Investigating the Effectiveness of Cycloid Vibration Therapy on the Quality of Life, Mobility and Nutrition of Aged Care Residents

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Abstract

In Australia, 3.8 million people are aged 65 or over; this age group is projected to grow to 8.7 million by 2056, making up 22 per cent of Australians (1). This rapid 'ageing' of the population is thanks to current advancements in medical technology and public health schemes (2). Although individuals can now expect to live into their sixties and beyond, ageing is associated with an accumulation of generalised impairments to health (3-5). Therefore, managing healthy ageing in older adults to improve their quality of life, mobility and nutrition is an important social and economic challenge in Australia. Physical activity has been well established as a key factor to support an individual's biopsychosocial health and is essential to prevent age-related impairments (6-8). However, several established barriers (e.g., physical limitations, competing priorities and access barriers) prevent older adults from undertaking physical activity (9-12). Vibration therapy has been reported to mechanically stimulate muscle spindles, initiating muscle contractions like physical activity, without the need for wide-ranging movements (13, 14).

A systematic review was conducted to understand the effectiveness of vibration therapy on the quality of life, mobility and nutrition of older adults. The review highlighted a total of five studies examining these variables. These randomised controlled trials revealed that participants undertaking vibration therapy had improved knee joint mobility (15, 16), general functional mobility (15, 17, 18), gait and walking ability (17, 18) and balance ability (15, 18, 19). Some of these studies also reported significant improvement in certain aspects of quality of life (15, 17). However, nutrition was not a key variable assessed in any of the studies. Along with these findings, seated cycloid vibration therapy was considered the most viable form of vibration therapy for older adults with impaired mobility due to its postulated ease of use, portability and safety compared to standing whole-body vibration. However, the study focusing on seated cycloid vibration therapy was of low quality, suggesting further research for this therapy. A pilot intervention study was conducted on the effectiveness of cycloid vibration therapy on the quality of life, mobility and nutrition of aged care residents to cover the gaps evaluated by the systematic review.

In the pilot intervention study, 14 eligible aged care facility residents aged 65 and over who met the inclusion criteria were allocated into either the cycloid vibration therapy

(intervention) group or the control group based on exclusion criteria. Initially, those in the intervention group were to participate in the intervention for 12 weeks, with outcome measurements being conducted at baseline, week four, week eight and week 12. However, due to restrictions placed on aged-care facilities due to COVID-19 at week four of the intervention, the cycloid vibration therapy treatment was only provided for four weeks. Additionally, outcome measures were conducted at baseline and six months post-intervention when COVID-19 restrictions were relaxed. Consequently, outcome measures were not performed at the end of week 4, 8 and 12. However, this allowed for any long-term effects to be measured using the 6-Dimensional Quality of Life Assessment, Physiotherapy Mobility Assessment and Mini Nutritional Assessment. No significant differences at six months post-intervention were observed in the quality of life, mobility or nutrition of participants undertaking the cycloid vibration therapy treatment compared to baseline. Despite these findings, participants evaluated the intervention as relaxing and comfortable and desired the intervention to have been at the aged care facility during the COVID-19 pandemic.

A qualitative study was also conducted to assess the experiences of these participants during the COVID-19 pandemic concerning their quality of life, mobility and nutrition. Semi-structured, one-on-one interviews addressed resident life during the full-scale COVID-19 aged-care restrictions imposed by the Queensland Government. Participant experiences comprised three major themes: (1) reduced face-to-face contact with close ones, (2) disruption to daily routines and activities and (3) aged care staff affecting resident wellbeing. These major themes were observed to affect the quality of life, mobility and nutrition of older adults in several ways. Thus, they were considered potential confounding factors to the previous intervention study.

Overall, these studies validate the need for further research into the effectiveness of cycloid vibration therapy on the quality of life, mobility and nutrition in aged care residents. Unavoidable limitations of the study, that is, the break in the intervention period and the effect of COVID-19, make the findings of this research project inconclusive. However, participant evaluations revealed that they enjoyed the cycloid vibration therapy program and desired to redo the intervention. With participants expressing disruption to services and staff availability, providing the residents with cycloid vibration therapy may have proved invaluable to their quality of life, mobility and nutrition. Recommendations based on the limitations of this study may help design a large-scale intervention study

regarding the effectiveness of cycloid vibration therapy on the quality of life, mobility and nutrition of aged care residents.

Statement of Originality

This work has not previously been submitted for a degree or diploma in any university. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made in the thesis itself.

(Signed)_____

Ben Vu

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List of Abbreviations

10mTW	10-metre timed walk
30s-CST	30-Second Chair Stand Test
A	Amplitude
ABC	Activities-Specific Balance Confidence
AIHW	Australian Institute of Health and Welfare
AQoL-6D	6-Dimensional Quality of Life
BI	Barthel Index
BMI	Body Mass Index
CVT	Cycloid vibration therapy
F	Frequency
FVT	Focal vibration therapy
GU	Griffith University
MCS	Mental health component score
MNA	Mini Nutritional Assessment
PA	Physical activity
PBT	Postural balance test
PCS	Physical health component score
PG	Placebo group
PMA	Physiotherapy Mobility Assessment
POMA	Performance-oriented mobility assessment

POMA-B	POMA Balance scale
POMA-G	POMA Gait scale
POMA-T	Total POMA scale
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
PWT	Parallel Walk Test
QoL	Quality of life
RCT	Randomised controlled trial
RoB 2	Cochrane risk-of-bias tool for randomised trials (Version. 2)
SD	Standard deviation
SIM	Simulated whole-body vibration
SPSS	Statistical Package for the Social Sciences version 26.0
TG	Treatment group
TUG	Timed Up and Go Test
VT	Vibration therapy
WBV	Whole-body vibration
WHO	World Health Organization

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Chapter 1: Introduction

1.1 Introduction

To promote healthy ageing, a well-established method that maintains an individual's quality of life (QoL), mobility and nutrition is essential. For most populations, physical activity is an effective method to counteract the generalised impairments that come with age. However, for many elderly individuals, a range of barriers to participation exist (e.g., low compliance, comorbidities and risk of falls) (9-12). Vibration therapy (VT) is an emerging method proposed to have similar benefits to physical activity without the need for wide-ranging movement movements (13, 14). Within VT, cycloid vibration therapy (CVT) has been hypothesised to be the most viable method of physical activity for older adults with impaired mobility. This is because of CVT's perceived portability, ease of use and safety compared to standing whole-body vibration (WBV) therapy. However, to date, the effects of CVT on the factors of healthy ageing have not been widely investigated, particularly in the context of residential aged care. Thus, this study aimed to determine if CVT influences the QoL, mobility and nutrition of aged care residents.

1.2 Background

According to the United Nation's World Population Prospects: the 2019 Revision, by 2050, one in six people will be over the age of 65, making up 16 per cent of the global population (20). In Australia, it is projected that the number of people aged 65 and over will grow from 3.8 million to 8.8 million by 2056, making up 22 per cent of all Australians (1). Population ageing is rapidly becoming one of the most significant social transformations with implications for nearly all sectors of society, financial markets and the demand for goods and services, such as housing and healthcare (2).

The concept of 'healthy ageing' has become a more central concept than ever before (21). The World Health Organization (WHO) defines healthy ageing as 'the process of developing and maintaining the functional ability that enables wellbeing in older age' (21). Functional ability comprises all the mental and physical capacities from which an individual can draw, including their ability to walk, think, see, hear and remember (21). Being free of illness or disease are not requirements for healthy ageing.

Therefore, healthy ageing can be defined by three main factors:(1) QoL, (2) mobility and (3) nutrition (21).

Physical activity is a well-established method for maintaining and improving most aspects of an individual's biopsychosocial health. For ageing individuals, physical activity is essential in counteracting the generalised impairments that come with age (6). In a systematic review by Daskalopoulou et al. (22), increased physical activity levels in older adults were found to improve the odds of healthy ageing by 39 per cent. Physical activity has been shown to be significantly associated with improved sarcopenia components, a key cause of age-related mobility decline (23). By improving muscle mass, strength and mobility in older adults, physical activity has been hypothesised to improve the nutritional status of older adults through increased basal metabolic rates and increased appetite (24). Therefore, with physical activity improving both the mobility and nutrition of older adults, individuals can experience a better QoL. Although physical activity may be beneficial, compliance from ageing individuals is challenging (9-12). According to the Australian Institute of Health and Welfare (AIHW), two in five older Australian individuals reported being sufficiently active during the preceding week (25). Several systematic reviews and qualitative studies explain this insufficient physical activity in older adults is due to multiple barriers, including physical limitations, competing priorities and access difficulties (9-12).

For patients contraindicated for physical activity, VT could be an option for maintaining the factors required for healthy ageing. As the name suggests, VT generates vibration at certain frequencies (Hz), indicating the number of complete up-and-down movement cycles per second, amplitudes (mm), as well as different directions of the vibration movement (26). VT is a broad term for different types of vibratory devices available, including CVT and WBV therapy. Several systematic reviews observed VT improving functional ability, mobility and muscle recovery (27-29). It has also been hypothesised that mechanically induced muscle contractions from VT can increase glucose uptake and metabolism (30). With these physical improvements and high participant compliance (31-33), QoL, mobility and nutrition could be affected. However, in the context of healthy ageing, no systematic review or intervention study has examined the effectiveness of VT on the QoL, mobility and nutrition of older adults. This study aimed to investigate the effectiveness of VT on these healthy ageing factors.

1.3 Research Aims and Objectives

The overall aim of this study was to examine the effectiveness of VT on the QoL, mobility and nutrition in aged care residents. Further, the most viable form of VT for older adults with mobility impairments was evaluated in terms of portability, ease of use and safety with a systematic review. From here, preliminary evidence on the effectiveness of the most viable VT device to improve the QoL, mobility and nutrition for mobility-impaired older adults was provided with a pilot intervention study with aged care residents. Due to COVID-19 aged-care restrictions being introduced near the beginning of the intervention study, participants' experiences with the COVID-19 pandemic were investigated regarding any effects on the preliminary evidence. Before these aims, the study first aimed to provide a comprehensive review of the background literature on the ageing population and their age-related impairments to QoL, mobility and nutrition. Additional literature was also reviewed on how physical activity can benefit these older adults and their current participation in physical activity. Current literature on VT in older adults was also reviewed.

1.4 Significance

Common complications such as decreased mobility, poor nutrition and reduced QoL become more prevalent with age (3-5). Physical activity is the recommended form of overall health management for older adults to counteract these age-related complications (34). However, due to age-related barriers preventing elderly individuals from participating in physical activity (e.g., decreased mobility, competing priorities and access barriers) (9-12), a need for an alternative or complementary therapy is presented. With the ability to induce muscular contractions like physical activity without the need for wide-ranging movements, VT could be a possible therapy for overcoming these age-related barriers in mobility-impaired older adults. However, a gap in the literature is apparent when describing the effectiveness of VT on the QoL, mobility and nutrition of older adults. By assessing the effectiveness of VT on these age-related implications with a systematic review, justification for further research of VT technology on older adults can be provided. Moreover, by determining the most viable form of VT technology with this review, further research into VT can be more feasible for mobility-impaired older adults. The outcomes of the later pilot intervention study have the potential to provide preliminary evidence of the chosen VT (CVT) on the QoL, mobility and nutrition in aged care residents, adding to the already scarce literature on VT. The qualitative COVID-19

study also outlines the experiences of aged care residents during this current phenomenon concerning their QoL, mobility and nutrition. Other than examining the pandemic as a potential confounding factor, no other study has examined the experiences of aged care residents during the Queensland COVID-19 aged-care restrictions concerning these healthy ageing factors. These qualitative findings will add to the much-needed literature on the effect of the COVID-19 aged care restrictions.

1.5 Research Questions

Systematic Review

1) Does VT improve the QoL, mobility and nutrition of older adults?
2) Which type of VT is most viable for older adults contraindicated for physical activity?

Pilot Intervention Study

1) Does CVT affect the QoL, mobility and nutrition of aged care residents?

Qualitative COVID-19 Effects Study

1) How did participants experience the effects of the COVID-19 aged-care restrictions in relation to their QoL, mobility and nutrition?

1.6 Research Hypotheses

1) VT will provide improvements in the QoL, mobility and nutrition of older adults.
2) CVT will be the most viable form of VT for older adults with mobility impairments.
3) Participants in the CVT treatment group will experience improved QoL, mobility and nutrition compared to baseline.
4) Participants in the intervention study will be negatively affected by the COVID-19 aged-care restrictions concerning their QoL, mobility and nutrition.

1.7 Structure of Thesis

Chapter 1 has provided a brief overview of the research background to this study as well as its significance and research questions. The study aims and objectives were also provided.

In Chapter 2, a comprehensive literature review is presented. Here, the ageing population and healthy ageing factors of QoL, mobility and nutrition are discussed. Along with these factors, the topic of physical activity in older adults is introduced. Current literature on VT and its hypothesised effects on QoL, mobility and nutrition are highlighted.

In Chapter 3, a systematic review of the different types of VTs and their effectiveness on the QoL, mobility and nutrition in older adults is presented. The methodology, including search strategy, data collection and critical appraisal of sources, are outlined. Along with the methodology, the findings from the included studies are discussed in a narrative synthesis.

In Chapter 4, details of the pilot CVT intervention study with aged care residents are presented. Methodological considerations, including design, sampling strategy, data collection, analysis and ethical considerations, are outlined. Findings examining the effectiveness of CVT on the QoL, mobility and nutrition in aged care residents are presented.

During the intervention study, several COVID-19 aged-care restrictions were introduced, halting the progress of the study period. These restrictions were hypothesised to affect the findings presented in Chapter 4.

In Chapter 5, participant experiences during the COVID-19 aged-care restrictions regarding their QoL, mobility and nutrition are provided. The qualitative study's theoretical framework, data collection and analysis procedures are outlined. Major themes and sub-themes found in participant experiences are discussed.

Chapter 6 provides a detailed discussion of both the intervention study findings and qualitative study findings. The overall findings are discussed in the context of the literature identified in the systematic review. Study limitations are also examined.

Chapter 7 concludes the study findings and their implications. This chapter also provides recommendations for future research.

Chapter 2: Literature Review

2.1 Introduction

This chapter presents an overview of the ageing population and their associated general health status. A particular focus is provided on the QoL, mobility and nutrition in older adults (≥ 65 years). Alongside the challenges of ageing, its influence on the ability to participate in physical activity is highlighted. Existing relevant literature on VT and its possible desirable effects are examined. Additionally, the different forms of VTs are described. The next chapter carries on from this literature review as a systematic review of the effects of VT on the QoL, mobility and nutrition in older adults. The systematic review also compares the various relevant VTs in relation to older adults contraindicated for physical activity.

2.2 The Ageing Population

With this current generation's access to advanced medical technology and public health schemes, individuals can expect to live into their sixties and beyond (2). According to the WHO, between 2015 and 2050, the proportion of the world's population over 60 years is expected to double from 12 to 22 per cent (35). In Australia, the population aged 65 and over is projected to grow from 3.8 million to 8.8 million by 2056, making up 22 per cent of Australians (1). Overall, Australians are now enjoying one of the highest life expectancies in the world. Within the Australian community, older individuals contribute valuably to society by participating in family and community life; the AIHW reported that one in five older Australians had volunteered their time within the last 12 months (1). Older Australians are also a vital part of the economy through their continued engagement in the workforce along with their post-retirement incomes and assets (1).

With the rapidly increasing ageing population and invaluable contributions they make to the broader community, managing the healthy ageing of older adults is an important social and economic challenge both in Australia and globally (1, 2). The WHO defines healthy ageing as 'the process of developing and maintaining the functional ability that enables wellbeing in older age' (21). Functional ability comprises all the mental and physical capacities from which an individual can draw, including their ability

to walk, think, see, hear and remember (21). Being free of illnesses or disease are not requirements for healthy ageing but can be defined as maintaining one's QoL, mobility and nutrition. Associated with ageing is the accumulation of generalised impairments to health that negatively affect these key factors to healthy ageing and overall QoL.

Due to these accumulative impairments and the growing older population, the AIHW reported a 17 per cent increase in the number of older Australians in permanent residential aged cares from 2007 to 2017 (1). As defined by the Australian Government Department of Health (36), residential aged cares are for older Australians that no longer have the capacity to live within their own home (36). Compared to most community-dwelling older adults, aged care residents can experience more severe limitations to their day-to-day activities (1). Providing both accomodation and support to older individuals residing in aged care then becomes crucial to promoting 'healthy ageing' in the Australian population.

2.3 Mobility in Older Adults

Mobility, defined as the physical ability to move, is considered a key promotor of healthy ageing, as it relates to the basic human need for physical movement (37). Mobility is necessary for accessing commodities and participation in meaningful social, cultural and physical activities (37). However, with advancing age, mobility can decline rapidly (38). Longitudinal data based on older persons in the Chianti area, Italy, observed rates of decline in measures of lower extremity performance, including walking to accelerate, between the ages of 60 and 70 years (38). These age-related declines in mobility can hinder the ability to manage tasks of daily life and increase the need for assistance, leading to disability or institutionalisation (3). When providing insight into the older Australian population, the AIHW reported a decline in mobility among individuals aged 65 and over (1). This older Australian-based review reported that in 2015, 15 per cent of men and 22 per cent of women aged 65 and over experienced disability as a severe or profound core activity limitation (i.e., requires help with self-care, mobility or communication) (1).

Several complex reasonings for the rapid age-related decline in mobility and overall functional ability exist. However, increasing evidence suggests that neuromuscular impairments and resulting muscle weakness are most predictive of unfavourable mobility outcomes later in life (39). A review assessing some of the risk

factors for falls in older people suggested muscular weakness was strongly associated with impaired mobility and increased falls (40). Losses in muscle strength (dynapenia) and muscle mass (sarcopenia) are introduced with age due to several degenerative processes (41, 42). Both neural and morphological factors and their interactions are responsible for age-related declines in muscle strength and mass (41, 42). Ageing is characterised by a gradual loss of spinal motor neurons responsible for the control of all muscle movements through transmitted impulses to skeletal and smooth muscle (41). The age-related loss of spinal motor neurons leads to a decline in muscle fibre number and size, resulting in impaired mechanical muscle performance (41, 42). Therefore, older adults exhibiting poor mobility are prime candidates for rehabilitation focused on improving these impairments.

2.4 Nutrition in Older Adults

Nutrition is an important element of health in the older population. Meeting the diet and nutritional needs of older adults is crucial for the maintenance of functional independence and quality of life, supporting healthy ageing (43-45). Malnutrition, defined as a state of deficiency or imbalance of nutrients (46), is increasing among the elderly population. In their 2021 final report, The Australian Royal Commission into Aged Care Quality and Safety reported that approximately 50 per cent of older Australians in residential aged care were either at risk of malnutrition or were malnourished (47). Termed the ‘anorexia of ageing’ (43-45), advanced age introduces multifactorial physiological and psychosocial changes that can make it more difficult for nutritional needs to be met (see Figure 2.1).

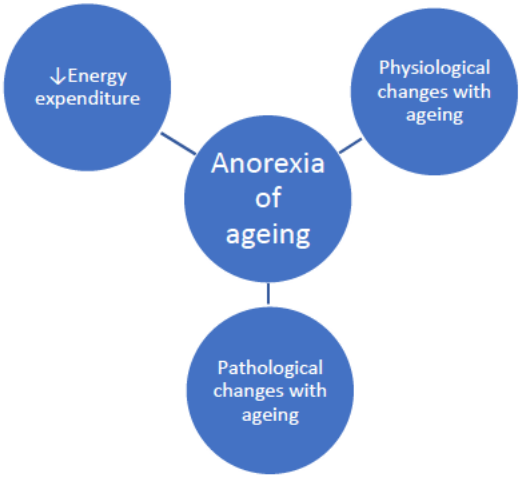

Figure 2.1. Factors Contributing to the 'Anorexia of Ageing'.

Notes. Adapted from (43).

The 'anorexia of ageing' predisposes older adults to a decrease in food intake through changes in the complex system of appetite regulation (48). Regarding the pathophysiology that affects satiation and dietary behaviours, there are age-related derangements in both peripheral and central regulatory systems (49). This includes age-related gradual decreases in smell and taste perception, hormonal changes in gut mediators and altered secretions of ghrelin (50). Further, gastrointestinal muscular tone and motility both decrease during ageing (4). Consequently, older adults may experience longer-lasting satiety due to delayed gastric emptying. To address and counteract these age-related changes, several studies have recommended food and nutritional manipulation and the preliminary elimination of all potentially reversible contributing factors (50). However, regarding the 'anorexia of ageing's' multifactorial origin, these nutritional problems can only be solved with a multidisciplinary approach.

Besides age-related pathophysiology, the physiological changes in older adults are a widely suggested cause of appetite loss (51). As adults begin to age, individuals begin to experience losses in lean body mass as shown in both cross-sectional and longitudinal studies (52, 53). This can be due to the same degenerative processes introduced by sarcopenia in which gradual muscle loss occurs for older adults (41, 42). This loss in lean body mass is further exacerbated by the pathophysiological reasons for lack of appetite and decreased energy intake (54). Loss of this fat-free mass leads to a

reduction in basal metabolic rate causing a rise in body fat (55). Not only does this negatively affect an older adult's nutritional status, but it also affects their mobility status. (41, 42). Recent studies have suggested implementing physical activity interventions to improve appetite control in young adults; however, the effects in older adults are less clear (56). In a recent systematic review, physical activity was proposed to improve appetite and energy intake, and energy intake was proposed to increase with habitual physical activity; however, the review found insufficient evidence to support this suggestion (51). However, there are several benefits associated with physical activity, including increasing lean body mass and resting metabolic rate (57), which are both positively associated with appetite (24).

2.5 Quality of Life in Older Adults

As stated earlier, the concept of healthy ageing has become an important pillar of research as the ageing population increases rapidly (21). As healthy ageing is expected to affect QoL, understanding the features and determinants of QoL is of primary relevance to support the healthy ageing of older adults. QoL is referred to as health-related QoL in this context. Health-related QoL is a multidimensional population health outcome that complements more traditional measures of mortality and morbidity, providing a broad summary of measures of perceived health (58). Determinants of health-related QoL include measures of physical health, mental health and social functioning (59). In older adults, adverse effects to health-related QoL have been widely documented due to the accumulative complications associated with ageing (5, 60). In a recent panel survey study assessing the QoL of older Australians living in rural and urban communities, a repeated-measures analysis of variance showed a decrease in QoL over time (61). This decline in QoL among older adults over time was also observed in a separate two-year follow-up study by Rantakokko et al. (62). This evident decline in health-related QoL in older adults can be associated with age-related declines in mobility and nutrition, among other factors (62-68).

In the same two-year follow-up study assessing QoL in older adults mentioned earlier, Rantakokko et al. (62) also observed a decline in QoL associated with a decline in life-space mobility (62). Life-space mobility was referred to as the spatial area in which a person moves in daily life while considering distance, frequency and assistance needed (62). Another study that explicitly evaluated the relationship between mobility

impairment and health-related QoL in older adults showed that higher mobility impairment was significantly associated with decreased health-related QoL (63). In a meta-synthesis of qualitative studies examining older adult perceptions of mobility, Goins et al. (64) observed that mobility to older adults was 'an integral part of sense of self and feeling whole'. As a basic human need, mobility signifies independence and wellbeing, contributing to an individual's overall health-related QoL (21, 64). Thus, supporting the mobility of an older adult may enhance one's health-related QoL.

By supporting the nutrition of older adults, this may substantially reduce the burden of disease and improve QoL. In a cross-sectional study of older adults with gastrointestinal malignancies, a high prevalence of malnutrition was observed in these individuals that was associated with a reduced health-related QoL (65). In another cross-sectional analysis examining the relationship between diet quality, physical activity and health-related QoL in older adults, Xu et al. (66) observed that consuming a healthier diet was associated with better general health. If undernutrition becomes extreme in older adults with malnutrition, diminished muscle mass and vigour, functional impairment and decreased health-related QoL occurs (67, 68). Therefore, it is essential to monitor and manage an older adult's nutritional status to improve their health-related QoL.

2.6 Physical Activity in Older Adults

'Physical activity' is defined by the WHO as any bodily movement that requires energy expenditure produced by skeletal muscles (69). For a variety of populations, being physically active has been well established as a key factor in maintaining and improving biopsychosocial health (6-8). For ageing individuals, physical activity is essential in counteracting the generalised impairments that come with age (6). By counteracting these health-related impairments with physical activity, the healthy ageing of older adults can be supported (22). Increased physical activity levels in older adults have been found to improve the odds of healthy ageing by 39 per cent, as observed in a systematic review and meta-analysis of longitudinal studies by Daskalopoulou et al. (22). Due to the significant strength in evidence, the AIHW recommends that individuals aged 65 and over should accumulate at least 30 minutes of moderate-intensity physical activity on most or preferably all days (25). When introduced to older adults, physical activity has several hypothesised mechanisms improving mobility, nutrition and QoL in older adults.

In an umbrella review re-examining the relationship between physical activity, risk of fall-related injury, and overall mobility in older adults, Dipietro et al. (70) observed strong evidence that physical activity reduced the risk of fall-related injuries from 40 to 32 per cent. Dipietro et al. (70) also reported significantly improved physical function with physical activity, reducing the risk of age-related loss of physical function among older adults. Declines in mobility have been previously indicated in older adults due to several age-related impairments (39-42). One of the leading causes of mobility decline in older adults is the age-related loss of muscle mass and strength (39). In a cross-sectional study examining a large group of older adults, physical activity was observed to be significantly associated with sarcopenia components (i.e., muscle mass, muscle strength and muscle function) (23). Meier et al. (23) found that physically active older adults maintained higher levels of upper and lower body strength while avoiding sedentary time. In a separate yearlong study measuring the physical activity level of older Japanese individuals, seniors that walked at least 7,000 to 8,000 steps per day were observed to have a likely chance to have a muscle mass above the sarcopenia threshold (71). Therefore, by maintaining the age-related loss of muscle mass and strength in elderly individuals, evidence suggests that physical activity is a viable factor for supporting the mobility of older adults.

The ‘anorexia of ageing’, defined as a loss of appetite or reduced food intake, has also been previously found to affect the nutritional status of a number of older adults (48). In a systematic review evaluating the potentially modifiable determinants of malnutrition in older adults, moderate evidence observed that poor physical function was positively associated with malnutrition, along with other determinants (72). Research suggests that by improving physical function with physical activity, physical activity may improve older adult nutrition along with improved mobility (70). It has also been hypothesised that the age-related loss of lean muscle mass and reduced basal metabolic rate in consequence (55), is associated with the age-related loss of appetite (24). Physical activity has been previously associated with the effective maintenance of muscle mass in older adults (23) and could improve the onset of age-related appetite loss in older adults through increased basal energy expenditure. Therefore, as mobility and nutrition improve with physical activity, older adults will experience a better QoL (62, 66) as previously mentioned.

2.6.1 Physical Activity Participation in Older Adults

Although the AIHW recommends that older adults should be accumulating at least 30 minutes of moderate-intensity physical activity every day, 75 per cent of older Australians were reported not to be sufficiently active during 2014–15. This large proportion of insufficiently active older adults was also observed in the United States, with only 14.7 per cent of Americans aged 65–74 years meeting the recommended amount of weekly physical activity (73). Along with the large proportion of insufficiently active older Australians, the average time spent on sedentary activities by non-working older Australians exceeded six hours on the average weekday (25). Sedentary activity is defined by the AIHW as prolonged sitting or lying down in which low levels of energy are expended (excluded time spent sleeping) (25). For non-working older Australians, the long hours of sedentary activity were measured as sitting while watching TV or using a computer, and other leisurely activities, such as reading or sitting down for meals (25). Knowledge of the determinants of insufficient physical activity and sedentary behaviour is needed to promote healthy ageing in older adults effectively.

