-identified to protect your privacy and confidentiality.

WHAT HAPPENS AFTER THE STUDY OR IF I CHANGE MY MIND?

All information will be stored in password protected computers accessible only by the investigators. Only the investigators will have access to the complete data set. Investigators are aware and will comply with all Privacy Act tenets and requirements. Information will be stored as de-identified numbers with no individual information reported. The Health (Retention of Health Information) Regulations 1996 require that some health information be retained for a period of ten years.

WHO DO I CONTACT FOR MORE INFORMATION OR IF I HAVE CONCERNS?

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

Professor Carol Wham
Telephone number: 09 213 6644
Email: c.a.wham@massey.ac.nz

If you want to talk to someone who isn't involved with the study, you can contact an independent health and disability advocate on:

Phone:	0800 555 050
Fax:	0800 2 SUPPORT (0800 2787 7678)
Email:	advocacy@advocacy.org.nz
Website:	https://www.advocacy.org.nz/

For Maori Heath support, please contact:

Dr Bevan Erueti, Associate Dean – Maori, Massey University
Telephone number: (06) 356 9099 ext. 83087
Email: B.Erueti@massey.ac.nz

You can also contact the Health and Disability Ethics Committee (HDEC) that approved this study on:

Phone: 0800 4 ETHIC
Email: hdecs@health.govt.nz

Appendix B: Participant Consent Form

Consent Form

MASSEY UNIVERSITY
COLLEGE OF HEALTH
TE KURA HAUORA TANGATA

Please tick to indicate you consent to the following

I have read or have had read to me in my first language, and I understand the Participant Information Sheet.		☐
I have been given enough time to consider whether to participate in this study.		☐
I have had the opportunity to use a legal representative, whanau/ family support or a friend to help me ask questions and understand the study.		☐
I am satisfied with the answers I have been given regarding the study and I have a copy of this consent form and information sheet.		☐
I understand that taking part in this study is voluntary (my choice) and that I may withdraw from the study at any time without this affecting my medical care.		☐
I consent to the research staff collecting and processing my information, including information about my health.		☐
If I decide to withdraw from the study, I agree that the information collected about me up to the point when I withdraw may continue to be processed.	Yes ☐	No ☐
I consent to my GP or current provider being informed about my participation in the study and of any significant abnormal results obtained during the study.	Yes ☐	No ☐
I consent to my personal health records being released to the research team by the Clinical Manager.	Yes ☐	No ☐
I agree to an approved auditor appointed by the New Zealand Health and Disability Ethic Committees, or any relevant regulatory authority or their approved representative reviewing my relevant medical records for the sole purpose of checking the accuracy of the information recorded for the study.		☐
I understand that my participation in this study is confidential and that no material, which could identify me personally, will be used in any reports on this study.		☐
I understand the compensation provisions in case of injury during the study.		☐
I know who to contact if I have any questions about the study in general.		☐

I understand my responsibilities as a study participant.	☐
I wish to receive a summary of the results from the study.	Yes ☐ No ☐

Declaration by participant:
I hereby consent to take part in this study.

Participant's name: _____

Signature: _____ Date: _____

Declaration by member of research team:

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

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

Researcher's name: _____

Signature: _____ Date: _____

Questionnaires- Eating Well in Residential Aged Care

Start of Block: Introduction

Participant ID number

_____

Which study does this assessment relate to?

- Oral nutrition supplementation (1)
- Food fortification (2)

These measures are at:

- Baseline (1)
- Follow up (2)

Village

- Aria bays (1)
- Aria Gardens (2)

- ○ Aria Parks (3)

End of Block: Introduction

Start of Block: MNA-SF

Nutrition status

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

- ○ Severe decrease in food intake (1)
- ○ Moderate decrease in food intake (2)
- ○ No decrease in food intake (3)

Have you lost weight in the last 3 months, if so how much?

- ○ No weight loss (1)
- ○ Weight loss between 1 and 3 kg (2.2 and 6.6 lbs) (2)
- ○ Weight loss greater than 3 kg (6.6 lbs) (3)
- ○ I do not know (4)

How would you describe your mobility?

- ○ Bed or chair bound (1)
- ○ Able to get out of bed/chair but does not go out (2)
- ○ Able to go out (3)

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

- ○ Yes (1)
- ○ No (2)

Do you have any neuropsychological problems?

(Prioritise eCase answer over self reported answer. Take from medical information survey)

- ○ Severe dementia or depression (1)
- ○ Mild dementia (2)
- ○ No psychological problems (3)

What is your BMI?