Several systematic reviews and qualitative studies have explored the barriers to physical activity participation in older adults (9-12). In a thematic synthesis of the qualitative literature on older people's perspectives on physical activity participation, Franco et al. (12) observed that some older adults believe physical activity to be unnecessary or potentially harmful. Other than motivation and beliefs, Franco et al. (12) reported other major themes regarding low physical activity participation in older adults due to physical limitations, competing priorities and access difficulties. Regarding physical limitations, physical activity was perceived as both physically and emotionally demanding (12). Further, older adults feared falling and sustaining serious injuries during physical activities (12). In Franco et al.'s (12) thematic synthesis, 56 per cent of studies reported older adults being unable to participate in physical activities due to existing comorbidities (i.e., musculoskeletal disorders) (12). In another systematic review exploring barriers to physical activity in mobility-limited older adults, Rasinaho et al. (74) reported that older individuals with severe mobility limitations often reported more physical activity barriers than those with no mobility limitation.

In 40 per cent of studies examined by Franco et al. (12), competing priorities such as work and family responsibilities provided little to no time for older participants to participate in physical activity. For aged care residents, environmental barriers such as

poor access to transport and lack of accessible space and equipment for physical activity in institutions were significant factors in the low participation in physical activity (75). In Franco et al.'s (12) review, 55 per cent of studies also reported the unavailability of appropriate physical activity programs. Finding an alternative or complementary method to physical activity that can satisfy these barriers is desired and imperative in supporting the healthy ageing of older adults, especially those contraindicated for physical activity.

2.7 Vibration Therapy

A rising interest in the use of VT for safely achieving therapeutic or physical performance goals has been observed over recent years (76, 77). As the name suggests, VT generates vibration at certain frequencies (Hz), indicating the number of complete up-and-down movement cycles per second, amplitudes (mm) and directions of the vibration movement (26). The force and intensity of VT increase with the frequency and the amplitude of the vibration (26). A wide range of protocols exists to conduct studies on VT, depending on the type of vibratory device used (29, 78-80). For WBV, the user typically stands or lies down on the vibratory platform in a static position or performs static movements (29, 78, 79). CVT differs from WBV with the type of therapeutic stimulus produced at an arguably lower intensity than WBV (80). CVT consists of cycloid vibrations produced in three perpendicular directions, producing alternating pulsations at different frequencies, amplitudes and accelerations (80). During CVT protocol, participants are typically seated with cycloidal vibrations being administered with a lightweight vibratory device rather than a large platform (29, 80). With either VTs, users are not required to use wide-ranging movements compared to physical activity, making them ideal for older participants with mobility impairments (76, 77).

The exact mechanism of action of VT remains a matter of controversy among researchers (81). However, it is mainly hypothesised that vibrations mechanically stimulate muscles' spindles and alpha-motor neurons, initiating a muscle contraction similar to physical activity (13, 14). By inducing concentric-eccentric contractions through mechanical oscillations, VT is hypothesised to prevent the age-related loss of muscle (sarcopenia) and improve an individual's mobility status. In a systematic review examining the effect of WBV on balance, mobility and falls in older adults, WBV improved relatively basic functional ability and mobility, particularly among frailer older adults (27). In another recent systematic review assessing the effects of WBV in

institutionalised older adults, Alvarez-Barbosa et al. (28) reported WBV to be most beneficial for their functional mobility. While the only one of its kind, an outdated study found that locally applied CVT of low amplitude and frequency was equally as effective as flexibility exercises in increasing short-term mobility (82). In another study, compared to sports massage and stretching, CVT showed no significant difference in promoting muscle recovery after muscle-damaging exercise (29). Thus, by assisting muscle recovery, mobility can also be improved. Although the effectiveness of VT on the nutrition of older adults has not been established, it has been hypothesised that mechanically induced muscle contractions from VT can increase glucose uptake and metabolism (30). With this positive association with VT use, the improved mobility and nutrition of older adults are hypothesised to result in a better health-related QoL. In a systematic review examining studies that assessed the effects of WBV in patients with fibromyalgia, WBV was observed to improve health-related QoL (83).

In terms of participant compliance, several studies have examined the feasibility of VT in older adults. In a randomised control trial (RCT) assessing the feasibility of WBV in institutionalised elderly persons, Bautmans et al. (84) observed that 96 per cent of treatment participants attended their WBV exercise sessions. This high compliance rate to WBV therapy (≥90%) was also observed in several other studies (31-33). In another feasibility study assessing CVT's effectiveness on intermittent claudication in older adults, participant compliance with CVT was high with no participant dropout (85). Atkin et al. (85) also observed that 24 per cent of participants used the CVT device more frequently than recommended. Compared to the high compliance rates with VT in older adults, adherence to physical activity was extremely low in older adults, as presented in a population-based study (≤15%) (86). This low adherence to physical activity in older adults has previously been raised by the AIHW (25). Thus, VT has the potential to be a complementary or alternative therapy to support the healthy ageing of older adults with low compliance to physical activity. However, a systematic review assessing the effectiveness of VT on the factors of healthy ageing, including mobility, nutrition and QoL in older adults, does not yet exist in the literature. Further, with the variety of VTs currently available, comparing the safety, ease of use and effectiveness of each therapy for older adults, especially those with barriers to physical activity, is increasingly relevant.

2.8 Chapter Summary

Health-related declines in the rapidly ageing population present a significant global health problem (21). To support the healthy ageing of older adults, the AIHW recommends regular engagement in physical activity to improve the mobility, nutrition and QoL of older adults (1, 25). Despite strong evidence and existing initiatives aimed at facilitating physical activity, a large proportion of older adults remain insufficiently active and lead mainly sedentary lifestyles (1, 25). This chapter provided an overview of the underlying barriers preventing older adults from participating in physical activity such as physical limitations and access difficulties (9-12). As an alternative or complementary therapy to support the healthy ageing of older adults, the feasibility and effectiveness of VT in older adults was explored. The potential of VT to support mobility, nutrition and QoL in older adults was revealed with its high compliancy, safety and portability, as presented in numerous studies. With the differing VTs available, a comprehensive review of these therapies in their ability to support the QoL, mobility and in older adults is desirable. A systematic review examining the different VTs available and overall effectiveness on the healthy ageing factors of older adults is presented in Chapter 3.

Chapter 3: Systematic Review

3.1 Introduction

A systematic review was conducted to systematically extract and analyse relevant primary articles on VT and the QoL, mobility and nutrition of older adults. The objective of this review was to evaluate whether VT could improve these aspects of healthy ageing within older adults. Additionally, the type of VT most feasible for older adults contraindicated for physical activity was also considered. In Chapter 3, the protocol used to conduct this systematic review is defined. The main findings, analysis, critical appraisal and discussion of key articles are also outlined. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist was used to report the systematic review explicitly and effectively (87). The PRISMA checklist is an evidence-based minimum set of items for the transparent and effective reporting of systematic reviews and meta-analyses (87).

Research Question (s)

1) Does VT improve the QoL, mobility and nutrition of older adults?
2) Which type of VT is most viable for older adults contraindicated for physical activity?

3.2 Methods

3.2.1 Eligibility Criteria

As the volume of literature in this topic area was still relatively small, all clinical and comparative studies were eligible, provided they were based on original primary research and published in peer-reviewed journals. To focus on the overarching research questions, all studies included: 1) human participants aged 65 and over, 2) observation of the sole effects of VT, 3) comparison with a control/placebo group(s) and 4) at least a partial focus on either mobility, nutrition or QoL. Studies that combined VT with physical exercise were excluded to ensure the research questions were answered. Due to the novelistic nature of these interventions and devices in the field, studies from creation until 2021 were included. Finally, non-English studies were excluded to avoid any translational errors.

The following inclusion and exclusion criteria guided the inclusion/exclusion of sources to be included in the systematic review (see Table 3.1):

Table 3.1. Inclusion and exclusion criteria of chosen articles

Inclusion Criteria	Exclusion Criteria
• Primary research papers. • All clinical and comparative studies. • Participants aged 65 and over. • Studies investigating solely vibration therapy with outcome measures on mobility, nutrition or QoL. • Comparing against a control/placebo group (s). • Human studies only. • English studies included.	• Non-English studies. • Animal studies. • Secondary research papers. • Participants aged under 65 years.

3.2.2 Search Strategy

A search using the databases MEDLINE (Pubmed), EMBASE, Web of Science, Scopus, CINAHL and CENTRAL was conducted, covering articles from creation until February 2021. These databases all emphasise biomedicine, allied health, health sciences and medicine, providing a complete outreach on the topic. With the supervision and support of a Griffith University librarian, a preliminary search strategy was drafted for MEDLINE (PubMed). An initial scoping search was performed in MEDLINE, as it is arguably one of the largest health databases, indexing more than 27 million journal articles in life sciences with a concentration on biomedicine. This initial scoping search provided an outlook on both the quantity and quality of literature available on the topic, allowing for the broadening or tightening of the research question scope. Additional search terms relevant to the topic were extracted from the titles and abstracts of the initially scoped key articles to better retrieve information in later searches.

The final search strategy drafted from MEDLINE (PubMed) was adapted to the main search in the other chosen databases. The main search conducted used the following key words and terms: ‘vibration therapy’, ‘older adults’, ‘mobility’, ‘nutrition’ and ‘quality of life’. These search terms allowed for the extraction of literature on the different diverse methods of VT available and their observed effects on the mobility nutrition and QoL of older adults. Boolean operators such as ‘AND’ and ‘OR’, and quotation marks were used with these key terms to extract the most relevant articles of interest. Truncation search techniques, specifically by using asterisks, were used to broaden the search and include various word endings and spellings. The searches were run with no date limits, with the last search being conducted on 22 February, 2021. Some databases included filters based on participant age, which were also used to filter out articles that included participants younger than 65 years. Details of the search strategy used are included in Appendix A.

3.2.3 Source Selection

Articles extracted from the main search were uploaded to a reference management database (Endnote), where duplicates were removed. Duplicates were removed using the software's tools and then hand-checked for titles. The remaining duplicates were then independently checked via the abstracts.

Under the supervision of two other reviewers, one reviewer was involved in independently conducting the screening of de-duplicated articles in two stages: (1) by title and abstracts and (2) by full texts. Articles were included or excluded based on the pre-determined eligibility criteria. Articles were excluded for combining VT with another intervention, such as physical activity, as the other intervention would be a confounding factor. Studies with participants younger than 65 years of age were also excluded to focus on the older adult population. Any studies that did not have a partial focus on the outcome measures of at least mobility, nutrition or QoL were also excluded, as these were decided to be the most important factors to healthy ageing.

Another reviewer was involved in checking the excluded records to determine any records that could be key articles. Any disagreements were resolved through weekly discussions with all three reviewers. Selected articles were placed into Excel tables with key data highlighted to provide easy access to information. The data selection process is presented in a PRISMA flow diagram (see Figure 3.1) that provides the number of studies screened, assessed for eligibility and included in the review, with reasons for exclusion at each stage.

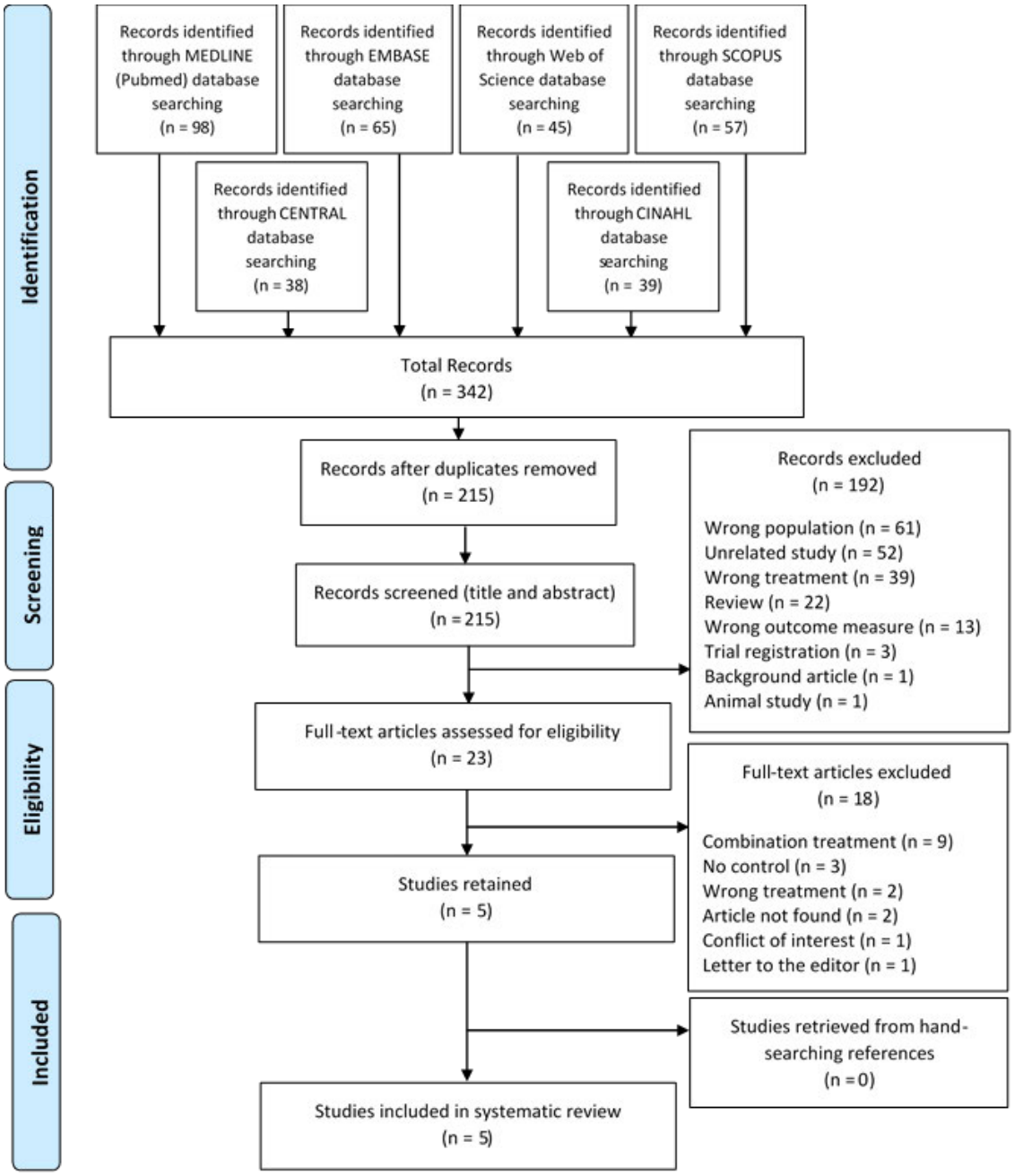

Figure 3.1. PRISMA Flow Diagram—Process of Inclusion of Key Articles.

3.2.4 Data Collection Process

Data were independently extracted using a series of tables in Excel based on the eligibility criteria and basic study characteristics. The supervisory team was involved in double-checking the types of data being extracted and provided guidance on any extra aspects that should be extracted from each article/study. Any discrepancies were again resolved through weekly discussions with the research team. Due to the time constraints of the study, authors could not be contacted for further information. Where available, data were collected on study design, sample size and characteristics, vibration type, control/placebo type, length of intervention, tests performed, results and overall outcome.

3.2.5 Critical Appraisal of Sources

Version 2 of the Cochrane risk-of-bias tool for randomised trials (RoB 2) was used to assess the risk of bias of the individual articles at the study level (88). RoB 2 focuses on the different aspects of trial design, conduct and reporting, structured into a fixed set of domains of bias. Within each domain includes a list of signalling questions aimed to elicit information about the features of each study that would relate to the risk of bias. A provided Excel algorithm generates a proposed judgement about the risk of bias of each study based on the answers to the signalling questions. These generated judgements can be ‘low risk of bias’, ‘some concerns of risk of bias’ and ‘high risk of bias’. These judgements determined the level of risk of bias for each article and were considered when discussing the findings of each study. Details of the RoB 2 tool used are presented in Appendix B.

The five domains for individually randomised trials are 1) bias arising from the randomisation process, 2) bias due to deviations from intended interventions, 3) bias due to missing outcome data, 4) bias in measurement of the outcome and 5) bias in selection of the reported result (88). The first domain assesses the randomisation process of the chosen article. The study must provide details on the allocation sequence of participants to attain randomisation to achieve clearance within this domain. Subsequently, the study should describe the concealment of the allocation sequence until after recruitment has been confirmed to prevent selective enrolment.

The second domain assesses if the individual study deviates from the intended interventions (88). Such deviations can include the administration of additional interventions that are inconsistent with the trial protocol, failure to implement the protocol interventions as intended or non-adherence by trial participants to their assigned intervention. The third domain addresses the risk of bias due to missing outcome data, including biases introduced by the procedures used to account for missing outcome data. Some participants may be excluded from an analysis for reasons other than missing outcome data.

The fourth domain relates to when the measured outcome values do not equal the true or underlying values due to measurement, misclassification or under- or over-ascertainment error (88). Consideration of the risk of bias in this domain depends on 1) whether the outcome measurement method is appropriate, 2) whether the measurement of the outcome differs between intervention groups, 3) who is the outcome assessor, 4) whether the outcome assessor is blinded to intervention assignment and 5) whether the outcome assessment is likely to be influenced by knowledge of the intervention received. The final domain addresses bias that arises because the reported result is selected from among the multiple intervention effect estimates calculated by trial investigators.

3.2.6 Synthesis of Results

The outcome and results of each article were tabulated in detail along with individual study details to enable ease of inspection and assessment of potential patterns. A meta-analysis was not conducted because of the heterogenous nature of each study's treatment type, length and outcome measures. Instead, a narrative synthesis of the data was undertaken to highlight each study's findings. The main outcomes of each study and the intervention details were grouped based on the type of outcome (i.e., mobility, QoL or nutrition) while discussing article results. The percentage change for each study's outcome measures were calculated and included in the results section as to provide an estimate of the actual effect of VT used. Recommendations on the best form of VT for older adults contraindicated for physical activity were also discussed. Based on the discussed results with critical appraisal considered, future recommendations for future research or intervention were provided.

3.3 Results

3.3.1 Study Selection

A total of 342 articles were retrieved from the literature search, with 215 articles remaining after the deletion of duplicates. After screening through titles and abstracts, 23 studies remained and were included for full-text screening. After full-text screening, five articles (15-19) remained and were back-referenced for related articles. No related articles were extracted from the key article reference lists.

3.3.2 Study Characteristics

All five chosen studies were RCTs with heterogenous blinding designs. Of these chosen studies, three observed standing WBV (15, 17, 18), one observed seated CVT (16) and one observed seated focal vibration therapy (FVT) (19). Three studies also included a control group participating in usual care/treatment to compare to the intervention (15, 16, 18). The FVT study used a Sham treatment group instead of a control group (19), whereas one of the articles observing standing WBV included an additional placebo group (17). Each study was heterogeneous in terms of intervention protocol and duration, ranging from three days to six months of VT. Each study also implemented different repetitions/sets of VT per day. Additional details of individual study characteristics, including the type of vibratory device used, is presented in Table 3.2. Participants were all aged 65 and over and resided in different settings while participating in their studies, including rest home facilities (17), nursing homes (18), hospital , social center and outpatient facilities. Inclusion criteria in each study were also heterogenous, observed by the diversity of participants between each study. Intervention studies were based in different regions of the world: China (15), New Zealand (17), Belgium (16, 18), and Italy (19) (see Table 3.3).

Table 3.2. Individual Study Characteristics.

Article	Groups (Treatment, Placebo and/or Control)	Study Design	Intervention (Duration, Training Protocol, Placebo, Control)	Vibratory Device (Name, Frequency, Amplitude)
Zhang et al.(15)	Standing WBV (TG) and CG	Pilot, randomised, assessor-blinded, controlled trial	8 weeks, 3-5 times weekly, 4-5 bouts x 60sec partial squat vibration platform. CG: usual care, physical therapy and routine exercises	Galileo platform, *F*: 6-26Hz, *A*: 1-3mm
Wadsworth et al.(17)	Standing WBV (TG), SIM (PG) and CG	Open randomised-controlled trial	16 weeks, 3 times weekly, 5 bouts x 60sec progression overloaded up to 10 bouts x 60sec partial squat vibration platform, 60 sec rest. PG: no vibration, mimicked stance, and duration. CG: standard residential care only	Galileo platform, *F*: 6 Hz, *A*: 2mm, *F* and *A* progression overload determined by participants (up to *F:* 26Hz/*A*: 4mm)
Buckinx et al.(18)	Standing WBV (TG) and CG	Randomised, single-blinded, controlled trial	6 months, 3 times weekly, 5 bouts x 15sec partial squat vibration platform, 30sec rest. CG: usual care, no new PA	Vibrosphere platform, *F*: 30Hz, *A*: 2mm
Lievens et al.(16)	Seated CVT (TG) and CG	Randomised-controlled trial, blinding method unknown	10 days, 20mins daily, CVT under thigh and on knee. CG: Not treated with CVT	Vibration cushion and hand unit (unnamed), unknown *F* and *A*
Celletti et al.(19)	Seated focal vibration (TG) and Sham (CG) Each group consisted of three sub-classifications of fall risks: high, moderate and low risk	Pragmatic, randomised, triple-blinded, controlled trial	3 days, 3 bouts x 10mins seated focal vibration on quadriceps, soft tissues compressed 60sec rest. CG: vibrator positioned close to quadriceps, not touching, same duration	Device consisting of an electromechanical transducer, mechanical support fixed to floor, and electric control device. *F:* 100Hz, *A:* 0.2-0.5mm

Notes. WBV: whole-body vibration, TG: treatment group, CG: control group, F: frequency, A: amplitude, SIM: simulated whole-body vibration, PG: placebo group, PA: physical activity, CVT: cycloid vibration therapy.

Table 3.3. Participant Demographics in Each Individual Study.

Article	Participants (n), Mean/Range Age	Baseline gender Characteristics	Country	Setting	Eligibility Criteria (Characteristics)
Zhang et al.(15)	(36), 85.27 ± 3.63 years	*Intervention:* (17 male/2 female) *Control:* (15 male/ 3 female) *(p > 0.05)*	China	Chinese PLA General Hospital, Department of Rehabilitation Medicine.	Clinician-identified elderly outpatients, meeting three or more of the Fried Frailty criteria, without severe cognitive impairment, and without illness likely associated with life expectancy of <12 months.
Wadsworth et al.(17)	(117), 82.45 ± 7.9 years	*Intervention:* (15 male/ 21 female) *Placebo:* (8 male/ 27 female) *Control:* (18 male/ 28 female)	New Zealand	Rest home facilities, Greater Wellington area.	Rest home residents, displaying a moderate degree of frailty suggested by a functional ambulation scale.
Buckinx et al.(18)	(62), 83.2 ± 7.9 years	*Intervention:* (64.5% female) *Control:* (87.1% female) *(p < 0.05)*	Belgium	Two nursing homes located in Liege, Belgium.	Nursing home residents able to remain standing and to move with or without technical assistance.
Lievens et al.(16)	(16), 70-90 years	All female	Belgium	Not listed.	Older women with clinically and radiologically confirmed bi-lateral osteoarthritis of the knee.
Celletti et al.(19)	(350), 73.4 ± 3.11 years	All female	Italy	Recruited from social centres, Roman municipalities, living at home at the time, testing facility unknown.	Autonomous, living-at-home older volunteers, no presence of dementia, vestibular diseases, acute orthopaedic injuries, or drug therapies altering movement or spatial perception.

3.3.3 Risk of Bias Within Studies

Of the five critically appraised articles overall, two of the studies were observed to be of low risk of bias (40%) (17, 19), two had some concerns of bias (40%) (15, 18), and one had a high risk of bias (20%) (16) (see Table 3.4). The two low-risk articles by Wadsworth et al. (17) and Celletti et al. (19) achieved clearance in all domains of the RoB 2 tool by Cochrane. The studies by Zhang et al. (15) and Buckinx et al. (18) both had some bias concerns due to only partly achieving clearance in one domain of bias. Zhang et al.'s (15) was observed to have some bias concerns in the fifth domain of Cochrane's RoB 2 tool due to not including a protocol plan detailing a pre-specified analysis plan to analyse their outcome measures. Moreover, this study did not present certain findings based on the numerical results. Buckinx et al.'s (18) had some concerns of bias within the first domain due to detailing a significantly larger baseline scale of women in the control group ($p < 0.05$), which could represent problems within the randomisation process.

Table 3.4. Overall Risk of Bias Within Studies—RoB 2.

Article	Domains of Bias					Overall risk
	D1	D2	D3	D4	D5	
Zhang et al.(1)	+	+	+	+	!	!
Wadsworth et al.(2)	+	+	+	+	+	+
Buckinx et al.(3)	!	+	+	+	+	!
Lievens et al.(4)	!	-	+	+	!	-
Celletti et al.(5)	+	+	+	+	+	+

+ Low risk of bias
! Some concerns of bias
- High risk of bias

Lievens et al.'s (16) study had a high risk of bias with their intervention within the second domain, which addresses the study's deviations from the intended interventions. The study only briefly described the method of analysis and did not provide details on the blinding design of the trial. Some concerns of bias were also observed within the first and fifth domain using the RoB 2 tool. The allocation sequence method of the study was not detailed, nor were participant baseline differences between intervention and control groups included. However, baseline differences in terms of outcome measures between the two groups were provided. The protocol plan was also not included. The overall risk of bias within each study based on the RoB 2 tool is detailed in Table 3.4.

3.3.4 Key Measurements and Effects

As outlined by the eligibility criteria, the five chosen articles reported the effects of VT on either mobility, QoL or nutrition in older adults. All five articles assessed mobility, whereas only two studies (15, 17) assessed QoL. No articles assessed nutrition. The tests performed for each outcome measure were heterogenous for each study. Multiple outcomes were observed, as detailed in Table 3.5.

Table 3.5. Main Outcome Observed by Individual Studies.

Article	Groups (Treatment, Placebo and/or Control)	Tests Performed (Measures, Data Points, Follow-Up)	Outcome Measures	Main Outcomes
Zhang et al. (15)	Standing WBV (TG) and CG	TUG, 30s-CST, maximal isometric knee extensor test, PBT, ABC, Short-Form Health Survey questionnaire Measures @ baseline, 4 and 8 wks during intervention. No follow-up	TUG (secs), 30s-CST (n), peak force (left/right knee), surface area ellipse, confidence score, PCS, MCS	TG @ 4/8wks post compared to baseline (statistically significant): ↓TUG (secs), ↑peak force, ↑postural balance, ↑confidence score, ↑PCS, ↑MCS TG compared to control in relation to time (statistically significant): ↑peak force, ↑confidence score, ↑PCS
Wadsworth et al. (17)	Standing WBV (TG), SIM (PG) and CG	TUG, PWT, 10mTW, Barthel Index Measures @ baseline, 8 and 16 wks during intervention. Follow-up @ 3, 6 and 12months post-exercise	TUG (secs), PWT (secs), 10mTW (secs), Barthel Index scores	TG @ 8/16wks post compared to baseline/control (statistically significant): ↓TUG (secs), ↓10mTW (secs), ↓PWT (secs), ↑ Barthel Index score TG @ 3/6-months follow-up compared to baseline (statistically significant): ↓10mTW (secs), ↓PWT (secs), ↑Barthel Index score
Buckinx et al. (18)	Standing WBV (TG) and CG	POMA, TUG, Locometrix test, falls Measured @ 6 months during intervention	POMA (score), TUG (s), step distance, falls (amount)	TG @ 6 months compared to control (no difference): TUG (secs), POMA score, TUG (secs), step distance.

Article	Groups (Treatment, Placebo and/or Control)	Tests Performed (Measures, Data Points, Follow-Up)	Outcome Measures	Main Outcomes
		Follow-up @ 12-month period		TG @ 12-month follow-up compared to control (no difference): TUG (secs), POMA score No difference in falls
Lievens et al. (16)	Seated CVT (TG) and CG	Active and passive extension of knee, active and passive flexion of knee Measured @ baseline and 10th day No follow-up	Knee mobility of left and right leg (angle)	TG @ 10 days compared to control (no difference): knee mobility No difference between TG and CG at 10 days
Celletti et al. (19)	Seated focal vibration (TG) and Sham (CG)	POMA Measured @ baseline Follow-up @ 3- and 18- days	POMA-T, POMA-B, POMA-G	TG @ 30- and 180-day follow-up compared to baseline/control (statistically significant): ↑POMA-T in all groups of risk More effective ↑POMA-T rise in high falls risk groups compared to low falls risk groups

Notes. WBV: whole-body vibration, TG: treatment group, CG: control group, TUG: Timed Up and Go Test, 30s-CST: 30-Sec Chair Stand Test, PBT: Postural Balance Test, ABC: Activities-Specific Balance Confidence Scale, PCS: physical health component score, MCS: mental health component score, SIM: simulated whole-body vibration, PG: placebo group, 10mTW: 10 Metre Timed Walk, PWT: Parallel Walk Test, POMA: Performance-Oriented Mobility Assessment, CVT: cycloid vibration therapy, POMA-T: total POMA scale, POMA-B: POMA balance scale, POMA-G: POMA gait scale.

3.3.4.1 Mobility

Knee Mobility and Strength

Two of the RCTs evaluated the effects of VT on knee mobility and strength in older adults, specifically knee joint extension/flexion (16) and knee extensor strength (15). In Lievens et al.'s (16) CVT study, participants were instructed to lay on a massage table in a half-lying position to measure four parameters: active and passive flexion/extension of the knee. This involved measuring the flexion or extension angle of the knee at baseline and after 10 days of CVT underneath the thigh and on the knee. There was no significant statistical difference in knee mobility after 10 days of treatment (4.14% increased active extension mobility, 11.3% increased active flexion mobility).

In Zhang et al.'s (15) study evaluating the effects of eight weeks of WBV on general mobility, maximal isometric knee extensor (quadriceps) strength in both knees was measured using a handheld dynamometer (MicroFet 2 dynamometer). This tool allows for the measurement of knee extensor peak force while ensuring the objectivity of the force measures. Measurements were taken at pre-training, four weeks and then eight weeks. A statistically significant increase ($\alpha < 0.018$) in knee extensor peak force was observed for both knees at four (27.3% increased left foot peak force; 29.0% increased right foot peak force) and eight (62.8% increased left foot peak force; 52.3% increased right foot peak force) weeks compared to pre-training. This statistically significant increase in peak force was also observed in the treatment group in relation to time when compared against the control group (left foot: $p = 0.001$; right foot: $p = 0.012$).

Seated-to-Standing Function

Three studies (15, 17, 18) assessed the effects of standing WBV on functional mobility in older adults through seated-to-standing outcome measurements. All three RCTs used the Timed Up and Go (TUG) Test to measure participant functional mobility. The TUG Test was developed for a frail community-dwelling population in which the subject is asked to rise from a standard chair with arm rests, with their walking aid if need be, and walk at a comfortable speed for three metres and back, to sit down again (89). This activity is timed and scored in seconds to complete the test—the lower the score, the better. In addition to using the TUG Test, one of these studies also used a 30-Second

Chair Stand Test (15), a single-item physical performance tool to assess lower extremity strength. It is performed by counting the number of stands from a seated position completed in 30 seconds with hands crossed against the chest (90). The higher number of stands, the better.

After four (12.54 second decrease) and eight (19.13 second decrease) weeks of WBV therapy, one study observed participants taking significantly less time to complete the TUG Test than at baseline ($\alpha < 0.018$) (15). Relative to time, the treatment group's decrease in TUG score was more significant compared to the control group's TUG score ($p = 0.005$) (15). This significant decrease in TUG score was also observed in another study evaluating 16 weeks of WBV on participants (17). In this study, the WBV treatment group presented a significant decrease in TUG scores compared to the simulated vibration (placebo) group and control groups at eight and 16 weeks ($p < 0.01$) (17). In contrast to these two studies, Buckinx et al.'s study did not find a significant difference in TUG between their WBV group and control groups after six months of treatment (18). Short-term effects were not retained three months post-WBV treatment in Wadsworth et al.'s study (17). No significant difference was observed in the 30-Second Chair Stand Test score between the treatment and control group over time in Zhang et al.'s study (15).

Gait and Walking Function

To further assess the effects of WBV therapy on functional mobility in older adults, two studies evaluated the gait and physical function of their participants using the Parallel Walk Test (PWT), 10 Metre Timed Walk (10mTW) test (17) and a Locometrix 10-s walk test (18). The PWT is a validated, quick and simple quantitative measure of dynamic balance during gait (91). The subject is instructed to walk between two parallel lines of a designated width (30 cm) and is scored if they step on or outside the lines (91). A higher PWT score indicates a lack of stability (91). In the 10mTW, the participant is simply timed as they are instructed to walk 10 metres. This provides a simple assessment of function and inference of lower limb strength. Wadsworth et al. observed significantly lower PWT scores in the treatment (0.8-1 PWT score) group when compared to the placebo (3.5 PWT score) group at eight and 16 weeks of the intervention ($p < 0.01$), suggesting stability improvement with WBV therapy (17). This increase in stability observed in the treatment group was retained at least three months post-treatment (17). There was no significant difference observed between the treatment and control groups

(17). Wadsworth et al. also observed that the treatment (< 5% increased time (s)) group took significantly less time on the 10mTW test three months post-treatment than the placebo (approx. 25% increased time (s)) group ($p < 0.01$) (17).

In Buckinx et al.'s study, the Locometrix 10-s walk test was used to provide a quantitative walking analysis (18). The subject is asked to walk 20 metres, three times. The first run is a preliminary test, the second is a simple task analysis and the third task is a dual analysis. In the dual analysis, the subject is instructed to count down out loud from 70 while walking. The number of digits said out loud and the number of errors made in the countdown are recorded. By attaching a sensor composed of three accelerometers near the subject's centre of gravity, dynamic gait parameters can also be tracked to detect any gait deterioration in the older adult. No significant inter-group difference was detected between the treatment and control group (18).

Balance

Three studies (15, 18, 19) evaluated the effects of VT on balance function using several outcome measures. Two of these RCTs (18, 19) used a Performance-Oriented Mobility Assessment (POMA) to measure an older adult's gait and balance. The POMA (POMA-T), also recognised as the Tinetti test, is a widely used 28-point instrument consisting of both a balance (POMA-B) and a gait (POMA-G) scale (92). The POMA-B assesses the subject's ability at changing positions, reflecting stability tasks related to daily activities (92). In the POMA-G, several qualitative aspects of the locomotive pattern are examined (92). Each item is scored on a two- or three-point scale, resulting in a maximum score of 28 on the POMA-T (92). In Celletti et al.'s study (19), participants' POMAs were measured at 30 and 180 days after being administered FVT for three days. This treatment group was observed to have a significantly higher POMA-T score at 30 and 180 days post-treatment compared to baseline ($p < 0.001$), with 49.19% of high fall risk participants obtaining the full POMA-T score at T2 (19). In contrast, Buckinx et al.'s findings observing WBV on POMA-T scores showed no significant changes between treatment and control at six and 12 months (18). Buckinx et al.'s (18) study also found no significant difference between treatment and control groups when observing participants' history of falls during the 12-month study.

One other study (15) evaluated the effects of WBV therapy on balance in older adults using the Postural Balance Test and Activities-Specific Balance Confidence (ABC) Scale. The Postural Balance Test requires participants to stand on a baropodometric platform (BIORescue system) for 30 seconds with their eyes closed or open. The platform is used to assess participants' balance control function by measuring the centre of pressure under each foot. A posturographic profile is produced for the standing participant—the wider the surface area ellipse, the worse the balance ability. At four and eight weeks of WBV, the surface area ellipse of the treatment group was significantly narrower compared to baseline. However, there was no significant inter-group difference at any of the time points. The ABC Scale is a self-reported 16-item questionnaire used to measure participants' balance confidence while performing 16 different activities (93). The score is rated from 0 per cent (no confidence) to 100 per cent (complete confidence). An overall mean ABC score was calculated for every participant. By week eight of WBV, the treatment group showed a significantly higher confidence score than at baseline (20.65% balance confidence increase; $\alpha < 0.018$). In relation to time, the treatment group was observed to increase their confidence score at a significantly faster rate compared to the control group ($p = <0.001$).

3.3.4.2 Quality of Life

Out of the chosen articles, only two studies (15, 17) evaluated the effect of VT on the QoL of older adults. In Zhang et al.'s study (15), QoL was assessed using the Short-Form Health Survey. The Short-Form Health Survey is a self-administered 12-item questionnaire comprising two summary measures: the physical health component and the mental health component score (94). Scores range from 0 to 100, with 100 being a complete absence of impairment (94). At four (52.7% score increase) and eight weeks (83.7% score increase), physical health scores significantly improved in the treatment group compared to baseline ($\alpha < 0.018$). This significant improvement was also observed in mental health scores at week eight (31.4% score increase) for the treatment group compared to baseline ($\alpha < 0.018$). Significant inter-group differences in physical health scores were also observed between the treatment and control groups at all time points, with the treatment group recording the higher scores. At week eight, the treatment group also had significantly higher mental health scores than the control group. This significant

increase in both physical ($p = <0.001$) and mental ($p = 0.001$) health scores in the treatment group was stronger in relation to time when compared to the control group .

In Wadsworth et al.'s study (17), participants were instructed to complete the Barthel Index (BI) via interview to measure their daily activities and functional independence. The BI questionnaire is a 10-item instrument comprising 10 activities of daily living that are graded a score of 0, 5 or 10, with an overall maximum score of 100 (95, 96). During the 16-week intervention, the WBV treatment group presented significantly higher scores than the control group at week 8 (Effect size: 0.53; $p = 0.026$) and at week 16 (Effect size: 0.94; $p = <0.001$). Increased BI scores in the WBV treatment group were retained up to six months post-treatment when followed up. The control group presented a consistent drop in BI scores throughout the study in comparison to their baseline (12% decreased BI score at 12 months compared to baseline).

3.4 Discussion

3.4.1 Summary of Evidence

The goal of this evidence-based data search was to evaluate the effectiveness of VT on mobility, QoL and nutrition in older adults. The most viable version of VT for older adults contraindicated for physical activity was also considered. Despite some of the moderate and high levels of bias for some studies, several acute and long-term desirable effects were reported from the use of VT. The five RCTs revealed that VT might improve several aspects of mobility in an older adult, including knee joint mobility (15, 16), general functional mobility (15, 17, 18), gait and walking ability (17, 18), and balance ability (15, 18, 19). Some of these studies also reported significant improvement in certain aspects of QoL (15, 17). Although nutrition was not a key outcome measure in either study, VT's significant improvements in mobility or QoL may also influence nutritional status (70). Improved mobility with VT may indicate muscle maintenance, supporting the basal metabolic rate and nutrition of older adults (70).

Concerning knee-joint mobility, Lievens et al.'s study (16) observed that by applying CVT for 20 minutes per day underneath the thigh and on the knee, did not find a significant improvement in knee range of motion was achieved after 10 days. A high risk of bias was also evaluated for this study, making these results highly unreliable. However, Lieven's findings are contradicted by observations made by Zhang et al.'s (15) intervention study, which is of better quality. This study observed that after applying standing WBV for 4–5 minutes per day, 3–5 times per week, participants experienced a significant increase in knee extensor strength at week four and eight of the intervention compared to baseline. However, as both studies examined different aspects of knee mobility (i.e. range of motion vs. knee strength), this may explain the inconsistency in knee mobility improvements with VT. Also, in Lieven et al.'s (16) CVT protocol compared to Zhang et al.'s (15) WBV protocol, Lieven et al. provided only 10 days of CVT treatment compared to eight weeks of WBV treatment. Zhang et al.'s (15) participants had a longer treatment time overall, which may explain the significant increases in knee mobility, not seen in Lieven et al.'s (16) participants. By allowing for longer treatment times, CVT may be a potentially viable therapy for improvement in knee mobility without needing to stand on a dynamic platform.

There were large differences in vibration treatment effects on general functional mobility. In both Zhang et al. (15) and Wadsworth et al.'s (17) study, the ability for participants to stand from a seated position was significantly improved with the application of standing WBV. However, this short-term improvement in functional mobility using WBV treatment was not observed in Buckinx et al.'s (18) study. These discrepancies may reflect differences in WBV protocols and devices used. The two studies reporting significant short-term improvements in functional mobility used the Galileo platform (15, 17), whereas the single study presenting contrasting results used the Vibrosphere platform (18). This indicates that the use of the Galileo platform may be a better WBV platform for improving general functional mobility. Regarding protocol differences, the two studies (15, 17) reporting mobility improvements applied WBV at an increased amplitude and frequency each week for every participant compared to Buckinx et al.'s (18) study. By implementing an overload principal protocol, this may have allowed for participants to rapidly improve their general functional mobility with WBV compared to only implementing a constant workload.

Regarding walking and gait function, Wadsworth et al. (17) evaluated that standing WBV significantly improved participants' manner of walking. They also observed treatment participants completing a 10-metre walk faster than at baseline, with treatment effects lasting up to three months post-treatment. However, when gait function was evaluated after WBV in Buckinx et al.'s (18) study, no significant inter-group differences were reported at any time point. Although both studies have implemented long treatment durations (i.e. 3 and 6 months treatment), the studies measure walking and gait function differently. When measuring walking ability, Wadsworth et al.'s (17) participants are scored when stepping out of their designated path, indicating lower gait function. In Buckinx et al.'s study (18), participants are asked to also count down from 70 backwards while doing a similar path, with any mistakes being recorded as gait deterioration. This higher difficulty level of measurement may introduce potential floor effects, preventing observation of potential participant improvement, and resulting in insignificant findings.

Mixed results were also presented when assessing the effects of VT on the balance function of older adults (15, 18, 19). When assessing balance function using the POMA tool, standing WBV did not increase participants' ability to balance (15, 18). However, participants presented with a significantly improved ability to balance after 30 days and 180 days of treatment when using seated FVT instead (19). In regard to the POMA test

used in Buckinx et al.'s study (18), potential ceiling effects may explain the non-significant balance results with WBV. A majority of Buckinx et al.'s participants had already scored very high on the POMA test at baseline (18). This would prevent observation of any significant improvement with the small variance that could be achieved. In contrast, Celletti et al.'s study had mixed participants with different fall risks, and varied baseline POMA-T scores. Most of the significant improvements to balance were observed in the high risk fall group in Celletti et al.'s study with initially lower POMA scores, indicating potential for balance improvement with VT (19). The differing vibration protocol used in each study may also explain the inconsistency of results. The two studies with insignificant results (15, 18) had participants stand on a vibrating platform, providing generalised vibration to the body. Celletti et al. (19) instead, provided focused vibration to participant quadriceps. By focusing VT on a specific leg muscle, this may have led to a more effective strengthening of balance ability.

QoL was also evaluated to have significant improvements after the use of WBV. Zhang et al. (15) observed significant short-term improvements in physical and mental health scores for participants treated with WBV therapy. BI scores from the WBV treatment group in Wadsworth et al.'s (17) study presented significant short-term improvements in functional independence that were retained for at least six months post-treatment.

3.4.2 Feasibility of Vibration Therapy in Older Adults Contraindicated for Physical Activity

For older adults or even older adults contraindicated for physical activity, a safety or feasibility study on the provision of VT has yet to be conducted. Despite this, several important characteristics regarding the vibratory devices, protocols, duration and compliancy recorded in each study should be considered. Overall, this review has found that, whether standing or seated, VT requires less physical effort when compared to physical activity. With similar mobility and QoL benefits to physical activity, VT could present as a safer alternative therapy for older adults, especially for those contraindicated for physical activity. Moreover, no side effects were reported after providing short- or long-term doses of VT for the older adults. In addition, participants provided positive anecdotal feedback about the VT with which they would be treated. Participants perceived VT to be easy to master, reported low levels of exertion and that it required less time compared to physical activity.

As observed from the chosen studies, several forms of VT available could support healthy ageing in an older adult. Currently, more evidence is available supporting WBV therapy's ability to improve mobility and QoL in older adults compared to the other VTs presented (i.e. CVT and FVT). Although more evidence for WBV therapy exists, there remain concerns about the protocol required to improve mobility and QoL. WBV therapy, as presented in these studies, requires the user to stand on a dynamic platform while in a partial squat form. Although this may be fine for older adults with minimal degrees of frailty, older adults with contraindications for physical activity may find the protocol quite difficult. Supervision would be mandatory for this population for set-up of the machine and guidance, possibly introducing higher costs. The vibratory platforms mentioned in these studies also have a large mass and are not as portable as other VTs.

Although scarcer in evidence, CVT and FVT presented similar desirable effects to WBV therapy without requiring the participant to stand during the protocol. Instead, subjects are instructed to remain seated for the duration of the intervention. These protocols show ease of use and safer practice for older adults contraindicated for physical activity. Without the need for older adults to stand on a moving platform, supervision can be reduced and, in turn, improve cost-effectiveness. The devices used for CVT and FVT are of lighter mass and introduce increased portability. However, with FVT, the subject must clamp the spherical-shaped device tightly onto the muscle to achieve proper transfer of vibrations. This could prove to be painful for some participants and reduce compliance. However, with CVT, the handheld device or massage pad relies purely on low-frequency vibrations without clamping onto the subject's muscle. Thus, CVT could provide the safest version of VT to improve an older adult's healthy ageing factors.

3.4.3 Limitations

Several limitations should be considered. Due to the heterogeneous methodological approaches and multiple outcome measures, the research available on VT in older adults remains difficult to compare (see Tables 3.2 and 3.5). Although reliant on general vibration, each vibratory device is different in type and the underlying mechanism. With differing vibratory devices, the assigned protocol for improving mobility or QoL is heterogeneous in nature. This was highlighted by the fact that some participants were required to be seated or partially squatting across the individual studies.

A partial squatting position can be regarded as physical activity and would place a large bias on whether VT has a causative effect on mobility or QoL in older adults. The duration of VT and the provided vibration settings (i.e., amplitude/frequency) were also vastly different between studies, ranging from three days to six months of consecutive VT. Other than the multiple outcome measures on mobility or QoL, these measures were also taken at very different time points during each intervention. This may record very different acute and long-term effects due to the range of time points chosen. Regarding study quality, only two of the five extracted studies had a low risk of bias (see Table 3.4), while the other studies had a high or moderate risk of bias.

When evaluating the most viable option of VT for older adults contraindicated for physical activity, differences in participant demographics may influence the generalisability of this population (see Table 3.3). Participants in each study were sampled from unique settings ranging from nursing homes to older adults living in social centres independently. Further, the sample size dramatically differed between each study, with some including only females in their studies. Apart from limitations introduced from the different study designs, the actual search strategy itself may have affected the number of key articles that could have been reached. Due to strict time-constraints, further keywords relevant to mobility, quality of life, or nutrition could have been used to have a wider outreach on related articles. Given that VT is currently a novel treatment, several important studies could have been extracted from the grey literature. However, only peer-reviewed articles were included to ensure the quality of studies. This could result in several articles being selected with mainly significant results, possibly biasing the review. However, any significant results from these studies should not be ignored. While the success of VT in older adults has been outlined clearly in the studies, further investigation is required to comprehensively evaluate the effects of VT on the mobility, QoL and nutrition of older adults.

3.5 Conclusions and Future Directions

From this systematic review, VT presents as a promising method of supporting the healthy ageing of older adults. Although the findings from these studies were a mixture of significant and non-significant results, VT provided improvements in knee mobility, functional mobility, walking and gait function and balance function. These desirable effects were also presented in significant improvements to participant QoL after receiving VT. Even though further high-quality research is needed to evaluate the results

of VT properly, the acute and long-term effects presented by these studies should not be ignored. There are those in the older adult population who are contraindicated to physical activity. Due to postulated costs, safety, portability and ease of use, CVT could be the most feasible vibratory device for supporting healthy ageing in older adults contraindicated for physical activity. However, the article presenting improvements in knee mobility after CVT use was of very low quality; thus, further research is needed to evaluate the effectiveness of CVT on healthy ageing factors.

Aside from the desirable effects that VT can achieve for older adults, this overview of the evidence on VT emphasises the need for additional high-quality research into VT in older adults and healthy ageing. Nutrition is a critical factor for healthy ageing, and it is unfortunate that no articles covered this aspect. With clear improvements in mobility and QoL with VT, this could, in turn, improve the nutritional status of older adults as well. A study evaluating the effectiveness of CVT on the mobility, QoL and nutrition of aged care residents was conducted to cover these gaps in research into VT in older adults. Details of this study are covered in Chapter 4 of this thesis.

Chapter 4: Intervention Study

4.1 Introduction

To promote healthy ageing, a well-established method that maintains an individual's QoL, mobility and nutrition is essential (21). For most populations, physical activity is an effective method to counteract the generalised impairments that come with age (6). However, for most elderly individuals, a range of barriers to participation exist (e.g., low compliance, comorbidities and risk of falls) (9-12). CVT is an emerging method proposed to have similar benefits to physical activities without the need for wide-ranging movement (16, 76, 77).

As concluded in Chapter 3, CVT showed promising increases in knee mobility in older adults. Although CVT has not been studied in the context of other mobility and QoL measures in older adults, previous studies have observed VT to significantly improve older adult functional mobility, walking and balance function (15, 17-19). Further, due to the perceived associated lower costs, increased safety and easier portability than other forms of VT, CVT may be better suited to supporting healthy ageing in older adults, especially those contraindicated to physical activity. Due to the scarcity and lack of quality research into CVT, further investigation into CVT's effectiveness on the QoL, mobility and nutrition of older adults was conducted. This chapter details the pilot non-RCT within a Gold Coast Bupa Aged Care facility, including methods, results, analysis and discussion.

Due to the introduction of the COVID-19 aged-care restrictions during this intervention, important effects on the methodology and overall study design occurred and are detailed within this chapter. This protocol was approved by the Griffith University Ethics Committee (GU Ref No: 2020/038) (see Appendix C).

Research Questions

To test the aims and objectives, three research questions were assessed in this study:

1. Does CVT affect the QoL of aged care residents?
2. Does CVT affect the physical mobility of aged care residents?
3. Does CVT affect nutrition in aged care residents?
4. Is CVT a feasible intervention for aged care residents?

4.2 Methods

4.2.1 Study Design

Before the introduction of the COVID-19 aged-care restrictions, the human non-randomised controlled pilot trial was initially planned to run over 12 weeks, with outcome measures being measured every four weeks. CVT was to be provided to each participant three days per week for the duration of the trial. Given that the pandemic occurred at the end of the fourth week, only the baseline outcome measures were collected. After an approximately six-month visitor access restriction to aged cares within the Queensland region, the second and final data points were collected after six months. This allowed for any long-term effects after four weeks of CVT to be evaluated, if any. A final one-on-one interview for interested participants was conducted to obtain feedback on the intervention study.

Participants were recruited based on strict inclusion and exclusion criteria and allocated into their respective treatment (CVT) and control groups for comparison. Treatment groups were provided CVT treatment for three days per week, with both groups participating in surveys at baseline and six months post-treatment. Baseline data were provided by Bupa from the participants' lifestyle records. Before the start of the study, an induction was held to inform residents and their respective families of the details of the intervention and to introduce the CVT massage pad. Residents and their families were provided with the opportunity to enquire about the intervention and how the CVT device functions. Residents and families had the opportunity to provide expressions of interest and be screened for eligibility based on the inclusion and exclusion criteria.

Before the start of the intervention, an acclimatisation phase was conducted for four weeks. During this acclimatisation phase, eligible residents had the opportunity to try out the CVT devices before participating in the project. Staff and eligible residents were invited to provide suggestions on adjusting components (i.e., surveys) of the study to better benefit and improve the services delivered to the residents. After providing full details of the study to eligible residents, screening and informed consent forms and participation information sheets in the plain language statement were provided to participants to complete (see Appendices E, F and G). Ethics clearance was obtained before the start of data collection (GU Ref No: 2020/038) (see Appendix C).

4.2.2 Study Population

Aged care residents living at the facility were recruited into the study. Eligible participants were required to be aged over 65 years and have the capacity to provide written or verbal consent or both. Due to the small number of available VT intervention studies in older adults that specifically observed CVT, several exclusion criteria were applied to the treatment group to ensure the safety of the residents. The following inclusion and exclusion criteria guided the recruitment of participants in this study (see Table 4.1).

Table 4.1. Eligibility Criteria for Participants of CVT Intervention Study.

Eligibility Criteria	Treatment Group	Control Group
Inclusion criteria	Individuals aged 65 and over Individuals residing within an aged care centre Able to have capacity to provide written consent, verbal consent or both	Individuals aged 65 and over Individuals residing within an aged care centre Able to have capacity to provide written consent, verbal consent or both
Exclusion criteria	Individuals with a pacemaker/implantable cardioverter defibrillator (ICD) Individuals who have had a previous stroke Individuals who have suffered from vertigo Individuals with fibromyalgia/polymyalgia rheumatica Individuals in palliative care Individuals with severe cognitive, hearing or visual impairments (difficulty comprehending information and verbalising responses)	Individuals in palliative care Individuals with severe cognitive, hearing or visual impairments (difficulty comprehending information and verbalising responses)

4.2.3 Sampling Strategy

After providing residents and family members with an induction on the details of the study and intervention available, individuals had the opportunity to express interest in participating. After this induction session, flyers detailing the requirements for the study were passed out to all residents and placed onto community boards (see Appendix D). Residents expressing interest to participate in the study were provided participant information forms, participant screening forms and participant informed consent forms (see Appendices E, F and G). Interested residents were invited to discuss their involvement in the study with their family members and friends before completing any of the provided documents. A member of the research team answered any questions regarding the study details. Before eligible participants completed the provided documents, they were once again informed that anyone could leave the study without reason or consequence.

The allocation sequence of each participant into either the treatment or control group was non-randomised due to the extensive exclusion criteria listed by the research team. Only a small number of residents could participate in the study due to the exclusion criteria. Consequently, residents still interested in partaking in the study as a control participant could do so with a more relaxed exclusion criterion. Additionally, those allocated to the control group would be offered use of the CVT pad after the trial completion and under consideration of their doctor. Researchers responsible for analysing data were blinded from participant IDs associated with either the treatment or control group.