(Take from excel spreadsheet)

- ○ BMI less than 19 (1)
- ○ BMI 19 to less than 21 (2)

- ○ BMI 21 to less than 23 (3)
- ○ BMI 23 or greater (4)

Calf circumference

(Take from functional measures survey. Only if non-weight bearing and BMI unavaliable)

- ○ Less than 31cm (1)
- ○ 31 cm or greater (2)

End of Block: MNA-SF

Start of Block: QOL SF-12 revised with all 12 questions

Health related quality of life The following questions are asking about your own health.

Please select only one answer.

In general would you say your health is...

- ○ Excellent (1)
- ○ Very good (2)
- ○ Good (3)
- ○ Fair (4)
- ○ Poor (5)

Does your **health limit you** in your activities that you might do during a typical day. If so, how much?

	Yes, limited a lot (1)	Yes, limited a little (2)	No, not limited at all (3)
Moderate activities such as moving a table, pushing a vacuum cleaner, bowling, or playing golf (1)	○	○	○
Climbing several flights of stairs (2)	○	○	○

During the past **4 weeks**, have you had any of the following problems with your regular daily activities **as a result of your physical health**?

	Yes (1)	No (2)
Accomplished less than you would like (1)	○	○
Were limited in the kind of work or other activities (2)	○	○

During the past **4 weeks**, have you had any of the following problems with your regular daily activities **as a result any emotional problems** (such as feeling depressed or anxious)?

	Yes (1)	No (2)
Accomplished less than you would like (1)	○	○
Didn't do work or other activities as carefully as usual (2)	○	○

During the past **4 weeks**, how much **did pain** interfere with your regular daily activities?

- ○ Not at all (1)
- ○ A little bit (2)
- ○ Moderately (3)
- ○ Quite a bit (4)
- ○ Extremely (5)

How much of the time during the past **4 weeks...**

	All of the time (1)	Most of the time (2)	A good bit of the time (3)	Some of the time (4)	A little of the time (5)	None of the time (6)
Have you felt calm & peaceful? (1)	○	○	○	○	○	○
Did you have a lot of energy? (2)	○	○	○	○	○	○
Have you felt down-hearted and blue? (3)	○	○	○	○	○	○

During the past **4 weeks**, how much of the time has your **physical health or emotional problems** interfered with your social activities (like visiting friends, relatives, etc.)?

- ○ All of the time (1)
- ○ Most of the time (2)
- ○ Some of the time (3)
- ○ A little of the time (4)
- ○ None of the time (5)

End of Block: QOL SF-12 revised with all 12 questions

Start of Block: GDS

Psychological well-being These last questions are to do with your psychological wellbeing over that past week.

Choose the best answer for how you felt **over the past week**.

	Yes (1)	No (2)
Are you satisfied with your life? (1)	○	○
Have you dropped many of your activities and interests? (2)	○	○

Do you feel that your life is empty? (3)	○	○
Do you often get bored? (4)	○	○
Are you in good spirits most of the time? (5)	○	○
Are you afraid that something bas is going to happen to you? (6)	○	○
Do you feel happy most of the time? (7)	○	○
Do you often feel helpless? (8)	○	○
Do you prefer to stay at home, rather than going out and doing new things? (9)	○	○
Do you feel you have more problems with memory than most people? (10)	○	○
Do you think its wonderful to be alive? (11)	○	○
Do you feel pretty worthless the way you are now? (12)	○	○
Do you feel full of energy? (13)	○	○
So you feel that your situation is hopeless? (14)	○	○

Do you think that most people are better off than you are? (15)	○	○

Start of Block: EAT 10

Swallowing The following questions are around swallowing while eating and drinking

Do you use an appliance to chew and eat (e.g. dentures)?

○ Yes, specify (5) _____

○ No (6)

How much of a problem is each of the following statements for you.

	Not at all (1)	A little (2)	A moderate amount (3)	A lot (4)	A great deal (5)
My swallowing problem has caused me to lose weight (1)	○	○	○	○	○

My swallowing problem interferes with my ability to go out for meals (2)	○	○	○	○	○
Swallowing liquids takes extra effort (3)	○	○	○	○	○
Swallowing solids takes extra effort (4)	○	○	○	○	○
Swallowing pills takes extra effort (5)	○	○	○	○	○
Swallowing is painful (6)	○	○	○	○	○
The pleasure of eating is affected by my swallowing (7)	○	○	○	○	○
When I swallow food sticks in my throat (8)	○	○	○	○	○
I cough when I eat (9)	○	○	○	○	○

Swallowing is stressful (10)	○	○	○	○	○

Page Break

Any notes?

e.g. participant didn't want to answer questions on PA today but willing to try again another day

e.g. refused questions on GDS

_____

_____

_____

_____

_____

End of Block: Block 10

Start of Block: QOL SF-12