4.2.4 Setting

This study was conducted in a Bupa Aged Care facility located on the Gold Coast, Australia. The Bupa Aged Care facility featured many residential suites split into two sectors where able residents could freely walk in-between. Surrounding these suites were several living areas, dining rooms, activity rooms and two large outdoor gardens spanning the length of the facility. A number of nurses, physiotherapists and general residential staff patrol the hallways at all times. Every entry gate has a front desk reception where individuals are monitored entering or exiting the premises. Due to the COVID-19 aged-care restrictions, all individuals were required to wear facial masks at all times and have

their temperature checked before entering the facility. All research staff complied with these requirements and conducted appropriate contact tracing as required by government restrictions.

For both the treatment and control groups, interventions and data collection took place wherever the participant desired. All study participants preferred to undertake the intervention and data collection in the comfort and privacy of their rooms. Every residential suite contained an emergency call button next to the resident's bedside table for medical emergencies. The door to each participant's room was left open during the intervention and data collection to allow easy access for the nurses if an emergency were to occur.

4.2.5 Intervention Protocol

As mentioned previously, after screening for eligible participants, an acclimatisation phase was conducted before the start of the study for four weeks. With resident and staff recommendations on how often CVT would be administered each week, the intervention protocol was decided on and immediately conducted after the acclimatisation phase. Participants provided written informed consent before the start of the intervention period. Each participant provided informed verbal consent before every intervention session. The device that produced cycloidal vibration was a non-invasive massage pad (CVT Pad, GH Healthcare). Two researchers were involved in conducting the intervention protocol and data collection.

The intervention took place in each participants' residential suite, where individuals remained seated for the duration. In the treatment group, vibratory stimulation was applied to participants' backs, quadriceps and soles of the feet. With the support of a research team member, the massage pad was moved between these different sites. Participants received CVT three times per week for 15 minutes per day. Vibration was applied to each site of interest for five minutes each. Due to the busy schedules of each participant, these individuals would let the research team know which days during the week would be most appropriate for the intervention to be conducted. Before the COVID-19 restrictions, CVT was to be applied for a total of 12 weeks. However, due to the COVID-19 restrictions at the aged care facility, the vibratory intervention could only be conducted for four weeks. The vibratory frequency and amplitude used was the lowest

setting as already preset by the device. This was achieved by simply pressing the power switch once at the start of the 15-minute intervention. The exact frequency and amplitude of the CVT pad could not be measured, as the vibratory device did not have this built-in functionality. No progression was implented into the protocol in terms of the intensity or duration.

The study's control group did not participate in the CVT intervention; instead, they received their usual care and treatment. All participants were de-identified and provided a participant ID. Researchers involved in the intervention and data collection were non-blinded due to time-constraints.

4.2.6 Measures

Several surveys evaluating QoL, mobility and nutrition were used to assess the different factors that influence healthy ageing in older adults. QoL was assessed using the 6-Dimensional Quality of Life assessment tool (AQoL-6D), resident mobility status was assessed using the Physiotherapy Mobility Assessment (PMA) and nutritional status was evaluated using the Mini Nutritional Assessment (MNA). In addition to these outcome measures, brief one-on-one interviews were conducted to obtain resident feedback on the intervention study. Demographic data were also obtained from participant health and lifestyle forms provided by Bupa Aged Care. Further details on these outcome measures are provided in the following sections.

4.2.6.1 6-Dimensional Quality of Life (AQoL-6D)

To evaluate the QoL of participants at each time point, the AQoL-6D was used. The AQoL-6D is a 20-item assessment of six domains of QoL, developed in part to increase the sensitivity to a range of factors influencing life quality (94). These six domains are characterised as 'independent living', 'relationships', 'mental health', 'coping', 'pain' and 'senses', which assess both the physical and psychosocial areas of QoL. This tool shows promise in assessing QoL impairment or improvement both cross-sectionally and over time (59).

Each item or question on the assessment tool consists of four to five responses that are allocated a score of between 1 and 4–5. A higher score represents a more impaired QoL and vice versa. To score each participant's overall QoL, an unweighted SPSS

algorithm developed by the AQoL developer website was used to derive a simple psychometric score for health-related QoL and provide profile scores on the different dimensions (94). The algorithm combines and reverses the scoring so that high scores indicate better mobility and standardises the scores on a 0–100 scale. The AQoL-6D tool used is presented in Appendix H.

4.2.6.2 Physiotherapy Mobility Assessment (PMA)

The PMA is a tool for assessing the functional mobility of aged adults and is currently used across all Bupa Aged Care facilities. This assessment tool uses the well-known physical mobility scale to evaluate functional mobility (97). The PMA consists of eight items observing 'supine to side lying', 'supine to sitting', 'sitting balance', 'sitting to standing', 'standing balance', 'transfer', 'locomotion' and 'distance walked' (97). For this intervention study, each response was weighted and the overall score derived by combining these scores. Higher scores indicated functional independence. Participants are able to score on a scale between 0-45 points. Participant overall PMA scores were also placed into one of four categories: 'severe mobility impairment' (0-18 points), 'moderate mobility impairment' (19-27 points), 'mild mobility impairment' (28-36 points) and 'highest independence' (37-45 points). Bupa provided each participant's PMA after receiving informed consent from the willing participant. Residents had their functional mobility evaluated every six months by Bupa's physiotherapists. The PMA tool used is presented in Appendix I.

4.2.6.3 Mini Nutritional Assessment (MNA)

The MNA tool is the most widespread tool for nutritional screening and assessment due to its ease of use and feasibility in many clinical care settings (98). This tool is currently and routinely used in all Bupa Aged Care facilities to monitor residents' nutritional statuses. The MNA consists of a six-item assessment to help identify elderly individuals who are malnourished or at risk of malnutrition (98). Each response is weighted and the overall score derived by summing the responses scores (98). Participants were able to score between 0-14 points. Participants were placed into three categories based on this overall score: 'normal nutritional status' (12-14 points), 'at risk of malnutrition' (8-11 points) and 'malnourished' (0-7 points). Higher scores indicate a higher risk of malnutrition. The MNA was scored by the registered nurses employed at Bupa Aged Care and were provided to the research team after receiving informed consent

from participating residents. Residents had their nutritional status evaluated quarterly by Bupa's physiotherapists. The MNA tool used is presented in Appendix J.

4.2.6.4 Feedback Forms

At the end of the intervention study at Bupa Aged Care, participants in the treatment group were invited to provide written feedback on their experiences as well as opinions on the CVT. Participants were asked six simple questions about any positive or negative aspects of the massage pad program, how they felt during the program, how they currently felt after finishing the program and what made them want to partake in the study. Additional feedback and opinions on how to improve the vibration program were welcomed. The feedback form used is presented in Appendix K.

4.2.7 Data Collection Procedures

As previously specified in the study design, this pilot study was trialled to run for 12 weeks, with data points being collected at baseline, four, eight and 12 weeks. Because COVID-19 restrictions were introduced in aged care facilities in Queensland, data was captured at baseline only. After the restrictions eased six months after being introduced, data collection recommenced to observe any long-term effects six months after the four weeks of treatment using CVT.

Before the commencement of the study, the research team conducted several meetings with the current Bupa clinical care manager and head nurses to discuss the study details. The research team introduced the cycloid vibration pad to the head nursing team to demonstrate how the vibratory device worked. Along with this demonstration, an explanation about the outcome measures the research team wanted to observe during the pilot study was provided to the nursing team. The research team received recommendations and opinions from the nursing team on how to appropriately measure these outcomes, as the sample was from a vulnerable population group. It was agreed upon that mobility measures and nutritional statuses would be provided to the research team by Bupa during the pilot study. At the same time, participant QoL would be assessed by the research team with a brief assessment tool so as not to disturb resident routine and schedules. Resident feedback forms would be provided to participants to obtain opinions and experiences with the cycloid vibration program.

After obtaining ethical approval for the study, this letter of approval was forwarded to the current clinical manager at the Bupa Aged Care facility. Commencement of baseline data collection began as soon as Bupa's routine resident health monitoring was conducted for each participant involved in the study. Baseline PMAs and MNAs conducted by the aged care staff were provided to the research team.

To assess participant QoL, two student researchers were involved with the AQoL-6D survey data collection. Every entry into the aged care facility was made aware by the clinical manager at the time, including the research team's tasks and goals for the day. Entry into Bupa Aged Care commenced every morning before noon to avoid clashes with daily resident routines. Participants were approached and informed verbal consent was obtained before participating in the AQoL-6D questionnaire. The surveys were self-completed in the privacy of their residential suites. A research team member was present if the participant had any questions about the questionnaire.

After the easing of COVID-19 aged-care restrictions, the current clinical care manager was emailed to assess the risks and viability of re-entering the aged care facility. After approval from the clinical care manager, the research team re-entered the aged care facility six months after the fourth week of the intervention. Current restriction protocols at the aged care facility were followed, including wearing appropriate personal protective equipment and being vaccinated with the current influenza vaccine at least two weeks before entering. Participants were then re-approached and asked if they would like to participate in the AQoL-6D survey once again. After providing informed consent, the same data collection procedure for assessing participant QoL used previously was conducted. The Bupa Aged Care facility provided current PMAs and MNAs after obtaining informed consent from participants.

Participants were also invited to provide their written experiences and opinions on the intervention study using the feedback form questions developed by the research team.

4.2.8 Assessor Blinding Protocol

All data were provided to the supervisory members of the research team so that participant IDs could be assigned to each participant. This allowed for de-identification of study participants and blinded the student research members responsible for analysing the results to the names associated with each participant ID. In addition to assigning participant IDs, any association that these participant IDs had with the treatment or control groups was hidden by the supervisory team. This blinded the student researcher involved with analysing the data to which intervention group with which each participant ID was associated. During the intervention and data collection phase, researchers were non-blinded due to time constraints.

4.2.9 Statistical Analyses

The IBM Statistical Package for the Social Sciences version 26.0 (SPSS ver. 26) was used to conduct all statistical analyses. Data were analysed according to the intention-to-treat principle (99). Using this principle, participants who dropped out of the intervention study or failed to adhere to protocol had their last known data carried forward (99).

Demographic and baseline characteristics were analysed through descriptive statistics (i.e., means and percentages). A Shapiro-Wilk test was conducted to verify the normality of continuous data. For normally distributed demographic and baseline data, any differences between groups were tested for using independent *t*-tests. For variables with non-normal distributions, the baseline scores of these variables were compared between the two groups using the Mann-Whitney U test. Categorical baseline characteristics were analysed for signficant differences using the Fischer's Exact test.

Mean scores were calculated for each outcome measure at six months post-treatment to compare to baseline. In normally distributed data, paired *t*-tests were conducted to identify any changes within each group for these variables. For non-normally distributed data, a Wilcoxon signed-rank test was conducted to compare these variables for any changes within groups. Independent *t*-tests were conducted to assess for differences between normally-distributed groups at six-months post-treatment. Mann-Whitney U tests were used for non-normal distributions, when assessing for inter-group

differences at six-months post-treatment. Excel was used to produce the associated bar graphs.

Due to the low sample size, it was concluded that the study did not have enough statistical power to observe for any group-by-time interactions with a mixed 2x2 factorial ANOVA. This was to avoid for misinterpretation of results associated with statistical errors.

4.2.10 Ethical Considerations

This human pilot study sought to investigate the effectiveness of CVT on the QoL, mobility and nutrition of aged care residents. Ethical approval from the Griffith University Ethics Committee (GU Ref No: 2020/038) and approval from the Bupa clinical care manager was obtained (see Appendix C).

The study was conducted in accordance with the values and principles outlined in the National Statement on Ethical Conduct in Human Research (updated 2018 ver.) (100). The application of these principles in the study is described below.

Research Merit and Integrity

Research deemed to have merit is well justified, meets quality criteria and is conducted by persons with sufficient experience and competence (100). As evaluated by the thorough systematic review of the literature on VT, several desirable effects on the QoL and mobility of older adults were observed. Additionally, a further literature review indicates older adult nutrition could be improved through improved dependence and mobility. With the rapidly increasing older adult population and associated comorbidities that come with ageing (35), this study's potentially beneficial findings should have merit. Well-established assessment tools already used by Bupa Aged Care and the validated AQoL-6D tool (59) were used to measure participant outcome measures. Conducting this study was a student researcher experienced in the biomedical sciences and trained in quantitative and qualitative research techniques. Heavily experienced team members in human research supervised the research team. This research team also received training on the use of the cycloid vibration pad before study commencement.

To demonstrate research integrity, the student researcher committed to follow the recognised principles of research conduct and conduct research honestly. Whether favourable or unfavourable, all study findings were reported to the student researcher's best of knowledge.

Justice

To conduct research that is just, the research team had a commitment to ensure the participant selection process was as fair as possible while considering the scope and objective of the proposed research (100). Only participants that fulfilled the inclusion criteria and did not fulfil each group's respective exclusion criteria were recruited. Each eligibility criteria were transparently explained and described to all residents interested in participating in the study. Participants in either group were treated with the same amount of respect.

All participants were informed about the purpose of the study, its benefits and any potential risks (see Appendix G). Before consenting to the study, eligible residents were first encouraged to discuss their involvement in the project with their family and friends. Only participants agreeing to the study by providing written consent were involved in the study (see Appendix F). Permission for Bupa Aged Care to provide the research team with their PMA and MNA records was also obtained after consenting. Any residents that had declined to participate in the study were all treated the same. Residents were informed that their decision whether to participate would not affect their care or introduce consequence. Research outcomes will also be made accessible to research participants in a way that is timely and clear.

Beneficence

The likely benefits and risks of the research were clarified to all participants (see Appendix G). In addition, the research team was responsible for designing the research in a way that would minimise the risks of harm or discomfort to participants (100). While this study is of minimal risk, the exclusion criteria outlined for the treatment group were developed to prevent any harm to the residents. Although these risks have not been observed in any articles evaluating the effects of CVT, limited studies are available to disregard these risks. If a participant exhibited pain or discomfort during the intervention

or interview, the call button next to the participant's bedside was available to press. Several nurses were also available outside in the hallways for emergencies with the door to the residential suites left open.

Finally, as mentioned previously, participants were informed that they had the right to refuse participation at any time without reason and prejudice. This also included withdrawal from the study at any time without consequence. Participants were also advised in writing and verbally that while this study may not directly benefit the participant, it may have the long-term benefit of increasing geriatric research knowledge.

Respect

The research team also had a commitment to provide equal respect for every participant involved in the study (100). In human research, recognition of a person's intrinsic value is the act of providing respect (100). To recognise participants' intrinsic values, the research team abided by the values of research merit and integrity, justice and beneficence (100). In addition to abiding by these values, the privacy, confidentiality and cultural sensitivities of the participants were respected (100). All participants were de-identified and provided with participant IDs. Participant identification has not and will not be disclosed in publications or seminar presentations. Any identifying details were kept in a separate locked filing cabinet to the de-identified data, and data could only be accessed by the student researcher and their supervisors. Any electronic data were stored on a password-protected computer in an office with limited access. The paper questionnaires will be stored in a locked filing cabinet for a maximum of five years before being destroyed.

Various meetings were held with the clinical care manager and head nurses to determine the most appropriate method of carrying out the study to respect participants' cultural sensitivities and communities. In addition, a four-week acclimatisation phase was conducted before the start of the study to gain opinions from residents and nurses on how to improve the intervention study. Participant autonomy was of absolute importance, and prospective participants were provided sufficient information about the study to make an informed decision. Participants were also encouraged to speak with their family and friends before consenting to their involvement in the project. The name and contact details

of the research team were provided in all information documents. The participants were able to contact the researcher if any questions arose during the study period.

4.3 Results

4.3.1 Participant Flow

The flow of participants throughout the study is outlined in Figure 4.1. This flow chart presents the number of participants assessed for eligibility, allocated to each group, received the intended treatment and included in the data analysis. Reasons for participant exclusion are also provided in Figure 4.1. Participants in this study were recruited from a Bupa Aged Care facility located on the Gold Coast, Australia. The data collection period for this intervention study was between February and October 2019. From the four-week acclimatisation phase, 19 participants expressed their interest to participate in the study through a combination of flyers and trying out the CVT massage pad. These participants were provided with informed consent forms and participant information forms detailing any time commitments and survey requirements. A total of five residents declined to participate in the study due to personal reasons or schedule clashes. After screening for eligibility, 14 eligible participants were included in the study. Seven participants were allocated into the treatment group based on the strict inclusion and exclusion criteria to avoid harm and reduce risks. The other seven participants were allocated into the control group based on the inclusion criteria. All included participants completed their intended intervention and outcome assessments, and no participants were lost to follow-up at the six-month assessment. Due to the introduction of COVID-19 restrictions during the study period, a second recruitment phase could not be conducted to obtain more eligible participants.

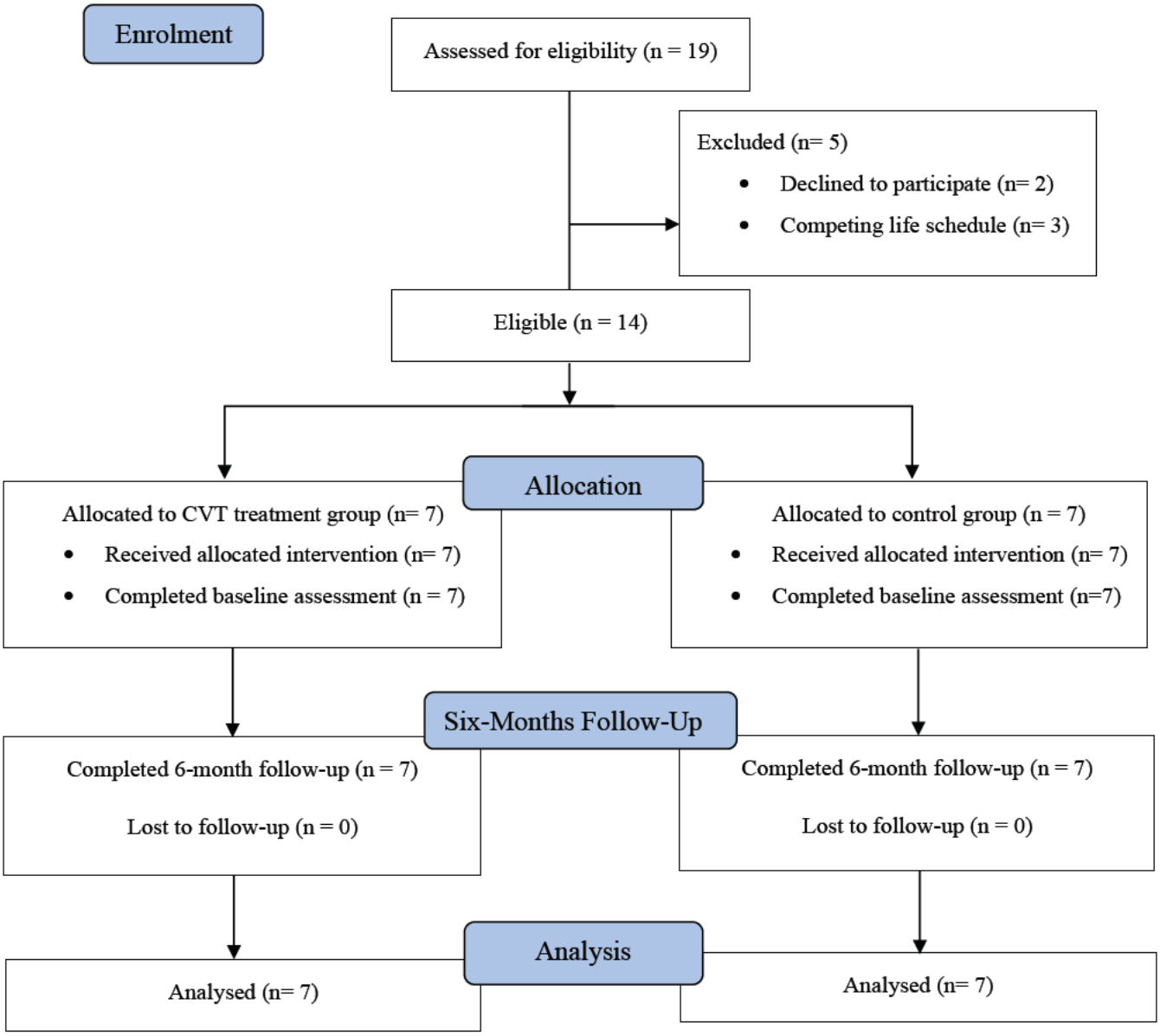

Figure 4.1. Flow Chart of Participants in Study.

4.3.2 Demographic Characteristics of Participants

The baseline characteristics of the subjects in each group are presented in Table 4.2. All participants were aged 65 and over, with an overall mean age of 83.79 years (SD = 8.2 years). Participants had an overall mean BMI of 28.7 kg/m² (SD: 7.12 kg/m²). More than half of these participants were female (n = 8; 57.1%). Baseline MNA measurements indicated that more than half of the participants had a 'normal' nutritional status (n = 9; 64.3%). The remaining participants were assessed as 'at risk of malnourishment' (n = 5; 35.7%). None of the sampled participants was observed as

'malnourished'. Baseline mobility status presented 'highest independence' in more than half of participants (n = 8; 57.1%). The remaining participants with mild, moderate or severe mobility impairments were equally distributed (n = 2; 14.3%). The treatment group was observed to have a significantly higher BMI than the control group (p = 0.016). There were no other significant baseline characteristic differences found between groups (p > 0.05).

Table 4.2. Baseline Characteristics of Treatment and Control Group Participants.

Variables	Overall	Control Group *(n =7)*	Treatment Group *(n=7)*	P-value
Age, mean ± SD	83.79 ± 8.2	82.43 ± 10.50	85.14 ± 5.52	0.556 [a]
BMI (kg/m²)	28.7 ± 7.12	24.38 ± 4.87	33.01 ± 6.52	0.016 [a]
Gender N (%)				0.592 [b]
Male	6 (42.9)	4 (57.1)	2 (28.6)	
Female	8 (57.1)	3 (42.9)	5 (71.4)	
Nutrition status N (%)				1.000 [b]
Malnourished	0 (0.0)	0 (0.0)	0 (0.0)	
At risk	5 (35.7)	3 (42.9)	2 (28.6)	
Normal	9 (64.3)	4 (57.1)	5 (0.0)	
Mobility status N (%)				1.000 [b]
Severe impairment	2 (14.3)	1 (14.3)	1 (14.3)	
Moderate impairment	2 (14.3)	1 (14.3)	1 (14.3)	
Mild impairment	2 (14.3)	1 (14.3)	1 (14.3)	
Highest independence	8 (57.1)	4 (57.1)	4 (57.1)	

Notes. [a] Unpaired independent samples *t*-test of inter-group differences (two-tailed significance). [b] Fischer's Exact test of categorical inter-group differences (two-tailed exact significance). SD: standard deviation, BMI: Body Mass Index.

The baseline outcome measure scores of the participants in each group are presented in Table 4.4. No significant inter-group differences were observed in MNA, PMA and overall QoL scores at baseline. Moreover, no significant inter-group differences at baseline were observed for any of the six QoL dimensions. However, treatment group AQoL-6D total scores and 'mental health' and 'coping' scores were lower than the control group at baseline; however, this difference was not significant.

Table 4.3. Baseline Outcome Measures of Treatment and Control Group Participants.

Outcome Measures	Control Group *(n = 7)* mean ± SD	Treatment Group *(n= 7)* mean ± SD	*p*-value
Quality of Life (QoL)			
AQoL-6D total score	62.75 ± 14.89	58.41 ± 16.43	0.614[a]
Independent living score	54.76 ± 26.71	57.14 ± 23.94	0.684[a]
Relationships score	72.86 ± 21.38	80.0 (70.0, 80.0)	0.829[b]
Median (Q1, Q3)			
Mental health score	81.25 (68.75, 87.50)	61.61 ± 23.23	0.272[b]
Median (Q1, Q3)			
Coping score	60.71 ± 16.47	45.24 ± 20.33	0.144[a]
Pain score	51.43 ± 34.85	50.00 ± 23.09	0.929[a]
Senses score	63.74 ± 10.62	64.84 ± 17.12	0.888[a]
Nutrition (MNA score)	11.29 ± 1.70	12.00 (11, 12)	1.000[b]
Median (Q1, Q3)			
Mobility (PMA score)	33.14 ± 11.13	33.86 ± 10.81	0.962[a]

Notes. [a] Unpaired independent samples *t*-test of inter-group difference (two-tailed significance). [b] Mann-Whitney U test of inter-group difference (two-tailed exact significance). AQoL-6D: 6-Dimensional Quality of Life

4.3.3 Quality of Life Outcomes

The mean and standard deviation of the change in scores for the AQoL-6D (i.e., total AQoL-6D, independent living, relationships, mental health, coping, pain and senses) are presented in Table 4.4. In Figure 4.2, changes in individual AQoL domain scores at baseline and six months post-intervention are presented. Figure 4.3 presents the changes in total AQoL-6D assessment scores at baseline and six months post-intervention.

Table 4.4. Outcomes of Treatment and Control Groups at Baseline and Six Months Post-Intervention.

Outcome Measures	Baseline			Six Months Post-Intervention		
	Control Group (n = 7) mean ± SD	Treatment Group (n = 7) mean ± SD	*p*-value[a]	Control Group (n = 7) mean ± SD	Treatment Group (n = 7) mean ± SD	*p*-value[a]
Quality of Life (QoL)						
AQoL-6D total score	62.75 ± 14.89	58.41 ± 16.43	0.614	73.06 ± 8.36*	64.92 ± 19.10	0.322
Independent living score	54.76 ± 26.71	57.14 ± 23.94	0.684	68.25 ± 21.79	61.11 ± 28.87	0.610
Relationships score ***Median (Q1, Q3)***	72.86 ± 21.38	80.0 (70.0, 80.0)	0.829	78.57 ± 14.64	74.29 ± 22.25	0.678
Mental health score ***Median (Q1, Q3)***	81.25 (68.75, 87.50)	61.61 ± 23.23	0.272	81.25 ± 13.01	70.54 ± 19.99	0.258
Coping score	60.71 ± 16.47	45.24 ± 20.33	0.144	69.05 ± 14.20	55.95 ± 23.92	0.237
Pain score ***Median (Q1, Q3)***	51.43 ± 34.85	50.00 ± 23.09	0.929	67.14 ± 30.40	70.00 (30.00, 90.00)	0.535
Senses score	63.74 ± 10.62	64.84 ± 17.12	0.888	73.63 ± 11.63*	68.13 ± 15.01	0.459
Nutrition (MNA score) ***Median (Q1, Q3)***	11.29 ± 1.70	11.29 ± 1.70	1.000	11.86 ± 1.46	13.00 (10, 13)	0.805
Mobility (PMA score)	33.14 ± 11.13	33.14 ± 11.13	0.962	34.57 ± 10.77	33.29 ± 10.50	0.825

Notes. [a] Unpaired independent samples *t*-test or Mann-Whitney U test of inter-group difference. * Significantly different compared with baseline ($p < 0.05$); paired dependent samples *t*-test or Wilcoxon signed-rank test. AQoL-6D: 6-Dimensional Quality of Life, MNA: Mini Nutritional Assessment, PMA: Physiotherapy Mobility Assessment.

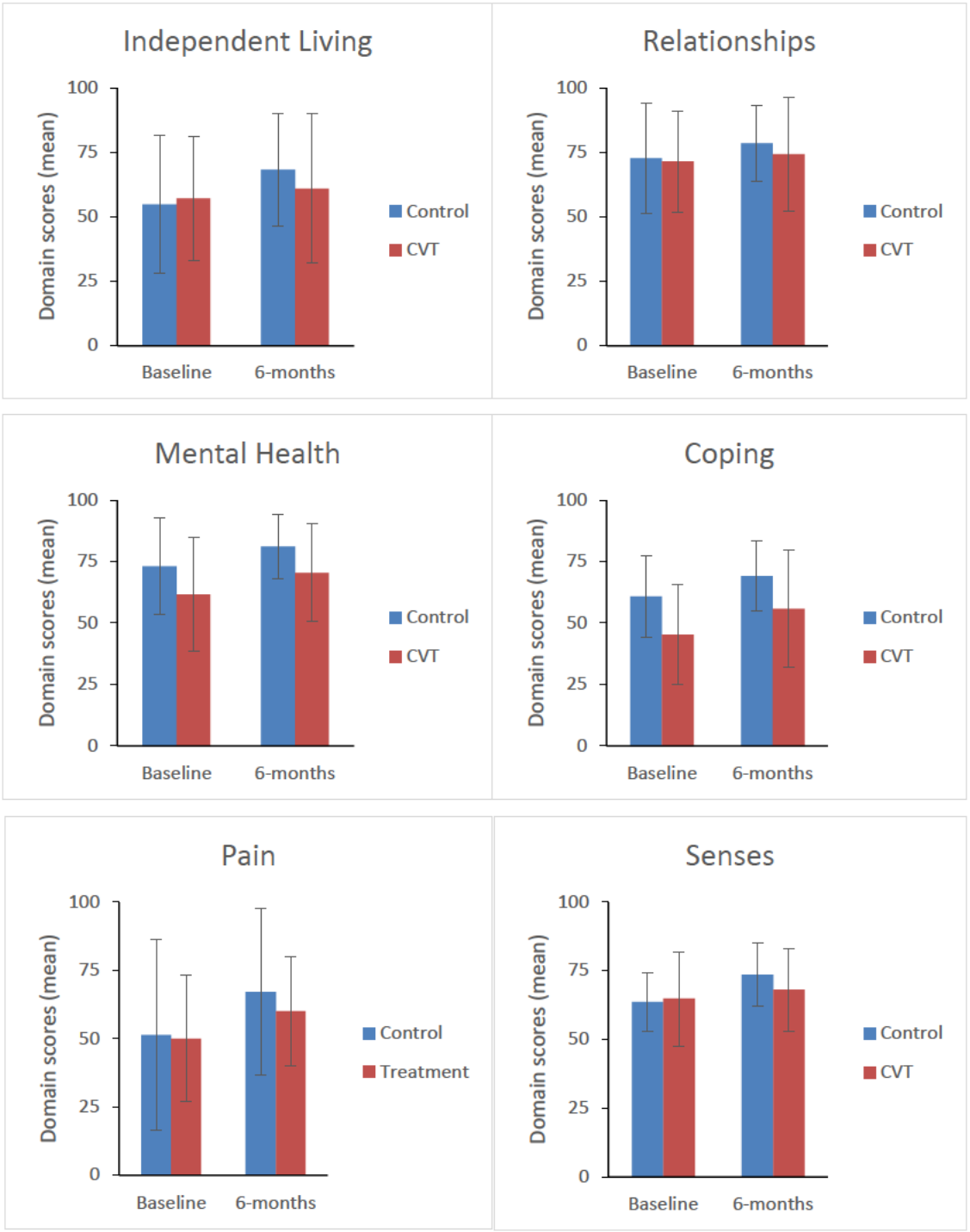

Figure 4.2. Change in Treatment and Control Group Individual Quality of Life Domain Scores at Baseline and Six Months Post-Intervention.

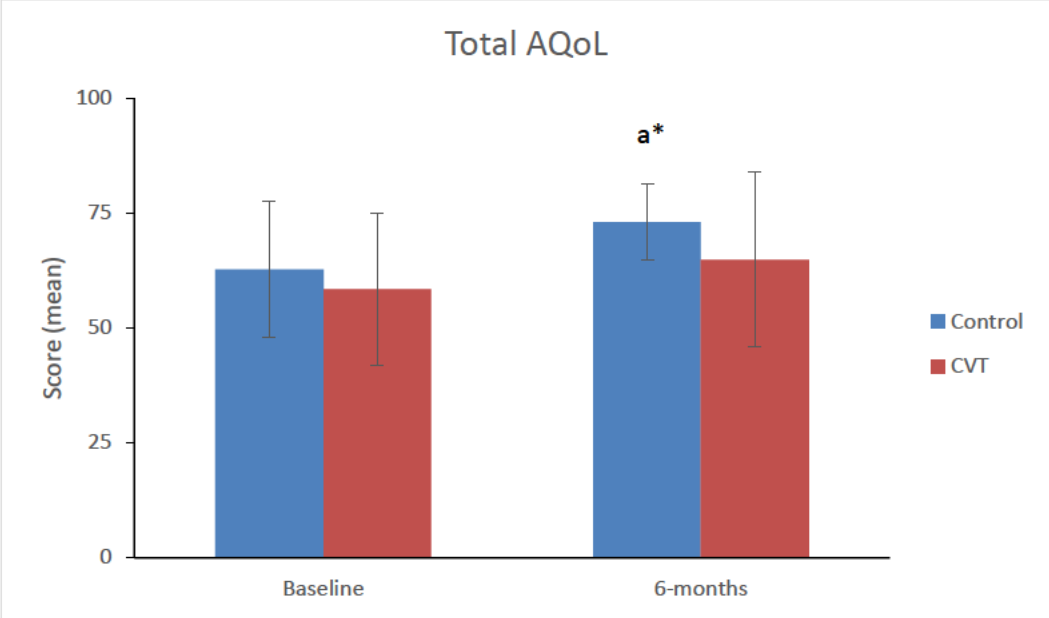

Figure 4.3. Overall Change in Treatment and Control Group 6-Dimensional Quality of Life Scores at Baseline and Six Months Post-Intervention.

Notes. *$p < 0.05$; [a] significance compared to baseline

At six months post-intervention, there was no significant inter-group difference in total AQoL-6D scores ($p = 0.322$) between the treatment ($M = 64.92$; SD = 19.10) and control group ($M = 73.06$; $SD = 8.36$). Compared to baseline (pre-intervention) ($M = 62.75$; $SD = 14.89$), the control group presented a significant improvement ($p = 0.02$) in overall QoL six months after the four-week intervention. In the treatment group, a slight improvement in total QoL was observed six months post-intervention compared to baseline ($M = 58.41$; $SD = 16.43$), although this finding was not significant ($p = 0.296$). However, the treatment group AQoL-6D scores show high variability of that data at six months post-intervention (*CI*: 95%) (see Figure 4.3).

When evaluating the individual AQoL domains, paired sample *t*-tests presented significant improvements ($p = 0.049$) in 'senses' scores for the control group at six months post-intervention ($M = 73.63$; $SD = 11.63$) compared to baseline ($M = 63.74$; $SD = 10.62$). There were no significant improvements for the remaining individual AQoL dimension scores observed in either group. No significant inter-group differences in individual AQoL dimension scores were observed at either time point as assessed by independent unpaired *t*-tests.

4.3.4 Mobility Outcomes

The mean and standard deviation of the change in PMA scores are presented in Table 4.4. Figure 4.4 presents the treatment and control group changes in PMA scores at baseline and six months post-intervention.

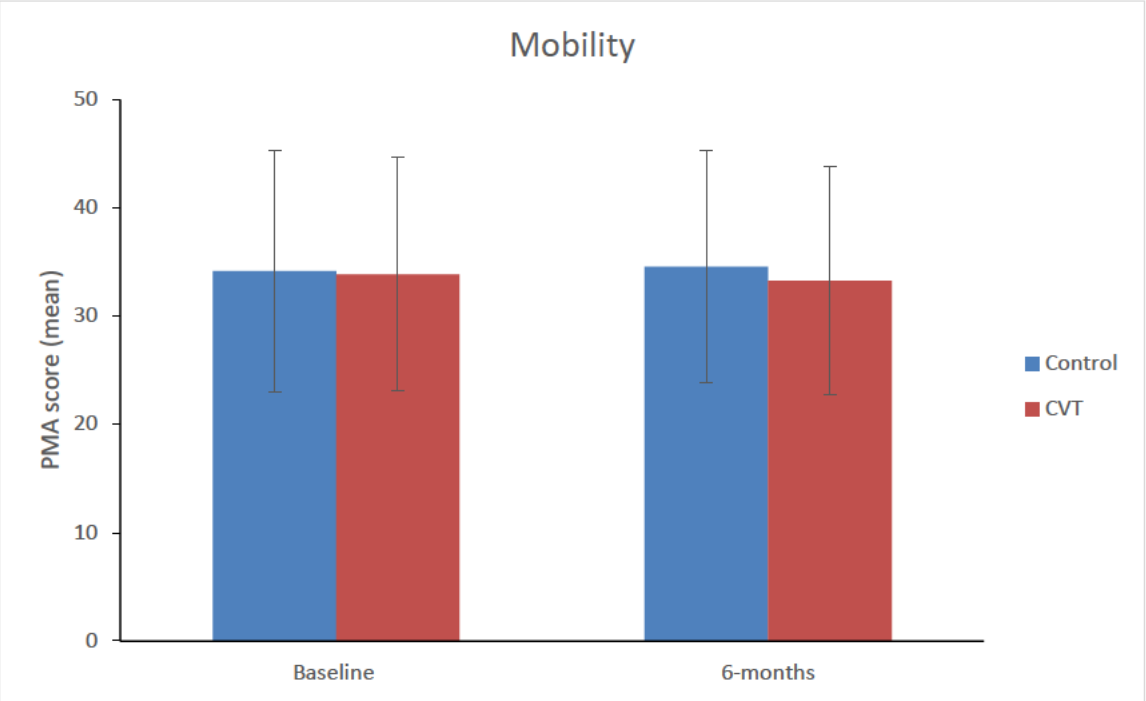

Figure 4.4. Change in Treatment and Control Group Physiotherapy Mobility Assessment Scores at Baseline and Six Months Post-Intervention.

No significant inter-group differences in PMA scores at baseline ($p = 0.962$) or six months post-intervention ($p = 0.825$) were observed between the treatment or control groups. Further, paired sample *t*-tests presented no significant differences in PMA scores for either the control ($p = 0.356$) or treatment groups ($p = 0.172$), at six months post-intervention compared to baseline. Changes in mean scores for both groups were by the decimal and minuscule.

4.3.5 Nutrition Outcomes

The mean and standard deviation of the change in scores for the MNA are presented in Table 4.4. Figure 4.5 presents the treatment and control group changes in MNA scores at baseline and six months post-intervention.

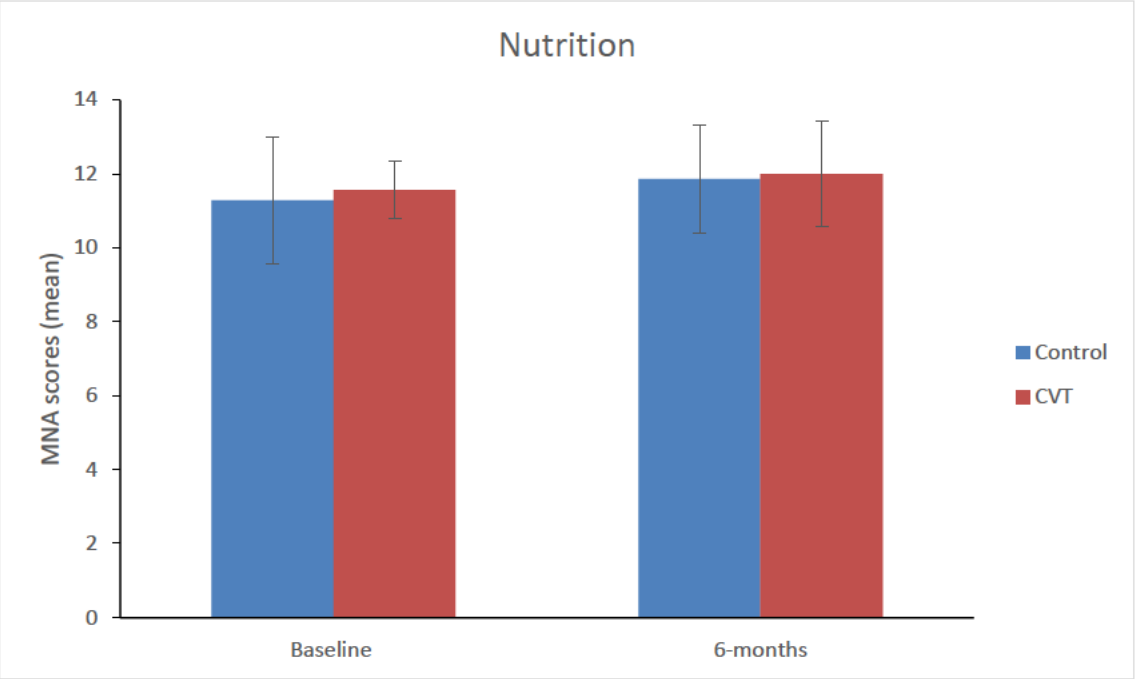

Figure 4.5. Change in Treatment and Control Group Mini Nutritional Assessment Scores at Baseline and Six Months Post-Intervention

No significant inter-group differences in MNA scores at baseline ($p = 1.000$) or six months post-intervention ($p = 0.805$) were observed between the treatment or control groups. A paired sample *t*-test presented no significant differences in MNA scores within the control group ($p = 0.231$) at 6-months post-treatment compared to baseline. Moreover, there were no significant differences ($Z = -0.828$; $p = 0.408$) in MNA scores at 6-months compared to baseline, within the treatment group using the Wilcoxon signed-rank test. However, within the treatment group, median MNA increased from 12 to 13, respectively.

4.3.6 Participant Evaluations

At the end of the six-month follow-up data collection, treatment group participants were provided evaluation forms to comment on their experiences with the CVT massage pad program. Three out of the seven participants in the treatment group completed and returned the evaluation forms. When asked to comment about whether they had any positive experiences with the massage pad program, all three participants mentioned that the vibrations from the CVT massage pad were relieving, relaxing and comfortable. One of these participants mentioned that due to lumbar back pain that could not be targeted without surgery, the CVT massage pad program helped take the pain off their mind. This participant further mentioned that the CVT massage pad program would serve as another source of pain relief when their physiotherapist was unavailable.

Regarding any negative experiences with the CVT massage pad program, these participants desired a longer intervention period and longer time with the massage pad. Given that the research team had to leave the aged care facility due to the COVID-19 restrictions, these participants mentioned a strong desire to have both the research team and massage pad program back at the facility. One participant mentioned that their back pain had reappeared due to the halting of the massage pad program and now found it difficult to get out of bed. Participants' reasons for participating in the study were mixed, including wanting to have an individual to talk with, initial perceptions of their back pain relief and curiosity about how the massage pad would feel. During the intervention study, participants who received CVT did not report any adverse side effects or reactions from using the massage pad.

4.4 Summary of the Chapter

In this chapter, the methodology used to investigate the effectiveness of CVT on the QoL, mobility and nutrition of aged care residents was detailed. The pilot non-RCT included participants using specific eligibility criteria as listed. The eligibility criteria were justified for both answering the specified research questions and ensuring participant safety. Fourteen participants were recruited into the study, with seven participants each allocated to the CVT treatment group or the control group based on eligibility criteria. A low recruitment rate was reported for this study due to eligible residents' competing life schedules or just declining to participate. This study reported no dropouts from the study, with all participants in the CVT treatment group attending every session available. The intervention was halted at week four as a result of the COVID-19 restrictions. However, data collection recommenced at six months post-treatment to observe potential long-term effects. All participants were still retained after this six-month post-treatment period, with no dropout. Informed consent was always provided by participants, with researchers following appropriate research ethical conduct during the study period.

At baseline, no significant differences in demographic or characteristic data were observed between the CVT treatment and control group. At six months post-intervention, there were no significant changes in overall health-related QoL compared to baseline in the CVT treatment group. Unexpectedly, the control group showed significant improvement in health-related QoL at six months post-treatment compared to baseline. However, there was no significant inter-group difference in health-related QoL between the treatment and control groups at six months post-treatment. No significant changes were identified for either group when examining mobility in the CVT treatment and control groups. In addition, no significant inter-group differences were observed in mobility measures at six months post-treatment. At six months post-treatment compared to baseline, the CVT treatment group showed no siginificant difference in nutritional status. There were also no significant differences in nutrition scores between the CVT treatment and control group at six months post-treatment.

CVT treatment participants were also invited to provide their feedback and experience with the CVT massage pad program. Three out of seven participants completed and returned their evaluation forms. Multiple positive comments were provided by these participants on how they found the massage pad to be relaxing,

comfortable and a form of pain relief. Further, CVT treatment participants desired a more extended intervention period and duration with the CVT massage pad. This desire among participants to participate in the massage pad intervention was more apparent during the COVID-19 aged-care restrictions. Adverse side effects or reactions were not reported by these participants.

These findings and their implications will be discussed in Chapter 6. As mentioned earlier, the introduction of the COVID-19 aged-care restrictions affected the intervention period of the study. Consequently, it was hypothesised that the COVID-19 aged-care restrictions might have been a significant confounding factor affecting the QoL, mobility and nutrition of study participants. To further examine the effect of COVID-19 aged-care restrictions on the participants involved in this intervention study, another qualitative study was conducted to investigate participants' experiences with these restrictions in relation to their QoL, mobility and nutrition. Details of this COVID-19 qualitative study are presented in Chapter 5 and discussed in tandem with the intervention study in Chapter 6.

Chapter 5: Impact of COVID-19 Restrictions on the Quality of Life, Mobility and Nutrition of Aged Care Residents

5.1 Introduction

As outlined previously, COVID-19 and subsequent aged-care restrictions occurred during the CVT pilot study. Consequently, the research and supervisory team questioned whether the ongoing COVID-19 aged-care restrictions would act as a significant confounding factor affecting the pilot study results. The experiences of participants during the COVID-19 lockdowns concerning their QoL, mobility and nutrition are explored in Chapter 5.

The first part of Chapter 5 describes the conceptual and methodological underpinnings of the qualitative study. It describes the method and design, the procedure used for data collection and the choice of analytical methods for the study. The final part of Chapter 5 presents the main findings as themes and sub-themes, followed by a discussion on the significance of these findings in relation to the research questions, conceptual framework and existing literature.

The Consolidated criteria for reporting qualitative research was used to report the study methods, findings and analysis explicitly and comprehensively (101). This comprehensive checklist consists of 32 items that cover the necessary components of a qualitative study design and is widely recognised as a tool for improving the quality of reporting.

5.1.1 Research Question

The following research question guided the questionnaire used to test the aims and objectives of the qualitative study:

3) How did participants experience the effects of the COVID-19 aged-care restrictions in relation to their QoL, mobility and nutrition?

5.2 Study Design

5.2.1 Theoretical Framework

A qualitative study design was chosen to investigate whether there was an effect from COVID-19 and subsequent restrictions on residents. Qualitative study designs are a widely used approach to explore the experiences and perspectives of individuals in healthcare research (102). These designs are essential for investigating new phenomenon such as the novel COVID-19 virus (103-105). A methodological approach of content analysis was chosen to support this qualitative study. The objective of content analysis is to systematically transform a large amount of text into a highly organised and concise summary of key results from a neutral standpoint/objective (106, 107). Krippendorff (108) defined content analysis as 'a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use'. Themes and concepts that emerge from the texts can be quantified and analysed to explore their presence, meanings and relationships.

The exploratory and descriptive nature of content analysis is based on inductive reasoning rather than deductive reasoning (107). Inductive reasoning is the process of weaving together new information into theories by developing conclusions from collected data (107). This method allows the researcher to analyse the text with an open mind to identify meaningful concepts when answering the research question. Deductive reasoning is the opposite; by testing hypotheses or principles, the researcher seeks pre-determined concepts within the texts. Since the aged care population has not yet been studied in terms of the effects of COVID-19 and subsequent aged-care restrictions, inductive reasoning allowed for non-biased exploratory content analysis.

5.2.2 Participant Selection

Participants (n = 10) were recruited from the CVT pilot study, a small-scale non-RCT observing the effects of CVT on the mobility, nutrition and QoL of aged care residents. As these participants were familiar with the student researchers from participating in the CVT study, these residents were approached face to face to ascertain their willingness to participate as volunteers in the COVID-19 study. Due to the time constraints of data collection brought on by COVID-19 aged-care restrictions (i.e., a

maximum period of two hours per visit), four of the approached residents (n = 4) were unable to participate in the two-week study because their schedules clashed with the investigation timetable. Therefore, the sampling strategy was purposive, with access being provided by Bupa Aged Care. Given that the research team were concerned about COVID-19 and the aged-care restrictions affecting the CVT study participants, these residents were considered the best sources for collecting rich and valuable information about their experiences with the COVID-19 virus and aged-care restrictions.

At the time of recruitment for the CVT study, demographic data were collected to ascertain the diversity of study participants. Bupa Aged Care regularly updates this demographic data in residents' health and lifestyle files, which were provided to the research team with prior participant consent. This information may also indicate relationships between the demographic variables and social variables of the participants.

5.2.3 Setting

The qualitative study was conducted within one of the Bupa Aged Care facilities within Queensland, Australia. The aged care facility is situated approximately 20 minutes from the Griffith University, Gold Coast campus, within a quiet suburban area. This home spans two larger residential areas, each containing 30+ rooms in which the residents live. There is also a range of communal spaces, activity rooms and dining areas across the two areas. Teams of nurses, physiotherapists and general lifestyle staff are constantly patrolling the hallways and communal areas.

During the qualitative study, COVID-19 aged-care restrictions allowed only two hours for family members and visitors to interact with residents each day. Consequently, fieldwork took place once per day for only two hours maximum at a time to accommodate these restrictions. Before every entry into the aged care home, researchers were thoroughly contact traced and had their temperature checked by the front-end nurse. All researchers wore required face masks and appropriate personal protective equipment before entering the aged care facility. Researchers were also vaccinated with the current influenza vaccine at least two weeks before data collection.

A convenient location for the qualitative study and interviews was negotiated with the participants. All participants wished to conduct the interviews within the safety and

privacy of their rooms, allowing for uninterrupted interviewing and open responses. Besides the participant and researcher, nurses would occasionally visit the participants as part of their routine healthcare. The appointed care manager of the Bupa Aged Care facility was made aware of the researcher's whereabouts before and after every interview for safety purposes.

5.2.4 Data Collection

One-on-one semi-structured interviews were conducted to explore participants' experiences and the meaning they attribute to them. Over two weeks, interviews were conducted by one researcher in the privacy of each participant's room. Prior verbal consent was obtained after approaching each participant. Before the start of each interview, participants were asked if they would prefer their responses audio-recorded or written down. Participants were advised that all audio recordings would be transcribed, destroyed and de-identified. Of the 10 participants, only three agreed to an audio recording, while the other participants preferred the researcher to write down the participant responses. Other than the written responses, field notes were recorded after each interview to ensure essential findings and ideas would not be forgotten. Having a chance to reflect immediately after each interview allowed for a lower probability of misunderstanding what the participant had been trying to convey. Recording fieldnotes after, rather than during each interview, reduced interruption during participant responses.

The semi-structured interview questions were developed by the researcher and research team to address the research question. As the research team were concerned about the possible effects of COVID-19 and subsequent aged-care restrictions on participant responses, the interview guide covered aspects on QoL, mobility and nutrition (see Appendix L). The topic questions and guides were based on the full-scale aged-care restrictions imposed by the Queensland Government in mid-February, 2020. Consequently, the main open question was incorporated into the interview: 'Has the COVID-19 lockdown affected you or your loved ones? If so, how?' Leading questions following this main question asked about how they felt, routine daily activities and staff services during COVID-19 aged-care restrictions. At the end of each interview, participants were invited to add anything they found relevant to COVID-19 and

subsequent aged-care restrictions. For this study, only data directly related to the COVID-19 virus and its aged-care restrictions were coded.

Care was taken to ensure that the questions were presented with sensitivity and in a non-threatening manner. Each participant was assured that they did not have to answer any questions that made them feel uncomfortable or upset. Participants were interviewed for no longer than 15 minutes each, depending on how long they carried on the conversation. The researcher ensured that they did not speak over or interrupt participants and provided them with the best opportunity to communicate their experiences and express their opinions. This allowed any unexpected ideas or themes to emerge from their willingness to participate and prevented unwanted influence over participants' responses. Interesting or seemingly important keywords were written down during the individual interviews to explore participants' answers further. Due to the project's time constraints, repeat interviews or the return of transcripts to participants for comment or corrections could not be conducted.

5.2.5 Data Analysis Method

NVivo (Release 1.0) was the software used to analyse both the recorded interviews and written responses. NVivo is a widely used application for effective and efficient coding of qualitative data (103, 109). In qualitative research, coding is the process of labelling and organising qualitative data (e.g., texts, images and transcribed audio) to identify themes and the relationships between these themes (106). Only one researcher was tasked with transcribing the recorded interviews verbatim using NVivo. Written responses were also transcribed into text form and imported into NVivo. Data were analysed using content analysis, involving thematic analysis to qualitatively identify and report patterns or themes within the dataset. Thematic analysis has been extensively used in healthcare research for understanding the perspective of the patient (103, 109).

Before attempting to code the data, the researcher first familiarised himself with the transcripts. Collected written responses and transcribed interviews were read and re-read while keeping the aim of the study in focus. Following Erlingsson's and Brysewicz's (106) hands-on guide to analysing qualitative data, the researcher conducted a 'hermeneutic spiral' when reading the text. This is the process of comparing 'parts' of the text to the 'whole' text. In addition to the field notes recorded after each interview, the

researcher recorded their initial impressions of the data while reading to gain a sense of the ‘whole’ meaning. This method is helpful when breaking down the whole text into smaller parts; the researcher can determine whether the ‘parts’ analysis matches their first impressions of the ‘whole’ text or vice versa (106).

Bengtsson’s (107) four stages to analysing qualitative content (i.e., decontextualisation, recontextualisation, categorisation and compilation) were followed to analyse the transcribed responses. A few key examples of how the raw data were progressed into the final themes and sub-themes are outlined in Table 5.1. To decontextualise the data, the transcribed text was broken down into smaller meaning units. A meaning unit is a condensed sentence that still clearly displays the essential meaning of the text (106, 107). During the division of the text into meaning units, it was made essential that the research aim and question were in focus. After identifying these meaning units, codes according to the context were assigned to each meaning unit. This is known as the ‘open coding process’ (107). Codes were generated through an inductive approach in which codes would change as the study progressed as more data became available. Therefore, the coding process was conducted repeatedly at different areas of the text to ensure stability and reliability (107). Initially generated codes were placed into a codebook for reference. One researcher was active in this ‘open coding process’ while discussing their findings with their supervisory team at least once a week.

Table 5.1. An Example of Content Analysis Phases. Transcribed Interviews of Participants' Experiences During COVID-19 Aged Care Restrictions.

Meaning Unit	Condensed Meaning Unit	Code	Sub-Theme	Theme
'See we can't go anywhere here. I need things, I need to go and buy things, but I can't go'.	Cannot go outside anymore	Cannot go outside	Reduced physical activity	Disruption to daily routine and activities
'Exercise around room cannot compare to walking outside'.	Indoor exercise cannot compare to outdoor exercise	Cannot go outside	Reduced physical activity	Disruption to daily routine and activities
'Son would drop food at the door to the home every week instead during the beginning stages of the pandemic'.	No time with son during lockdown	No time with close one	Social isolation	Reduced face-to-face contact with close ones
'Not able to see my friends. Not able to see my family. We have to isolate when we've been outside'.	Cannot see friends or family	No time with close one	Social isolation	Reduced face-to-face contact with close ones

The second stage, 'recontextualisation', involved checking whether all the transcribed text available had been covered in relation to the aim (107). Written responses and transcribed interviews were reviewed along with the final list of codes. Texts that were uncoded and did not provide answers to the research questions were excluded from the analysis. Uncoded texts that had some importance to the study were allocated a new code. Sentences were also reviewed to determine whether they matched the initial coding structure. Both the researcher and supervisory team were active in deciding whether an uncoded text should be included in the analysis. There were no extended meaning units that needed to be further condensed.

In the third stage, ‘categorisation’, the researcher began to classify the final meaning units/codes into categories and themes. Codes within the codebook were compared and appraised to determine which codes belonged to each other, thereby forming sub-categories. Through repeated discussions with the supervisory team, these sub-categories were then further and broadly divided into categories. Given that the data seemed rich with latent meaning, these sub-categories and categories were instead abstracted into sub-themes and themes. Identifying themes and sub-themes allows the researcher to interpret the underlying meaning of the text, answering the question ‘How?’ (107). This process of moving the identified meaning units/codes into different themes and sub-themes was performed repeatedly until a reasonable explanation for the research aim and question was reached. The identified themes and sub-themes were reviewed to ensure that the data did not fall between two groups or fit into more than one group. A coding tree displaying the relationship of the themes and sub-themes was produced (see Figure 5.1). After the themes and sub-themes were consolidated, the fourth and final stage, ‘compilation’, involved analysing writing up of these themes (107).

Due to the low statistical power of the small sample size, an appropriate quantitative analysis on the difference in life-experiences between the previous treatment and control groups could not be made.

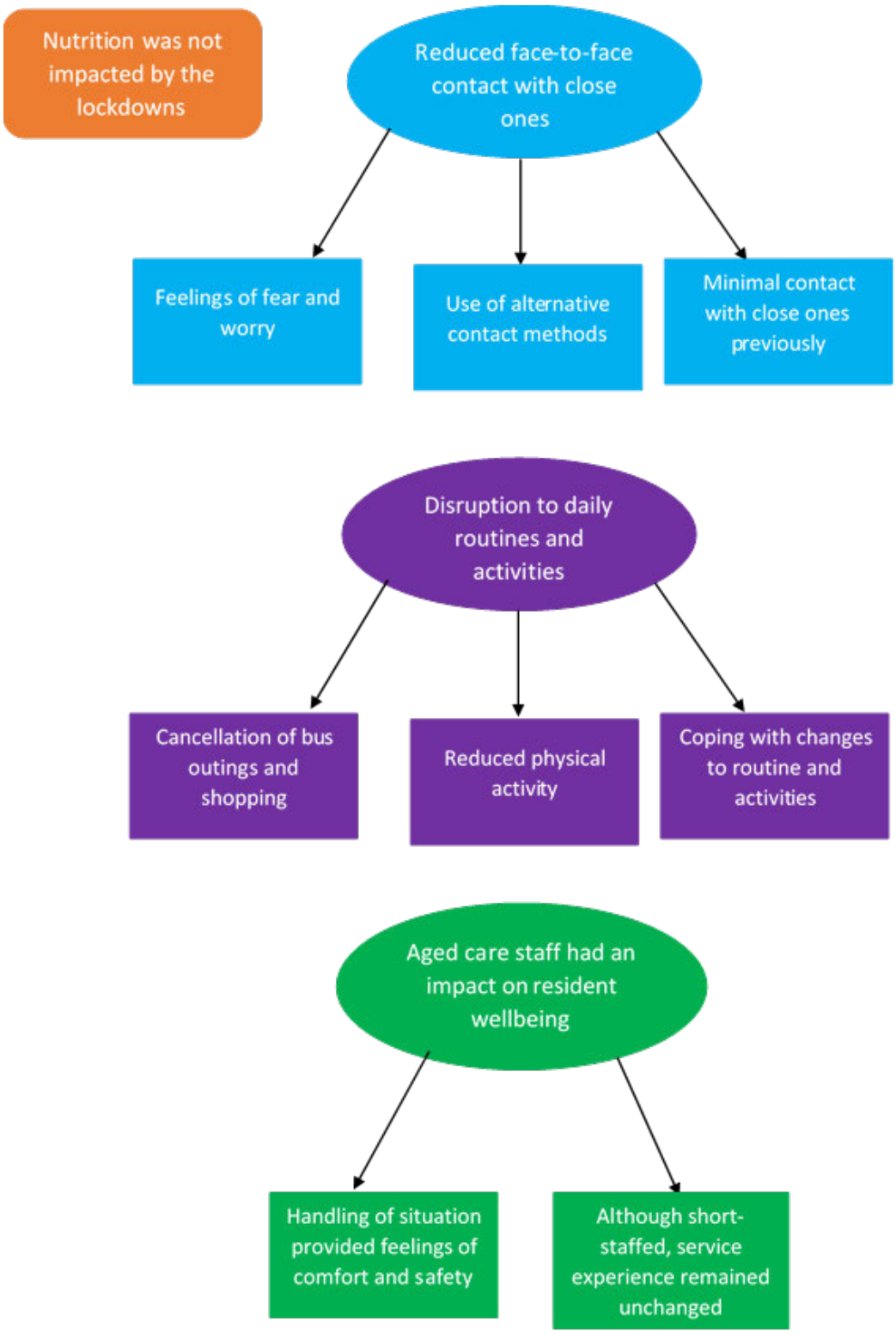

Figure 5.1. Mind-Map of Themes and Sub-Themes Coded from Transcribed Interviews.

5.3 Analysis and Findings

This section presents the main findings of the one-on-one interviews as themes and sub-themes (see Table 5.2). Residents participating in the CVT intervention study were approached (see Table 5.3). Participant experiences during the COVID-19 aged-care restrictions comprised of three major aspects: (1) reduced face-to-face contact with close ones, (2) disruption to daily routine and activities and (3) aged care staff affected resident wellbeing. Sub-themes were identified under each theme. Effects on nutrition were not observed in participant experiences.

Table 5.2. Themes and Sub-Themes Exploring How COVID-19 and Aged Care Restrictions Affected the Lives of Aged Care Residents.

Major Themes	Sub-Themes
Reduced face-to-face contact with close ones	Social isolation
	Feelings of fear and worry
	Use of alternative contact methods
Disruption to daily routine and activities	Cancellation of bus outings and shopping
	Reduced physical activity
	Coping with changes to routine and activities
Aged care staff affect resident wellbeing	Handling of situation provided feelings of comfort and safety
	Although short-staffed, service experience remained unchanged

Table 5.3. Participant ID and Study Group Involved in Qualitative Study.

No.	Participant ID	Study Group
1	AMBM01	Control
2	BBBM01	Control
3	BMBM01	CVT
4	DKBM01	CVT
5	ISBM01	CVT
6	JCBM01	Control
7	MJBM01	Control
8	NLBM01	CVT
9	NPBM01	Control
10	NWBM01	Control

5.3.1 Reduced Face-to-Face Contact with Close Ones

5.3.1.1 Social Isolation

At the height of the pandemic aged-care restrictions and even during the conducted interviews, participants overwhelmingly identified the experience of reduced contact with their family and friends. For the sake of resident and staff safety, Bupa Aged Care restricted all visitor access to residents living at the home as directed by the Queensland Government, putting residents into a form of social isolation. Participants mentioned that any family members or friends were refused entry into the aged care facility during this period of social isolation. With some family members being their only source of social contact, these participants described their experiences as 'awful' or 'frustrating'. For example, one of the participants recounted being unable to see their son during the beginning stages of the pandemic. Instead, this participant received food deliveries from their son once a week:

> *Son used to see me once a week. Son would drop food at the door to the home every week instead during the beginning stages of the pandemic. Felt awful. Missed son very much. (DKBM01)*

Although most participants described social isolation as the worst ordeal of the COVID-19 aged-care restrictions, some participants mentioned no previous social contact with family or friends. Many of these participants had family members located in different states of Australia or rarely ever visited:

> *No, I haven't got one. Problem is my family, part of my family. I've got a daughter in New South Wales. (AMBM01)*

> *Family members in different parts of Australia. Contact before and during pandemic was over the telephone. Contact did not change. (MJBM01)*

However, although these participants stated that their social contact was unaffected, they were aware of the consequences that COVID-19 and subsequent aged-care restrictions had on the rest of their community. As one participant outlined:

> *And it hasn't affected me but ... it's affected me in the way that I can see what's happening to a lot of people. Like, y'know, we've got no idea how—it must be unreal how it's affecting some people. See, some people want to travel with their family for Christmas every year, on Christmas Day and that. They can't do it now. (NPBM01)*

As most of the COVID-19 aged-care restrictions eased over time, participants mentioned that some could finally travel outside on their own for urgent matters. Although granted permission to walk outside the aged care facility, these residents were forced to isolate themselves in their rooms for two weeks when arriving back. These residents were socially isolated from other residents and required to eat in a separate dining room:

> *Yes. Social contact is a major issue. Going outside is a pain as there are too many forms to fill out. Not able to see my friends. Not able to see my family. We have to isolate when we've been outside. (JCBM01)*

> *Anyone who was outside had to quarantine and eat by themselves in a separate room. (DKBM01)*

5.3.1.2 Feelings of Fear and Worry

When asked about how they felt throughout the COVID-19 lockdowns, many participants felt anxious and fearful regarding the COVID-19 virus. Given that many participants had reduced face-to-face contact with their loved ones, it was unclear to the residents whether their family members were safe outside the aged care facility. Some felt worried that they would never be able to see family again due to seeing several deaths on television:

> *Worried if son with a cold is alright. Worried that he might have COVID-19. (ISBM01)*

Due to the sudden social isolation and reduced access to loved ones, participants were also worried that they had been carrying the virus and could potentially spread the illness to others:

> *Also scared of the possibility that I might have the virus and infect somebody else. (JCBM01)*

In contrast, some participants were not concerned about the pandemic when asked about how they felt about the restrictions. These residents perceived the surrounding environment as being the same as always during the pandemic. One of these residents mentioned having been through worse or similar natural disasters:

Lived through a number of natural disasters. Wasn't fazed by this pandemic at all. (MJBM01)

5.3.1.3 Use of Alternative Contact Methods

Since residents had reduced face-to-face contact with family members and friends, participants described having social contact through alternative contact methods. Conversing with close ones over the telephone was the most common form of alternative contact. For many, this was a sudden change that took getting used to:

Daughter comes in once a week. During the first month of the COVID-19 lockdown, could only contact daughter via telephone. (NWBM01)

After the first month or beginning stages of the COVID-19 pandemic, many of the aged-care restrictions had eased. This allowed family members and friends to enter the aged care facility; however, only for a limited time frame each visit:

Family members still visit regularly. However, there is more phone time rather than face-to-face chatting. (NLBM01)

Some residents expressed that they had always and only been contacted via telephone before the COVID-19 aged-care restrictions. These residents described themselves as not being affected by the COVID-19 aged-care restrictions. These perceptions contrasted with other residents who were used to regular face-to-face contact with family and friends:

Did not affect us or loved ones. Did not have anyone to see to begin with. Contact was not affected. (BBBM01)

5.3.2 Disruption to Daily Routine and Activities

5.3.2.1 Cancellation of Bus Outings and Shopping

As more aged-care restrictions were put in place due to the presence of the COVID-19 virus, participants described several activities previously offered at the aged care facility that were quickly reduced. On top of being socially isolated from visiting family members, weekly resident bus outings were cancelled outright from the beginning of the COVID-19 aged-care restrictions. Out of the activities offered at the aged care facility, bus outings were the only activity that allowed residents to travel outside their home to enjoy the outdoors or go shopping. Many participants expressed deep frustration for the cancellation of this essential activity:

> *Aw yeah, yeah ... see we can't go anywhere here. I need things, I need to go and buy things but I can't go ... I've gotta organise someone to come pick me up ... It's made it hard, it's made it hard. (NPBM01)*

> *Yes. Bus trips were cancelled entirely after the introduction of the pandemic lockdown. (JCBM01)*

Although the weekly bus outings and shopping trips were cancelled, some at-home activities were still being offered at the aged care facility, including quizzes, carpet bowls and weekly bingo events. These activities were run by the lifestyle team throughout the COVID-19 pandemic while maintaining social distancing between staff and residents. When asked about how participants felt about the reduced or cancelled activities, some had not been affected:

> *We still play bingo and they had the concerts here. Nothing else really. (AMBM01)*

> *Not affected. Still had lunch with friends. (NLBM01)*

In contrast, others described the current activities offered at the aged care facility as not enough to satisfy their needs:

> *Although they stayed, the amount of activities at the home right now or before is not enough to satisfy me. (JCBM01)*

5.3.2.2 Reduced Physical Activity

Participants observed a drop in the amount of physical activity they were receiving each week with the cancelled bus outings and shopping trips. Instead of being able to step outside the aged care facility each week, participants instead saw themselves walking less than usual. Participants also preferred being able to walk outdoors instead of indoors:

> *Level of activity dropped a little. Exercise inside room cannot compare to walking around outside. (DKBM01)*

As part of routine residential care, physiotherapists are situated within the aged care facility and conduct mobility exercises with each individual. Mobility exercises consist of assisted stretching and isolated movements to prevent pain and maintain physical health. Physiotherapists are also tasked with assisting residents with walking difficulties to walk outside and around the aged care facility. Without this assistance, some residents were not able to travel from point A to point B. According to participants, regular visits from the physiotherapists were reduced during the pandemic aged-care restrictions. Participants expressed that this reduction in physiotherapy sessions had a substantial effect on the physical activity they were able to achieve throughout the pandemic:

> *Physio was not allowed to help resident to walk outside and around the home. Physio had less time with me even when restrictions eased. (DKBM01)*

5.3.2.3 Coping with Changes to Routine and Activities

Participants clearly expressed their distress over the disruption to their daily routines and activities. However, as more time passed while experiencing the COVID-19 aged-care restrictions, participants provided insight into how they could cope with these sudden changes. Since residents had less access to the outside world, many participants explained that instead of giving in to the consequences of the pandemic, they exercised alone in their rooms or walked around the hallways of the aged care facility:

> *Was not affected. Did not stop walking around the home. Business as usual. (BBBM01)*

As already explored, daily physical activity was not the only aspect that was disrupted for residents. With reduced daily activities in which to partake, participants

found themselves with nothing to do during the aged-care restrictions. This reduced level of daily activities meant that residents were unable to see their friends as often as they wanted. Walking around the aged care facility and exercising alone in their rooms was one way to cope; however, one participant decided to take up crochet as a hobby:

> *Yeah. Because I do a lot of crochet work. To make the bags, small ones, big ones, all colours. They come from a carpet shop. I pray to my mother every day, she taught me to crochet. [Chuckles]. I couldn't sit here and do nothing. (AMBM01).*

Finally, some participants shared a more resilient approach to the COVID-19 aged-care restrictions. Instead of taking part in self-motivated exercise in their rooms or finding the need to take up a new hobby, a few participants decided to accept the world as it was and move on:

> *Not not really. Well you have to go with everybody. You gotta sit and take it really. The whole world has changed now like with the pandemic and now the weather. The weather around the world is the worst I've ever known it to be. I'm old so just gotta take it [chuckles]. (NPBM01)*

5.3.3 Effect of Aged Care Staff on Resident Wellbeing

5.3.3.1 Handling of Situation Provided Feelings of Comfort and Safety

While conducting each one-on-one interview, there was an overwhelming response regarding the level of service provided to the residents. Nearly all participants complimented and expressed their utmost respect to the aged care staff without being asked. Residents felt safe and supported during the COVID-19 aged-care restrictions, explaining it was because of how the staff handled the consequences of the pandemic. Much emphasis was placed on the thorough approach the aged care staff took to prevent the spread of COVID-19 throughout the aged care facility:

> *Yeah it hasn't affected me. See, they check every day. No one's allowed to come out unless they've been checked. They're very thorough, they do everything right here. Yeah we're safe. We're the safest place in the world, this place. You know they're very careful ... they know when you came in and when you walk out, they know exactly how you are, whether you've got it, whether you might get it or—and that's what they've gotta do. (NPBM01)*

Participants also explained that their ability to stay calm and collected was based on how the aged care staff acted. Aged care staff did not show signs of panic while in the presence of residents but instead displayed a calm attitude to residents. This display of calm assured many residents:

> *Staff was very calm and collected. They made the situation a lot more easy. (BBBM01)*

In the care of residents, aged care staff were required to wear facial masks. Participants expressed their dislike for the requirement to wear a facial mask, describing difficulties when speaking with staff, as they could not hear them properly or could not see the expressions on their faces. However, while disliking this requirement to wear masks, participants understood the importance of wearing a mask and that it contributed to feelings of safety for others. Some of these participants also felt pity for the aged care staff having to wear appropriate personal protective equipment:

> *[Chuckles] It was worse when the girls (nurses) had to wear the plastic ones ... Aw that was terrible ... for them, y'know? People (nurses) in there making their (residents) beds, showering some of them, bathing some of them, changing their clothes ... They were sweating and everything else. Oh it was awful. Even with these masks, they were sweating and everything else. (AMBM01)*

Participants showed immense appreciation for what the aged care staff endured to ensure that the residents were safe and cared for.

5.3.3.2 Although Short-Staffed, Service Experience Remained Unchanged

While participants appreciated the high-quality care provided by the aged care staff, residents were also aware of the staff shortage at the aged care facility during the pandemic. Other than the previously expressed shortage of physiotherapists, the supply of nurses at the aged care facility was also notable. Participants observed nurses receiving a great deal more work than what they could handle, forcing the nurses to work endlessly and tirelessly:

Seemingly short-staffed. (NWBM01)

They're very short, they can't get people. (NPBM01)

Although participants observed a shortage in staff, residents insisted that they were still extremely satisfied with the services received. Participants expressed their surprise at the work ethic of the nurses and wondered how the nurses remained able to visit the residents regularly:

Short-staffed at times. Didn't matter. Was still happy with the service. (NLBM01)

I don't know how they do it but they're wonderful … You know it's hard to say. They worked so hard and you know, I don't know how they do it. Cos a lot of them (other residents) were in bed or got mental problems. (AMBM01)

When asked about service quality, some participants mentioned a lack of staff before the pandemic. Participants all agreed that more staff were required for the sake of existing nurses and physiotherapists.

5.4 Summary of the Chapter

Underpinning this qualitative study was the 'content analysis' methodological approach. A total of 10 participants from the pilot intervention study were recruited from both the CVT treatment and control groups. These participants were invited to a one-on-one semi-structured interview in which individuals provided their experiences with the COVID-19 aged-care restrictions in relation to their QoL, mobility and nutrition. The guiding questions were constructed based on these aspects of healthy ageing measured in the intervention. Any additional information provided by the residents was also included in the content analysis. Transcribed audio and written responses were analysed to develop major themes and sub-themes within the text. Participant experiences comprised of three major themes: (1) reduced face-to-face contact with close ones, (2) disruption to daily routine and activities and (3) aged care staff affect resident wellbeing. Several other related sub-themes branched out under these major themes. Nutrition was not expressed by participants to be affected by the COVID-19 aged-care restrictions.

At the height of the COVID-19 aged-care restrictions, most participants expressed reduced face-to-face contact with their family and friends. Other than a minority of participants not having social contact with close ones before the pandemic, many participants felt socially isolated from family and friends. Consequently, participants felt worried and had feelings of fear during the pandemic. It was unclear to participants whether their close ones were safe from the pandemic, and they were worried that they themselves were carrying the COVID-19 virus. In contrast, some participants presented with resilience to the pandemic and were not worried by the situation. Having access to alternative contact methods, mainly over the telephone, was observed to be imperative to those feeling socially isolated. Nonetheless, these participants did not find communicating over the phone sufficient to ease their worries compared to face-to-face communication.

Along with feeling socially isolated from close ones, participants experienced major disruptions to their daily routines and activities. The cancellation of regular bus outings and shopping activities was the most frequently mentioned topic concerning activity disruption. Participants expressed frustration for the cancellation of this essential activity that allowed them to travel outside their home and enjoy the outdoors. Further, by cancelling this activity and restricting participants from walking outside their homes, participants observed a drop in the amount of physical activity in which they could

partake. Access to usual physiotherapists to support resident mobility was also reduced, adding to the substantial effect on their involvement in physical activity. However, some participants found alternative activities such as crocheting or exercising in their rooms to cope with these changes.

With the consequent feelings of anxiousness and worry introduced by the COVID-19 aged-care restrictions, participants found solace in the service provided by the aged care staff. Participants felt both supported and safe through the aged care centre's thorough approach to preventing the spread of the COVID-19 virus. While the participants appreciated the high-quality service provided by the aged care staff, participants also expressed concern about staff shortages at the aged care facility. These findings are discussed in Chapter 6 in the context of the relevant literature and in conjunction with the previously conducted pilot intervention study (see Chapter 4).

Chapter 6: Final Discussion

6.1 Introduction

A systematic review of the literature presented the potential desirable effects of VT on the health-related QoL and mobility of older adults. CVT was hypothesised to be the most viable form of VT for older adults with impaired mobility. However, there is a lack of quality evidence substantiating the effectiveness of CVT on older adults. Further, although this thesis hypothesised that VT could maintain nutrition in older adults through improved mobility, no studies have so far assessed this hypothesis. A pilot non-RCT was conducted to investigate the effectiveness of CVT on the QoL, mobility and nutrition of aged care residents. Due to the COVID-19 aged-care restrictions being introduced in the fourth week of the intervention, a separate qualitative study evaluating participant experiences with COVID-19 aged-care restrictions in relation to QoL, mobility and nutrition was conducted.

The results of the pilot intervention study and participant experiences with the COVID-19 aged-care restrictions have been previously presented in Chapters 4 and 5. Chapter 6 provides a discussion and interpretation of the research findings in the context of the literature on the healthy ageing of older adults. First, the findings of the intervention study relating to the effectiveness of CVT on the QoL, mobility and nutrition in aged care residents is discussed in the relation to the relevant literature. Next, the findings from the COVID-19 qualitative investigation will be interpreted in relation to the intervention study and relevant literature to further explain the results with CVT.

6.2 Effectiveness of Cycloid Vibration Therapy on the Quality of Life, Mobility and Nutrition of Aged Care Residents

As presented in Chapter 3's systematic review, previous studies have demonstrated the effects of VT on the mobility and QoL of older adults. No studies have previously examined the use of VT or CVT on the factors of healthy ageing, specifically the mobility, nutrition and QoL of older adults. The results of the current pilot study, as well as those with similar components to this non-RCT, are discussed below.

6.2.1 Cycloid Vibration Therapy on the Quality of Life of Aged Care Residents

The pilot non-RCT found no significant inter-group differences in either the AQoL domain (i.e., independent living, relationships, mental health, coping, pain and senses) or overall health-related QoL between the CVT and control groups. However, at six months, both groups were shown to have improved overall health-related QoL; in particular, the control group showed significant improvement in QoL compared to baseline. The changes in the QoL of the CVT treatment group were not significant. Thus, the results of this pilot study contrast with the current literature on the QoL of older adults after VT (15, 17). Previous studies, identified in the systematic review (see Chapter 3), have examined the sole effects of VT on the QoL of older adults and found significant improvements in participant QoL using the Short-Form Health Survey and BI assessment (15, 17). Several potential reasonings may explain the contradictory findings in the current pilot study.

An obvious reasoning may relate to the duration of the intervention period. Zhang et al. (15) observed significant improvements in both the physical and mental health scores of the Short-Form Health Survey after eight weeks of WBV therapy. These acute effects were compared to baseline and also their control group at the same time points (15). In Wadsworth et al.'s (17) study, 16 weeks of WBV therapy was observed to significantly improve treatment participants' QoL compared to baseline. These effects on QoL in the WBV participants were retained at six months post-treatment (17). These studies introduced similar durations of VT per week when compared to this pilot study. However, the intervention period in each previous study allowed for their participants to receive VT for an additional 4–12 weeks. The additional intervention period may have improved AQoL-6D scores in the participants of the current pilot study. However, due to COVID-19 aged-care restrictions at week four, the intervention period could not be

extended. Another potential reasoning for the contradictory findings may have been the use of different validated QoL tools among previous studies and the current study. For example, the Short-Form Health Survey tool used in Zhang et al.'s (15) study comprises only two components: mental and physical health (94). In contrast, the AQoL-6D, which was used in the present study, comprises a multidimensional perspective on the QoL of individuals (59) Therefore, the differing assessment items may explain the differences in QoL findings of the pilot study in comparison to previous studies of similar components.

6.2.2 Cycloid Vibration Therapy on the Mobility of Aged Care Residents

When examining participant mobility at six months post-treatment, the treatment group did not show improvement in mobility after four weeks of CVT compared to baseline. The control group also showed no improvements in mobility at six months when compared to baseline. No significant inter-group differences in mobility scores (PMA) were observed at six months between the treatment and control groups.

Also discussed in Chapter 3, several studies have reported significant mobility improvements with the use of VT (15, 17, 19). It is chiefly hypothesised that vibrations mechanically stimulate muscle spindles and alpha-motor neurons, initiating a muscle contraction similar to physical activity (13, 14). With muscular stimulation, VT can prevent the age-related loss of muscle (sarcopenia) and support mobility status in older adults (82). However, the current pilot study did not present any significant differences in mobility among the CVT treatment participants post-treatment. This result may also be explained by the relatively short time of the intervention period due to COVID-19 aged-care restrictions, as described earlier. In addition, while the pilot study used the PMA tool as a measure of mobility status, previous studies chose to examine other individual factors that influence an older person's mobility. These included the time taken from seated to standing (15, 17), lower extremity muscle force (15) and balance (15, 19). However, due to the wishes of the aged care staff team, determining participants' mobility using the routine PMA assessment already recorded quarterly was the safest option with a vulnerable population.

6.2.3 Cycloid Vibration Therapy on the Nutrition of Aged Care Residents

There were no significant differences in nutritional status at six months after being treated with CVT for four weeks. No changes were observed in nutritional (MNA) scores in the control group at six months. There were no significant MNA inter-group differences at six months between the treatment and control group. This pilot study was the first study of its kind to examine the effectiveness of CVT or VT on the nutrition of older adults or aged care residents. As previously hypothesised, CVT could improve the nutritional status of older adults by stimulating the muscle through mechanical oscillations. This muscle stimulation was hypothesised to prevent the age-related loss of lean muscle mass by increasing basal metabolic rate (55). With an increased basal metabolic rate, the age-related loss of appetite could be prevented (24). However, this pilot study's MNA improvements in the treatment group were not significant. Several attributing factors may be responsible for these findings.

As mentioned earlier, the intervention was shortened to four weeks instead of the 12-week intervention that was initially planned. In Clegg et al.'s (51) systematic review, one study suggested that older adults that had undertaken habitual physical activity had an increased energy intake. Rather than simulating a CVT intervention duration like habitual physical activity, the pilot study provided participants with an acute dose of CVT. Additionally, this pilot study did not observe a change in mobility score among CVT participants at six months post-intervention compared to baseline. With no change observed in mobility score among the CVT participants, the energy intake of these older adults may have remained neutral (55).

6.3 Impact of COVID-19 Aged Care Restrictions on the Quality of Life, Mobility and Nutrition of Aged Care Residents

The primary purpose of this qualitative study was to observe the experiences of the participants of the CVT pilot intervention study with COVID-19 aged care restrictions. These experiences were provided by participants in relation to the healthy ageing factors previously identified: QoL, mobility and nutrition. Three major themes, along with related sub-themes, emerged from the one-on-one interviews with these participants: (1) reduced face-to-face contact with close ones, (2) disruption to daily routine and activities and (3) aged care staff affecting resident wellbeing. Participants did not express that COVD-19 aged-care restrictions affected their nutrition. These findings are discussed below in the context of the current literature and the conducted pilot intervention study.

The content analysis observed several effects introduced by the COVID-19 aged-care restrictions that may have influenced the health-related QoL of participants. Participants were observed to experience reduced face-to-face contact with their close ones, resulting in a period of social isolation at the height of the pandemic. In editorials from the *Journal of Advanced Nursing* (110) and *Journal of Clinical Nursing* (111), it has been hypothesised and warned that the older adult population, especially those in residential aged care, would be disproportionately affected by social isolation due to COVID-19 restrictions. The findings from this study confirm these suspicions, with social isolation being detrimental to resident QoL. Participants described their experiences with social isolation due to the pandemic as ‘awful’ or ‘frustrating’. Further, in a United Kingdom survey of social support closures related to COVID-19, those older adults who could not access social support due to COVID-19 had a worse QoL and anxiety (112). The participants of this study also expressed this feeling of fear and worry due to social isolation because of COVID-19. With reduced contact with close ones, participants worried about the safety of their loved ones. Alternative contact methods, primarily through telephone, was reported by participants as a method to keep in contact with their family and friends. However, most participants agreed that this could not compare to face-to-face contact.

Participants also reported that COVID-19 restrictions disrupted several of their daily activities and routines. With the cancellation of bus outings, residents could not travel outside their homes to socialise or practise daily living activities. Deep frustration

was expressed by the participants on this matter. With ‘independent living’ as a key domain of health-related QoL (59), disruptions to essential daily activities could negatively affect an older person’s QoL. Along with social isolation and disruptions to daily routine, participants reported a reduction in the amount of physical activity they could partake in during the COVID-19 aged-care restrictions. In a mail survey of community-dwelling older adults living in Hokkaido, Japan, Makizako et al. (113) observed that approximately half of these older adults perceived declining physical and cognitive fitness during the COVID-19 state of emergency. Although some participants in the current study would instead exercise in their rooms, they still reported having a reduced amount of physical activity. As previously outlined, without sufficient physical activity, older adults are at risk of rapid age-related mobility declines (25).

As summarised previously, the effectiveness of CVT on the QoL, mobility and nutrition of older adults remain inconclusive. Although slight improvements were observed in the QoL and nutrition scores of the CVT treatment group compared to baseline, these findings were not significant. A primary reason for these findings may be the short length of the intervention because of COVID-19 aged-care restrictions. Further, participants’ experiences with the restrictions may also have contributed to the insignificance of the results. This finding, along with the further reduction in physical activity due to social isolation and cancellation of bus outings, may explain the insignificant effects of mobility scores in both the CVT treatment and control groups. Moreover, although participants expressed enjoyment of the CVT massage program, the effects of the COVID-19 restrictions may have restricted the improvement of their QoL.

6.4 Limitations

This research has several limitations that should be noted. First, due to the introduction of COVID-19 aged-care restrictions at week four of the intervention study, the CVT treatment group could not be provided with sufficient CVT treatment sessions to potentially observe an effect. The initially planned intervention period was essentially shortened. In other studies examining the effectiveness of VT in older adults (15, 17), the treatment duration for each participant was longer in comparison to this pilot intervention study. These studies observed improvements in both QoL and mobility in older adults (15, 17). Second, as previously outlined, with the presence of COVID-19 aged-care restrictions, participants expressed several possibly confounding experiences that affected their overall QoL, mobility and nutrition. However, these limitations brought on by the COVID-19 pandemic could not be helped and provides additional future directions that should be considered.

Further to the halting of the study, a second round of recruitment could not be conducted, leading to a smaller sample size for the intervention study. During the acclimatisation and main intervention phase, the research team observed a high number of new residents moving into the aged care facility where this study was conducted. There was promising potential of recruiting more participants if the COVID-19 pandemic had not occurred. Having a sufficient sample size is imperative to detect the statistical significance of an outcome measure (114). Further, having only a single intervention location prevented the study from having a higher sample size. For example, conducting a multi-centre study instead would raise the sample size and provide participants from various centres, enhancing the representativeness of the aged care resident community. However, the high retention rate and enjoyment expressed by participants validate the feasibility of conducting the study on a larger older adult population.

This study was also limited by the scarce evidence available on CVT or VT in older adults. Although a small number of studies have evaluated significant improvements in the QoL and mobility in older adults, the mechanism of VT on an older adult's healthy ageing factors lacks a proven theoretical background. Combined with even scarcer literature on CVT, the most effective protocol for conducting CVT in older adults remains inconclusive. This study attempted to provide a benchmark protocol that could improve healthy ageing factors in aged care residents. However, with the limitations

introduced by the COVID-19 aged-care restrictions, the most viable CVT protocol to improve the QoL, mobility and nutrition also remain inconclusive.

Outcome measure assessment of mobility in this study was based on regular PMA tests conducted by the aged care facility. Health-related QoL was assessed using the AQoL-6D. Previous studies used other validated assessments to produce their respective mobility and QoL findings. The limits comparisons between this study and previous studies on VT because each validated tool measured different aspects of mobility and QoL. However, as discussed previously with the aged care team, using findings measured by the experienced nurses and physiotherapists was safer for residents. Nutrition was also examined using the validated MNA tool provided by the aged care facility. There has been no evidence of VT on the nutrition of older adults. Thus, this study is the first of its kind to do so. However, this limits the conclusion of the findings, as there are no previous studies with which to compare the results. However, this pilot study has outlined the possibility of evaluating the nutrition of aged care residents, in the context of VTs.

Chapter 7: Conclusions

7.1 Introduction

A review of the literature indicated that the rapidly ageing global population has a high percentage of older adults not participating in sufficient physical activity. As physical activity is an effective means to support healthy ageing factors, promoting physical activity participation in older adults is essential. However, age-related impairments have been widely documented to prevent older adults from partaking in physical activity. The previously conducted systematic review outlined the potential benefits of VT to support healthy ageing in older adults. Further, CVT was hypothesised to be the most viable type of VT for older adults due to the device's perceived portability and safety. A pilot intervention study was conducted to investigate the effectiveness of CVT on the QoL, mobility and nutrition of aged care residents. However, due to the COVID-19 aged-care restrictions at week four of the intervention, an additional qualitative study examining the experiences of these participants with the COVID-19 aged-care restrictions in the context of the QoL, mobility and nutrition was conducted. The findings of these two studies were discussed in tandem in the previous chapter. The conclusions and limitations of the research project are presented in Chapter 7.

7.2 Conclusions

The findings of the pilot intervention study showed that four weeks of CVT on aged care residents did not significantly affect their QoL, mobility or nutrition when assessed at six months post-intervention. Therefore, no significant long-term effects could be observed after CVT usage. However, those participating in the CVT program were observed to have non-significant improvements in their QoL and nutritional status six months post-intervention. This intervention study presented potential desirable effects of CVT with only four weeks of treatment. Additionally, participants shared a variety of negative experiences related to the sudden lockdowns regarding their QoL and mobility. With residents being restricted from leaving the premises, participants reported reduced access to their friends and family. This 'social isolation' left participants feeling worried and anxious, with potential effects on their QoL. Along with social isolation, participants could not be sufficiently physically active with cancellations to their weekly bus outings.

With cancellations and current restrictions, participants also experienced less time with their physiotherapists and nurses in whom they found comfort. This reduced physical activity and less time with their physiotherapists may explain the non-existent change in participant mobility. However, in these times of susceptibility, introducing and providing the CVT massage pads during the restrictions may have made up for the insufficient physical activity. Feedback from residents participating in the CVT massage pad program observed enjoyment with the program and a strong desire to restart or bring back the intervention. The findings from this study validate the need for further research into the field of CVT or VT in aged care residents, especially if another phenomenon like the COVID-19 pandemic reoccurs.

7.3 Future Directions and Recommendations

Both the findings and limitations observed in this study present several future directions for further research. The positive participant evaluations provided by residents undertaking the CVT intervention and their desire to bring back the intervention validates further research. Unlike most VT studies in older adults, this pilot study had a very short intervention and long follow-up periods. In the planning of future research, a longer intervention study like what was originally planned (i.e., a 12-week protocol) should be implemented. This may allow for an effect to be observed like in previous studies with similar trial periods. Additionally, acute effects observed in older adults after CVT should also be considered, as this pilot study could not implement this factor. Along with a longer intervention period, using a larger sample size in future CVT research is recommended. Through a second round of recruitment, the significance of future findings can be determined with a larger sample. It is also recommended that a multi-centre study be conducted to enhance the representativeness of the sample to aged care residents. Each centre has unique daily activities and environments, and a multi-centre study would consider these factors.

References

1. Australian Institute of Health and Welfare. Older Australia at a glance. Canberra: AIHW; 2018.
2. World Health Organisation. Ageing and Health. World Health Organisation; 2018.
3. Onder G, Penninx BW, Ferrucci L, Fried LP, Guralnik JM, Pahor M. Measures of physical performance and risk for progressive and catastrophic disability: results from the Women's Health and Aging Study. J Gerontol A Biol Sci Med Sci. 2005;60(1):74-9.
4. Malafarina V, Uriz-Otano F, Gil-Guerrero L, Iniesta R. The anorexia of ageing: Physiopathology, prevalence, associated comorbidity and mortality. A systematic review. Maturitas. 2013;74(4):293-302.
5. Raggi A, Corso B, Minicuci N, Quintas R, Sattin D, De Torres L, et al. Determinants of Quality of Life in Ageing Populations: Results from a Cross-Sectional Study in Finland, Poland and Spain. PLoS ONE. 2016;11:e0159293.
6. Bangsbo J, Blackwell J, Boraxbekk C-J, Caserotti P, Dela F, Evans AB, et al. Copenhagen Consensus statement 2019: physical activity and ageing. British Journal of Sports Medicine. 2019;53(14):856-8.
7. Hallal PC, Victora CG, Azevedo MR, Wells JCK. Adolescent Physical Activity and Health. Sports Medicine. 2006;36(12):1019-30.
8. Bize R, Johnson JA, Plotnikoff RC. Physical activity level and health-related quality of life in the general adult population: A systematic review. Preventive medicine. 2007;45(6):401-15.
9. Simmonds BAJ, Hannam KJ, Fox KR, Tobias JH. An exploration of barriers and facilitators to older adults' participation in higher impact physical activity and bone health: a qualitative study. Osteoporosis International. 2016;27(3):979-87.
10. Farrance C, Tsofliou F, Clark C. Adherence to community based group exercise interventions for older people: A mixed-methods systematic review. Preventive Medicine. 2016;87:155-66.
11. Yardley L, Bishop FL, Beyer N, Hauer K, Kempen GIJM, Piot-Ziegler C, et al. Older People's Views of Falls-Prevention Interventions in Six European Countries. The Gerontologist. 2006;46(5):650-60.
12. Franco MR, Tong A, Howard K, Sherrington C, Ferreira PH, Pinto RZ, et al. Older people's perspectives on participation in physical activity: a systematic review and thematic synthesis of qualitative literature. British Journal of Sports Medicine. 2015;49(19):1268.
13. Cardinale M, Bosco C. The use of vibration as an exercise intervention. Exercise and sport sciences reviews. 2003;31(1):3-7.
14. Dipla K, Kousoula D, Zafeiridis A, Karatrantou K, Nikolaidis MG, Kyparos A, et al. Exaggerated haemodynamic and neural responses to involuntary contractions induced by whole-body vibration in normotensive obese versus lean women. Experimental Physiology. 2016;101(6):717-30.
15. Zhang L, Weng C, Liu M, Wang Q, Liu L, He Y. Effect of whole-body vibration exercise on mobility, balance ability and general health status in frail elderly patients: a pilot randomized controlled trial. Clinical rehabilitation. 2014;28(1):59-68.
16. Lievens P, Van de Voorde J. The influence of cycloidal vibrations on the knee joint mobility of osteoarthritic patients. Physiotherapy. 1984;70(6):241-3.

17. Wadsworth D, Lark S. Effects of Whole-Body Vibration Training on the Physical Function of the Frail Elderly: an Open, Randomized Controlled Trial. Archives of physical medicine and rehabilitation. 2020;101(7):1111-9.
18. Buckinx F, Beaudart C, Maquet D, Demonceau M, Crielaard JM, Reginster JY, et al. Evaluation of the impact of 6-month training by whole body vibration on the risk of falls among nursing home residents, observed over a 12-month period: a single blind, randomized controlled trial. Aging Clin Exp Res. 2014;26(4):369-76.
19. Celletti C, Fattorini L, Camerota F, Ricciardi D, La Torre G, Landi F, et al. Focal muscle vibration as a possible intervention to prevent falls in elderly women: a pragmatic randomized controlled trial. Aging Clinical and Experimental Research. 2015;27(6):857-63.
20. United Nations. World Population Prospects 2019: Highlights2019. 43 p.
21. Ageing: Healthy ageing and functional ability. World Health Organization.
22. Daskalopoulou C, Stubbs B, Kralj C, Koukounari A, Prince M, Prina AM. Physical activity and healthy ageing: A systematic review and meta-analysis of longitudinal cohort studies. Ageing research reviews. 2017;38:6-17.
23. Meier NF, Lee D-c. Physical activity and sarcopenia in older adults. Aging Clinical and Experimental Research. 2020;32(9):1675-87.
24. Blundell J, Finlayson G, Gibbons C, Caudwell P, Hopkins M. The biology of appetite control: do resting metabolic rate and fat-free mass drive energy intake? Physiology & behavior. 2015;152:473-8.
25. Insufficient physical activity. Australian Institute of Health and Welfare.
26. Lorenzen C, Maschette W, Koh M, Wilson C. Inconsistent use of terminology in whole body vibration exercise research. Journal of science and medicine in sport. 2009;12(6):676-8.
27. Lam FMH, Lau RWK, Chung RCK, Pang MYC. The effect of whole body vibration on balance, mobility and falls in older adults: A systematic review and meta-analysis. Maturitas. 2012;72(3):206-13.
28. Alvarez-Barbosa F, Del Pozo-Cruz J, Del Pozo-Cruz B, García-Hermoso A, Alfonso-Rosa RM. Effects of Whole-Body Vibration on Functional Mobility, Balance, Gait Strength, and Quality of Life in Institutionalized Older People: A Systematic Review and Meta-Analysis of Randomized Controlled Trials. Journal of aging and physical activity. 2020;28(2):219-30.
29. Fuller JT, Thomson RL, Howe PRC, Buckley JD. Vibration Therapy Is No More Effective Than the Standard Practice of Massage and Stretching for Promoting Recovery From Muscle Damage After Eccentric Exercise. Clinical Journal of Sport Medicine. 2015;25(4):332-7.
30. Sylow L, Kleinert M, Richter EA, Jensen TE. Exercise-stimulated glucose uptake-regulation and implications for glycaemic control. Nature Reviews Endocrinology. 2017;13(3):133-48.
31. Beaudart C, Maquet D, Mannarino M, Buckinx F, Demonceau M, Crielaard J-M, et al. Effects of 3 months of short sessions of controlled whole body vibrations on the risk of falls among nursing home residents. BMC Geriatrics. 2013;13(1):42.
32. Machado A, García-López D, González-Gallego J, Garatachea N. Whole-body vibration training increases muscle strength and mass in older women: A randomized-controlled trial. Scandinavian Journal of Medicine and Science in Sports. 2010;20(2):200-7.
33. Rubin C, Recker R, Cullen D, Ryaby J, McCabe J, McLeod K. Prevention of Postmenopausal Bone Loss by a Low-Magnitude, High-Frequency Mechanical Stimuli: A Clinical Trial Assessing Compliance, Efficacy, and Safety. Journal of Bone and Mineral Research. 2004;19(3):343-51.

34. Lewis SFP, Hennekens CHMDD. Regular Physical Activity: Forgotten Benefits. American Journal of Medicine, The. 2016;129(2):137-8.
35. World Health Organisation. Ageing and Health 2018 [Available from: https://www.who.int/news-room/fact-sheets/detail/ageing-and-health.
36. Health AGDo. About residential aged care 2021 [Available from: https://www.health.gov.au/initiatives-and-programs/residential-aged-care/about-residential-aged-care.
37. Rantanen T. Promoting mobility in older people. J Prev Med Public Health. 2013;46 Suppl 1(Suppl 1):S50-S4.
38. Ferrucci L, Cooper R, Shardell M, Simonsick EM, Schrack JA, Kuh D. Age-Related Change in Mobility: Perspectives From Life Course Epidemiology and Geroscience. The journals of gerontology Series A, Biological sciences and medical sciences. 2016;71(9):1184-94.
39. Ward RE, Beauchamp MK, Latham NK, Leveille SG, Percac-Lima S, Kurlinski L, et al. Neuromuscular Impairments Contributing to Persistently Poor and Declining Lower-Extremity Mobility Among Older Adults: New Findings Informing Geriatric Rehabilitation. Arch Phys Med Rehabil. 2016;97(8):1316-22.
40. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. Age Ageing. 2006;35 Suppl 2:ii37-ii41.
41. Aagaard P, Suetta C, Caserotti P, Magnusson SP, Kjær M. Role of the nervous system in sarcopenia and muscle atrophy with aging: strength training as a countermeasure. Scandinavian Journal of Medicine & Science in Sports. 2010;20(1):49-64.
42. Doherty TJ, Vandervoort AA, Taylor AW, Brown WF. Effects of motor unit losses on strength in older men and women. Journal of Applied Physiology. 1993;74(2):868-74.
43. Morley JE. Anorexia of aging: physiologic and pathologic. The American Journal of Clinical Nutrition. 1997;66(4):760-73.
44. Tsutsumimoto K, Doi T, Makizako H, Hotta R, Nakakubo S, Makino K, et al. Aging-related anorexia and its association with disability and frailty. Journal of Cachexia, Sarcopenia and Muscle. 2018;9(5):834-43.
45. Ahmed T, Haboubi N. Assessment and management of nutrition in older people and its importance to health. Clin Interv Aging. 2010;5:207-16.
46. Stratton RJ, Green CJ, Elia M. Disease-related malnutrition: an evidence-based approach to treatment: Cabi; 2003.
47. Royal Comission into Aged Care Quality and Safety. Final Report: Care, Dignity and Respect Commonwealth of Australia 2021.
48. Volkert D. Malnutrition in Older Adults - Urgent Need for Action: A Plea for Improving the Nutritional Situation of Older Adults. Gerontology. 2013;59(4):328-33.
49. Wysokiński A, Sobów T, Kłoszewska I, Kostka T. Mechanisms of the anorexia of aging-a review. Age (Dordr). 2015;37(4):9821.
50. Landi F, Calvani R, Tosato M, Martone AM, Ortolani E, Savera G, et al. Anorexia of Aging: Risk Factors, Consequences, and Potential Treatments. Nutrients. 2016;8(2):69.
51. Clegg ME, Godfrey A. The relationship between physical activity, appetite and energy intake in older adults: A systematic review. Appetite. 2018;128:145-51.
52. Genton L, Karsegard VL, Chevalley T, Kossovsky MP, Darmon P, Pichard C. Body composition changes over 9 years in healthy elderly subjects and impact of physical activity. Clinical nutrition. 2011;30(4):436-42.
53. Silver AJ, Guillen CP, Kahl MJ, Morley JE. Effect of aging on body fat. Journal of the American Geriatrics Society. 1993;41(3):211-3.

54. SJöGREN A, öSTERBERG T, STEEN B. Intake of energy, nutrients and food items in a ten-year cohort comparison and in a six-year longitudinal perspective: a population study of 70-and 76-year-old Swedish people. Age and Ageing. 1994;23(2):108-12.
55. Kyle UG, Genton L, Hans D, Karsegard L, Slosman DO, Pichard C. Age-related differences in fat-free mass, skeletal muscle, body cell mass and fat mass between 18 and 94 years. Eur J Clin Nutr. 2001;55(8):663-72.
56. Beaulieu K, Hopkins M, Blundell J, Finlayson G. Does Habitual Physical Activity Increase the Sensitivity of the Appetite Control System? A Systematic Review. Sports Medicine. 2016;46(12):1897-919.
57. Mora JC, Valencia WM. Exercise and older adults. Clinics in geriatric medicine. 2018;34(1):145-62.
58. Kindig DA, Asada Y, Booske B. A population health framework for setting national and state health goals. Jama. 2008;299(17):2081-3.
59. Allen J, Inder KJ, Lewin TJ, Attia JR, Kelly BJ. Construct validity of the Assessment of Quality of Life - 6D (AQoL-6D) in community samples. Health and Quality of Life Outcomes. 2013;11(1):61.
60. Giacalone D, Wendin K, Kremer S, Frøst MB. Health and quality of life in an aging population - Food and beyond. Food quality and preference. 2016;47:166-70.
61. Hancock S, Wells Y. The change in quality of life for older Australians: A rural and urban comparison. Australian Journal of Rural Health. 2019;27(4):322-7.
62. Rantakokko M, Portegijs E, Viljanen A, Iwarsson S, Kauppinen M, Rantanen T. Changes in life-space mobility and quality of life among community-dwelling older people: a 2-year follow-up study. Quality of Life Research. 2016;25(5):1189-97.
63. Davis JC, Bryan S, Best JR, Li LC, Hsu CL, Gomez C, et al. Mobility predicts change in older adults' health-related quality of life: evidence from a Vancouver falls prevention prospective cohort study. Health and Quality of Life Outcomes. 2015;13.
64. Goins RT, Jones J, Schure M, Rosenberg DE, Phelan EA, Dodson S, et al. Older Adults' Perceptions of Mobility: A Metasynthesis of Qualitative Studies. The Gerontologist. 2014;55(6):929-42.
65. Williams GR, Al-Obaidi M, Dai C, Mir N, Challa SA, Daniel M, et al. Association of malnutrition with geriatric assessment impairments and health-related quality of life among older adults with gastrointestinal malignancies. Cancer. 2020;126(23):5147-55.
66. Xu F, Cohen SA, Lofgren IE, Greene GW, Delmonico MJ, Greaney ML. Relationship between Diet Quality, Physical Activity and Health-Related Quality of Life in Older Adults: Findings from 2007–2014 National Health and Nutrition Examination Survey. The journal of nutrition, health & aging. 2018;22(9):1072-9.
67. MÜHlethaler R, Stuck AE, Minder CE, Frey BM. The Prognostic Significance of Protein-energy Malnutrition in Geriatric Patients. Age and Ageing. 1995;24(3):193-7.
68. La Rue A, Koehler KM, Wayne SJ, Chiulli SJ, Haaland KY, Garry PJ. Nutritional status and cognitive functioning in a normally aging sample: a 6-y reassessment. The American Journal of Clinical Nutrition. 1997;65(1):20-9.
69. World Health Organisation. Physical activity: World Health Organization; 2020 [updated 26/11/2020. Available from: https://www.who.int/news-room/fact-sheets/detail/physical-activity.
70. Dipietro L, Campbell WW, Buchner DM, Erickson KI, Powell KE, Bloodgood B, et al. Physical Activity, Injurious Falls, and Physical Function in Aging: An Umbrella Review. Medicine and science in sports and exercise. 2019;51(6):1303-13.

71. Park H, Park S, Shephard RJ, Aoyagi Y. Yearlong physical activity and sarcopenia in older adults: the Nakanojo Study. European Journal of Applied Physiology. 2010;109(5):953-61.
72. O'Keeffe M, Kelly M, O'Herlihy E, O'Toole PW, Kearney PM, Timmons S, et al. Potentially modifiable determinants of malnutrition in older adults: A systematic review. Clinical nutrition (Edinburgh, Scotland). 2019;38(6):2477-98.
73. Prevention CfDCa. How much physical activity do older adults need? | Physical Activity | CDC 2021 [updated 17/02/2021. Available from: https://www.cdc.gov/physicalactivity/basics/older_adults/index.htm.
74. Rasinaho M, Hirvensalo M, Leinonen R, Lintunen T, Rantanen T. Motives for and barriers to physical activity among older adults with mobility limitations. Journal of aging and physical activity. 2007;15(1):90-102.
75. Chen Y-M. Perceived barriers to physical activity among older adults residing in long-term care institutions. Journal of Clinical Nursing. 2010;19(3-4):432-9.
76. Kilebrant S, Braathen G, Emilsson R, Glansén U, Söderpalm A-C, Zetterlund B, et al. Whole-body vibration therapy in children with severe motor disabilities. Journal of Rehabilitation Medicine. 2015;47(3):223-8.
77. Boeselt T, Nell C, Kehr K, Holland A, Dresel M, Greulich T, et al. Whole-body vibration therapy in intensive care patients: A feasibility and safety study. Journal of Rehabilitation Medicine. 2016;48(3):316-21.
78. Beck B. Vibration Therapy to Prevent Bone Loss and Falls: Mechanisms and Efficacy. Current Osteoporosis Reports. 2015.
79. Alev A, Mihriban A, Bilge E, Ayça E, Merve K, Şeyma C, et al. Effects of whole body vibration therapy in pain, function and depression of the patients with fibromyalgia. Complementary Therapies in Clinical Practice. 2017;28:200-3.
80. Piotrowska AM, Bigosińska M, Potok H, Cisoń-Apanasewicz U, Czerwińska-Ledwig O, Tota ŁM, et al. Impact of oscillatory-cycloid vibration interventions on body composition, waist and hip circumference, and blood lipid profile in women aged over 65 years with hypercholesterolaemia. Przeglad Menopauzalny. 2018;17(4):161-7.
81. Nordlund M, Thorstensson A. Strength training effects of whole-body vibration? Scandinavian journal of medicine & science in sports. 2007;17(1):12-7.
82. Atha J, Wheatley DW. Joint mobility changes due to low frequency vibration and stretching exercise. British Journal of Sports Medicine. 1976;10(1):26-34.
83. Collado-Mateo D, Adsuar JC, Olivares PR, del Pozo-Cruz B, Parraca JA, del Pozo-Cruz J, et al. Effects of Whole-Body Vibration Therapy in Patients with Fibromyalgia: A Systematic Literature Review. Evidence-Based Complementary and Alternative Medicine. 2015;2015.
84. Bautmans I, Van Hees E, Lemper JC, Mets T. The feasibility of whole body vibration in institutionalised elderly persons and its influence on muscle performance, balance and mobility: A randomised controlled trial [ISRCTN62535013]. BMC Geriatrics. 2005;5:8P.
85. Atkin L, Stephenson J, Ousey K. Feasibility study to evaluate cycloidal vibration therapy for the symptomatic treatment of intermittent claudication. Pilot and Feasibility Studies. 2019;5:NA.
86. Jefferis BJ, Sartini C, Lee IM, Choi M, Amuzu A, Gutierrez C, et al. Adherence to physical activity guidelines in older adults, using objectively measured physical activity in a population-based study. BMC Public Health. 2014;14(1):382.
87. Page MJ, McKenzie JE, Bossuyt PM, Boutron I, Hoffmann TC, Mulrow CD, et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. BMJ. 2021;372:n71.

88. Sterne J, Savović J, Page M, Elbers R, Blencowe N, Boutron I, et al. RoB 2: a revised tool for assessing risk of bias in randomised trials. 2019 [Available from: https://sites.google.com/site/riskofbiastool/welcome/rob-2-0-tool.
89. Rydwik E, Bergland A, Forsén L, Frändin K. Psychometric Properties of Timed Up and Go in Elderly People: A Systematic Review. Physical & Occupational Therapy In Geriatrics. 2011;29(2):102-25.
90. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. Res Q Exerc Sport. 1999;70(2):113-9.
91. Lark SDP, McCarthy PWP, Rowe DAP. Reliability of the Parallel Walk Test for the Elderly. Archives of physical medicine and rehabilitation. 2011;92(5):812-7.
92. Faber MJ, Bosscher RJ, van Wieringen PC. Clinimetric Properties of the Performance-Oriented Mobility Assessment. Physical Therapy. 2006;86(7):944-54.
93. Lajoie Y, Gallagher SP. Predicting falls within the elderly community: comparison of postural sway, reaction time, the Berg balance scale and the Activities-specific Balance Confidence (ABC) scale for comparing fallers and non-fallers. Archives of Gerontology and Geriatrics. 2004;38(1):11-26.
94. Shah CH, Brown JD. Reliability and Validity of the Short-Form 12 Item Version 2 (SF-12v2) Health-Related Quality of Life Survey and Disutilities Associated with Relevant Conditions in the US Older Adult Population. Journal of clinical medicine. 2020;9(3):661.
95. Pascual JC, Belinchón I, Ramos JM. Use of the Barthel index, activities of daily living, in dermatologic surgery in patients aged 80 years and older. International Journal of Dermatology. 2015;54(2):222-6.
96. Mahoney FI, Barthel DW. Functional evaluation: The Barthel Index: A simple index of independence useful in scoring improvement in the rehabilitation of the chronically ill. Maryland State Medical Journal. 1965;14:61-5.
97. Pike E, Landers MR. Responsiveness of the physical mobility scale in long-term care facility residents. J Geriatr Phys Ther. 2010;33(2):92-8.
98. Cereda E. Mini Nutritional Assessment. Current Opinion in Clinical Nutrition & Metabolic Care. 2012;15(1).
99. McCoy CE. Understanding the Intention-to-treat Principle in Randomized Controlled Trials. West J Emerg Med. 2017;18(6):1075-8.
100. National H, Medical Research C, Australian Research C, Universities A. National statement on ethical conduct in human research 20072018 2018.
101. Tong A, Sainsbury P, Craig J. Consolidated criteria for reporting qualitative research (COREQ): a 32-item checklist for interviews and focus groups. International Journal for Quality in Health Care. 2007;19(6):349-57.
102. Teherani A, Martimianakis T, Stenfors-Hayes T, Wadhwa A, Varpio L. Choosing a Qualitative Research Approach. J Grad Med Educ. 2015;7(4):669-70.
103. Clark Bryan D, Macdonald P, Ambwani S, Cardi V, Rowlands K, Willmott D, et al. Exploring the ways in which COVID-19 and lockdown has affected the lives of adult patients with anorexia nervosa and their carers. European Eating Disorders Review. 2020;28(6):826-35.
104. Grabowski D, Meldgaard J, Rod MH. Altered Self-Observations, Unclear Risk Perceptions and Changes in Relational Everyday Life: A Qualitative Study of Psychosocial Life with Diabetes during the COVID-19 Lockdown. Societies. 2020;10(3):63.
105. Mathias K, Rawat M, Sharad P, Grills N. “We’ve got through hard times before: acute mental distress and coping among disadvantaged groups during COVID-19 lockdown in North India - a qualitative study”. International Journal for Equity in Health. 2020;19:1-12.

106. Erlingsson C, Brysiewicz P. A hands-on guide to doing content analysis. African Journal of Emergency Medicine. 2017;7(3):93-9.
107. Bengtsson M. How to plan and perform a qualitative study using content analysis. NursingPlus Open. 2016;2:8-14.
108. Krippendorff K. Content analysis: an introduction to its methodology. 2nd ed ed. Thousand Oaks, Calif: Sage; 2004 2004. 413 p.
109. Woods M, Paulus T, Atkins DP, Macklin R. Advancing Qualitative Research Using Qualitative Data Analysis Software (QDAS)? Reviewing Potential Versus Practice in Published Studies using ATLAS.ti and NVivo, 1994–2013. Social science computer review. 2016;34(5):597-617.
110. Chu CH, Donato-Woodger S, Dainton CJ. Competing crises: COVID-19 countermeasures and social isolation among older adults in long-term care. Journal of Advanced Nursing. 2020;76(10):2456-9.
111. Brooke J, Jackson D. Older people and COVID-19: Isolation, risk and ageism. Journal of Clinical Nursing. 2020;29(13-14):2044-6.
112. Giebel C, Lord K, Cooper C, Shenton J, Cannon J, Pulford D, et al. A UK survey of COVID-19 related social support closures and their effects on older people, people with dementia, and carers. International Journal of Geriatric Psychiatry. 2021;36(3):393-402.
113. Makizako H, Nakai Y, Shiratsuchi D, Akanuma T, Yokoyama K, Matsuzaki-Kihara Y, et al. Perceived declining physical and cognitive fitness during the COVID-19 state of emergency among community-dwelling Japanese old-old adults. Geriatrics & Gerontology International. 2021;21(4):364-9.
114. Faber J, Fonseca LM. How sample size influences research outcomes. Dental Press J Orthod. 2014;19(4):27-9.

Appendices

Appendix A: Search Strategy

Resource	Date Search Conducted	Search Type	Search Terms	Years Covered by Search	Refinements	Results	Search Result Refinements	Refined Results	Total Articles
MEDLINE (Pubmed) (PRIMARY)	22/02/2021	Advanced	(vibration therapy*) AND ((mobility) OR (nutrition*) OR (quality of life))	Creation-2021	Clinical trials, randomised controlled trials, 65+ years, English	98		98	342
EMBASE (PRIMARY) (drugs and therapeutics)	22/02/2021	All subjects	(vibration therapy*) AND ((mobility*) OR (nutrition*) OR (quality of life))	Creation-2021	Clinical trials, randomised controlled trials, 65+ years	65		65	
Web of Science Core Collection (Multidisciplinary)	22/02/2021	Topic	(vibration therapy*) AND ((mobility*) OR (nutrition*) OR (quality of life))	Creation-2021	Article	182	AND ((older adult*) OR (elderly))	45	
Scopus (Multidisciplinary)	22/02/2021	Title, abstract and keywords	(vibration therapy*) AND ((mobility*) OR (nutrition*) OR (quality	Creation-2021	Article	57		57	

			of life)) AND ((older adult*) OR (elderly))						
CINAHL (Cumulative Index to Nursing and Allied Health Literature) (PRIMARY)	22/02/2021	All text	(vibration therapy*) AND ((mobility*) OR (nutrition*) OR (quality of life))	Creation-2021	65+ years	39		39	
CENTRAL (Cochrane Central Register of Controlled Trials) (PRIMARY)	22/02/2021		(vibration therapy*) AND ((mobility*) OR (nutrition*) OR (quality of life)) AND ((older adult*) OR (elderly))	Creation-2021		38		38	

Appendix B: Excel ROB-2 Tool Used to Critically Appraise Included Articles

Unique ID		**Study ID**		**Assessor**	
Ref or Label		**Aim**			
Experimental		**Comparator**		**Source**	
Outcome		**Results**		**Weight**	

Domain	Signalling question	Response	Comments
Bias arising from the randomization process	1.1 Was the allocation sequence random?		
	1.2 Was the allocation sequence concealed until participants were enrolled and assigned to interventions?		
	1.3 Did baseline differences between intervention groups suggest a problem with the randomization process?		
	Risk of bias judgement		
Bias due to deviations from intended interventions	2.1.Were participants aware of their assigned intervention during the trial?		
	2.2.Were carers and people delivering the interventions aware of participants' assigned intervention during the trial?		
	2.3. If Y/PY/NI to 2.1 or 2.2: Were there deviations from the intended intervention that arose because of the experimental context?		

	2.4 If Y/PY to 2.3: Were these deviations likely to have affected the outcome?		
	2.5. If Y/PY/NI to 2.4: Were these deviations from intended intervention balanced between groups?		
	2.6 Was an appropriate analysis used to estimate the effect of assignment to intervention?		
	2.7 If N/PN/NI to 2.6: Was there potential for a substantial impact (on the result) of the failure to analyse participants in the group to which they were randomized?		
	Risk of bias judgement		
Bias due to missing outcome data	3.1 Were data for this outcome available for all, or nearly all, participants randomized?		
	3.2 If N/PN/NI to 3.1: Is there evidence that result was not biased by missing outcome data?		
	3.3 If N/PN to 3.2: Could missingness in the outcome depend on its true value?		
	3.4 If Y/PY/NI to 3.3: Is it likely that missingness in the outcome depended on its true value?		
	Risk of bias judgement		
Bias in measurement of the outcome	4.1 Was the method of measuring the outcome inappropriate?		
	4.2 Could measurement or ascertainment of the outcome have differed between intervention groups?		
	4.3 Were outcome assessors aware of the intervention received by study participants?		
	4.4 If Y/PY/NI to 4.3: Could assessment of the outcome have been influenced by knowledge of intervention received?		

	4.5 If Y/PY/NI to 4.4: Is it likely that assessment of the outcome was influenced by knowledge of intervention received?		
	Risk of bias judgement		
Bias in selection of the reported result	5.1 Were the data that produced this result analysed in accordance with a pre-specified analysis plan that was finalized before unblinded outcome data were available for analysis?		
	5.2 ... multiple eligible outcome measurements (e.g. scales, definitions, time points) within the outcome domain?		
	5.3 ... multiple eligible analyses of the data?		
	Risk of bias judgement		
Overall bias	**Risk of bias judgement**		

Appendix C: Ethical Clearance for Research Project

GRIFFITH UNIVERSITY HUMAN RESEARCH ETHICS REVIEW

Dear APro Indu Singh

I write further to the additional information provided in relation to the provisional approval granted to your application for ethical clearance for your project "Investigating the effectiveness of cycloid vibration therapy on quality of life, physical mobility, diet and pain of aged care residents" (GU Ref No: 2020/038).

This is to confirm that this response has addressed the comments and concerns of the HREC.

The ethics reviewers resolved to grant your application a clearance status of "Fully Approved".

Consequently, you are authorised to immediately commence this research on this basis.

Regards

Annmaree Jackson

Ethics Policy Officer | Office for Research
Level 0, Brae Centre | Nathan Campus | Griffith University
Phone: (07) 373 58043 | Email: Annmaree.Jackson@griffith.edu.au

Appendix D: Advertising Flyers Used to Sample Eligible Participants

Appendix E: Screening Form Used for Research Project

Griffith UNIVERSITY
Queensland, Australia

VOLUNTEER SCREENING

Project Title: Investigating the effectiveness of cycloid vibration therapy on quality of life, physical mobility and nutrition of aged care residents

Confidentiality: The information given on this form will be treated as confidential. The information will not be copied and will be destroyed if a subject is not selected for the study. Only the researchers involved will have access to this data.

Name: _____ **SUBJECT CODE** ☐ **M/F**

Date: _____

Date of Birth: _____ **Age:** **Weight:** **Height:**

VOLUNTEER INCLUSION CRITERIA:

- ☐ Aged 65 or above
- ☐ Resides in an Aged Care Facility
- ☐ Capacity to give written consent and/or verbal consent

VOLUNTEER EXCLUSION CRITERIA:

- ☐ Residents with a pacemaker
- ☐ Residents with diagnosed cardiovascular issues
- ☐ Residents with an Implantable Cardioverter Defibrillator (ICD)
- ☐ Residents with vertigo
- ☐ Residents with fibromyalgia or polymyalgia rheumatica
- ☐ Residents in palliative care
- ☐ Residents with cognitive, hearing or visual impairments (difficulty comprehending information and verbalising responses)

Thank you for your co-operation. We will be selecting a study group of 20-30 volunteers (10-15 residents participating in CVT, 10-15 residents not participating in CVT). Residents participating in CVT will have muscular stimulation sessions using cycloid vibrations for 15 minutes/day for 3 times/week. Mobility assessments of participants will be provided by Bupa for analysis, conducted as part of their routine resident care. Nutritional and quality of life (QOL) assessments will be conducted and analysed every 4-weeks for the 12-week study. Please do not be offended if you are not chosen as we would like to minimise any risks to you. We would however like to keep your name on our records for involvement with further studies if you agree.

GU ref no: 2020/038

Appendix F: Informed Consent Forms Used for Research Project

Griffith UNIVERSITY
Queensland, Australia

Consent Form

Project Title: Investigating the effectiveness of cycloid vibration therapy on quality of life, mobility and nutrition of aged care residents

Chief Investigator:	**Assoc Prof. Indu Singh**
Research Team:	**Dr. Avinash Kundur, Mrs Ginny Symons, Ms Desiree Robinson & Ms Debbie Robertson (investigators)** **Mr Ben Vu & Ms. Jissa Martin (student researcher)**
School(s)/Centre(s):	**School of Medical Science, Griffith University QLD, 4210 Australia**
Contact Phone:	**+61 (0) 7 5552 9821**
Contact Email:	**i.singh@griffith.edu.au**

VOLUNTEER INCLUSION CRITERIA:

- ☐ Aged 65 or above
- ☐ Resides in an Aged Care Facility
- ☐ Capacity to give written consent and/or verbal consent

VOLUNTEER EXCLUSION CRITERIA:

- ☐ Residents with a pacemaker
- ☐ Residents with diagnosed cardiovascular issues
- ☐ Residents with an Implantable Cardioverter Defibrillator (ICD)
- ☐ Residents with vertigo
- ☐ Residents with fibromyalgia or polymyalgia rheumatica
- ☐ Residents in palliative care
- ☐ Residents with cognitive, hearing or visual impairments (difficulty comprehending information and verbalising responses)

By signing below, I confirm that I have read and understood the information and have noted that:

- I understand that my involvement in this pilot research study may include participating in the cycloid vibration therapy sessions for 15 minutes per day, three days per week, for a total 12-week intervention period. It would also include completing questionnaires on quality of life and nutrition throughout the duration of the project (at baseline, week 4, week 8 and week 12) as well as participating in a focus group interview after the completion of the study.
- I understand that data from my physiotherapy assessments, collected as part of BUPA's routine resident care, will be provided to the research team for analysis;
- I understand that my involvement in this pilot research study will include participating in a focus group and answering structured and open-ended questions which takes around 20- 30 mins;
- I have had any questions answered to my satisfaction;
- I understand the risks involved;
- I understand that there are no direct benefits to me from my participation in this research;
- I understand that my participation in this pilot research study is voluntary;
- I understand that if I have any additional questions, I can contact the research team;

(GU Ref No: 2020/038)

Griffith UNIVERSITY
Queensland, Australia

Consent Form

- I understand that I am free to withdraw at any time, without explanation or penalty;
- I understand that my name and other personal information that could identify me will be removed or de-identified in publications or presentations resulting from this research;
- I understand that I can contact the Manager, Research Ethics, at Griffith University Human Research Ethics Committee on 3735 4375 (or research-ethics@griffith.edu.au) if I have any concerns about the ethical conduct of the project; and
- I agree to participate in the pilot study.

The Griffith University team would like to record audio during your participation in the focus group interviews to not forget or misinterpret information. The tapes will be kept safely in a locked facility until they are transcribed word for word, then they will be destroyed. The transcribed notes of the focus group will contain no information that would allow individual subjects to be identified or linked to specific statements. Participants are not required to be audio recorded and will still be able to participate in the focus group interviews without consequences.

☐ Please tick this box if you would like to consent to audio recording of your responses during the focus group interviews.

Participant ID	
Participant Name	
Signature	
Date	
Witness Name & Signature	
Date	

(GU Ref No: 2020/038)

Appendix G: Participant Information Form Used for Research Project

Griffith UNIVERSITY
Queensland, Australia

Participant Information Sheet

Project Title: Investigating the effectiveness of cycloid vibration therapy on quality of life, mobility and nutrition of aged care residents

Chief Investigator:	Assoc Prof. Indu Singh
Research Team:	Dr. Avinash Kundur, Mrs Ginny Symons, Ms Desiree Robinson & Ms Debbie Robertson (investigators) Mr Ben Vu & Ms. Jissa Martin (student researcher)
School(s)/Centre(s):	School of Medical Science, Griffith University QLD, 4210 Australia
Contact Phone:	+61 (0) 7 5552 9821
Contact Email:	i.singh@griffith.edu.au

Dear Participant,

You are invited to participate in a pilot study being conducted by Griffith University. This information sheet describes the project in a straightforward language or 'plain English.' Please read this sheet carefully and be confident that you understand its contents before deciding whether to participate. If you have any questions about the project, please ask one of the investigators.

Inclusion criteria

- Aged 65 and above
- Resides in an aged care facility
- Capacity to give written and/ or verbal consent

Exclusion criteria

- Residents with a pacemaker
- Residents with diagnosed cardiovascular issues
- Residents with an Implantable Cardioverter Defibrillator (ICD)
- Residents with vertigo
- Residents with fibromyalgia or polymyalgia rheumatica
- Residents in palliative care
- Residents with cognitive, hearing or visual impairments (difficulty comprehending information and verbalising responses)

GU Ref No: 2020/038

Griffith UNIVERSITY
Queensland, Australia

Why is the research being conducted?

The above-mentioned investigators want to evaluate if cycloid vibration massage therapy is effective in improving several aspects such mobility, nutrition and quality of life of aged care residents. Cycloid vibration therapy is essentially a massager that uses vibrations to move the muscle. This massager will be in the form of a cushion that can be placed on the person's back, legs and feet. As this massager requires no movement, any positive effects could inform the use of cycloid vibration therapy for individuals that have difficulty participating in physical activity.

Figure 1. Cycloid Vibration Massager

The results of the research will contribute towards the research students' Master of Medical Research program at Griffith University.

If I agree to participate, what will I be required to do?

If chosen for the pilot study, participants are allocated to two groups. Therefore, you may be allocated to a group that receives CVT, or not. If allocated to the group that does not receive CVT, a CVT massage cushion will still be provided for these participants after the study for free use. Participants receiving the intervention will be requested to participate in the cycloid vibration massage therapy sessions, 3 days per week for 15 minutes over a 12-week intervention period. All participants will be required to complete questionnaires on quality of life and nutrition throughout the duration of the project (at baseline, week 4, week 8 and week 12). The questionnaires will take around 20 mins to complete. Physiotherapy assessments, already conducted as part of Bupa's routine resident care, will be provided to the research team for analysis. All participants will be invited to attend a focus group interview after the end of the 12 weeks to provide their experience in participating in the study.

Participants who are already participating in the low impact exercise program cannot also take part in the cycloid vibration massage therapy program.

What are the benefits associated with participation?

There may be no direct benefits from in participating in this pilot study. Effects of CVT (either positive or negative) are not yet known in the current population, and hence why this research is being conducted. However, participants will be given a certificate of participation and appreciation from Griffith University for participating in the study. A summary on the outcome of the project will be presented to all the participants and staff of the BUPA Aged Care facility upon completion of the project.

Griffith UNIVERSITY
Queensland, Australia

What are the risks or disadvantages associated with participants?

Previous studies have observed muscular contractions when applying vibration to muscle. As this is how physical activity causes muscle soreness, cycloid vibration therapy may potentially cause this soreness.

Previous experiences of individuals with vertigo using cycloid vibration therapy have reported mild nausea. In the event that a participant experiences nausea/dizziness while participating in cycloid vibration therapy, the massage cushion will be turned off immediately.

Additionally, individuals may or may not receive the CVT (intervention/control). Potential burdens may include the time to receive CVT administration three times per week for 12 weeks and completing the required questionnaires at four time points.

What are my rights as a participant?

As a participant, you have:

- The right to withdraw participation at any time, without prejudice.
- The right to have any unprocessed data withdrawn and destroyed,
- The right to have any questions answered at any time.

The Griffith research team encourages you to discuss your decision with family members before deciding to participate in the program.

Confidentiality

All research data (questionnaire responses, analysis, photographs and recordings) will be retained in a locked cabinet and/or a password protected electronic file at Griffith University for a period of five years before being destroyed. All research data will be securely stored on the GU Research Storage platform (https://research-storage.griffith.edu.au/).

The research results will be reported to the Merrimac Bupa Aged Care Facility and may also be disseminated via journal articles and / or conference presentations. Data collected from or about you will be presented in research publications in a way that will not identify you or allow you to be identified by third parties.

Audio recordings of you will be identifiable and will only be used in research publications if you give specific consent.

Feedback to you

A summary of overall group mean and median results will be provided to you after the pilot study has been completed. No individual results will be presented.

Whom should I contact if I have any questions?

Associate Professor Indu Singh (i.singh@griffith.edu.au) or (07) 55529821

Griffith UNIVERSITY
Queensland, Australia

The ethical conduct of this research

Griffith University conducts research in accordance with the *National Statement on Ethical Conduct in Human Research*. If potential participants have any concerns or complaints about the ethical conduct of the research project they should contact the Manager, Research Ethics on 3735 4375 or **research-ethics@griffith.edu.au**.

Privacy Statement

The conduct of this research involves collection, access and/ or use of your identified personal information. The information collected is confidential and will not be disclosed to third parties without your consent, except to meet government legal or other regulatory authority requirements, A de-identified copy of this data may be for other research purposes. However, your anonymity will at all times be safeguarded. For further information please visit Griffith University's Privacy plan website at http://www.griffith.edu.au/privacy-plan

GU Ref No: 2020/038

Appendix H: AQoL-6D Tool Used to Evaluate Participant Quality of Life

Assessment of Quality of Life (AQoL- 6D)

Participant ID: Date Collected:

Q1 How much help do you need with jobs around your place of residence (eg preparing food, cleaning, gardening)?
☐ 0= I can do all these tasks very quickly and efficiently without any help
☐ 1= I can do these tasks relatively easily without help
☐ 2= I can do these tasks only very slowly without help
☐ 3= I cannot do most of these tasks unless I have help
☐ 4= I can do none of these tasks by myself.

Q2 How easy or difficult is it for you to get around by yourself outside your place of residence (eg to go shopping, visiting)?
☐ 0= getting around is enjoyable and easy
☐ 1= I have no difficulty getting around outside my place of residence
☐ 2= I have a little difficulty
☐ 3= I have moderate difficulty
☐ 4= I have a lot of difficulty
☐ 5= I cannot get around unless somebody is there to help me.

Q3 How easy or difficult is it for you to move around (using any aids or equipment you need eg a wheelchair, frame or stick)?
☐ 0= I am very mobile
☐ 1= I have no difficulty with mobility
☐ 2= I have some difficulty with mobility (for example, going uphill)
☐ 3= I have difficulty with mobility. I can go short distances only.
☐ 4= I have a lot of difficulty with mobility. I need someone to help me.
☐ 5= I am bedridden.

Q4 How difficult is it for you to wash, toilet, dress yourself, eat or care for your appearance?
☐ 0= these tasks are very easy for me
☐ 1= I have no real difficulty in carrying out these tasks
☐ 2= I find some of these tasks difficult, but I manage to do them on my own
☐ 3= many of these tasks are difficult, and I need help to do them
☐ 4= I cannot do these tasks by myself at all.

Q5 How happy are you with your close and intimate relationships?
☐ 0= very happy
☐ 1= generally happy
☐ 2= neither happy nor unhappy
☐ 3= generally unhappy
☐ 4= very unhappy

Q6 Does your health affect your relationship with your family?
☐ 0= my role in the family is unaffected by my health
☐ 1= there are some parts of my family role I cannot carry out
☐ 2= there are many parts of my family role I cannot carry out
☐ 3= I cannot carry out any part of my family role.

Q7 Does your health affect your role in your community (eg residential, sporting, church or cultural groups)?
☐ 0= my role in the community is unaffected by my health
☐ 1= there are some parts of my community role I cannot carry out
☐ 2= there are many parts of my community role I cannot carry out
☐ 3= I cannot carry out any part of my community role.

Q8 How often did you feel in despair over the last seven days?
☐ 0= never
☐ 1= occasionally
☐ 2= sometimes
☐ 3= often
☐ 4= all the time.

Q9 How often did you feel worried in the last seven days?
☐ 0= never
☐ 1= occasionally
☐ 2= sometimes
☐ 3= often
☐ 4= all the time.

Q10 How often do you feel sad?
☐ 0= never
☐ 1= rarely
☐ 2= some of the time
☐ 3= usually
☐ 4= nearly all the time.

Q11 Do you normally feel calm and tranquil or agitated?
I am
☐ 0= always calm and tranquil
☐ 1= usually calm and tranquil
☐ 2= sometimes calm and tranquil, sometimes agitated
☐ 3= usually agitated
☐ 4= always agitated.

Q12 How much energy do you have to do the things you want to do?
I am
☐ 0= always full of energy
☐ 1= usually full of energy
☐ 2= occasionally energetic
☐ 3= usually tired and lacking energy
☐ 4= always tired and lacking energy.

Q13 How often do you feel in control of your life?
☐ 0= always
☐ 1= mostly
☐ 2= sometimes
☐ 3= only occasionally
☐ 4= never.

Q14 How much do you feel you can cope with life's problems?
☐ 0= completely
☐ 1= mostly
☐ 2= partly
☐ 3= very little
☐ 4= not at all.

Q15 How often do you experience serious pain?
I experience it
☐ 0= very rarely
☐ 1= less than once a week
☐ 2= three to four times a week
☐ 3= most of the time.

Q16 How much pain or discomfort do you experience?
☐ 0= none at all
☐ 1= I have moderate pain
☐ 2= I suffer from severe pain
☐ 3= I suffer unbearable pain.

Q17 How often does pain interfere with your usual activities?
☐ 0= never
☐ 1= rarely
☐ 2= sometimes
☐ 3= often
☐ 4= always

Q18 How well can you see (using your glasses or contact lenses if needed)?
☐ 0= I have excellent sight
☐ 1= I see normally
☐ 2= I have some difficulty focusing on things, or I do not see them sharply. *E.g. small print, a newspaper or seeing objects in the distance.*
☐ 3= I have a lot of difficulty seeing things. *My vision is blurred. I can see just enough to get by with.*
☐ 4= I only see general shapes. *I need a guide to move around*
☐ 5= I am completely blind.

Q19 How well can you hear (using your hearing aid if needed)?
☐ 0= I have excellent hearing
☐ 1= I hear normally
☐ 2= I have some difficulty hearing or I do not hear clearly. *I have trouble hearing softly-spoken people or when there is background noise.*
☐ 3= I have difficulty hearing things clearly. *Often I do not understand what is said. I usually do not take part in conversations because I cannot hear what is said.*
☐ 4= I hear very little indeed. *I cannot fully understand loud voices speaking directly to me.*
☐ 5= I am completely deaf.

Q20 How well do you communicate with others (talking, signing, texting, being understood by others and understanding them)?
☐ 0= I have no trouble speaking to them or understanding what they are saying
☐ 1= I have some difficulty being understood by people who do not know me. I have no trouble understanding what others are saying to me.
☐ 2= I am understood only by people who know me well. I have great trouble understanding what others are saying to me.
☐ 3= I cannot adequately communicate with others.

Appendix I: Physiotherapy Mobility Assessment, Simplified to Evaluate Participant Mobility

Physiotherapy (Mobility) Assessment

Participant ID: Date Collected:

Supine to Side Lying

- ⌋ 0 = No active participation in rolling
- ⌋ 1 = Requires 2 staff and slide sheet
- ⌋ 2 = Requires facilitation at shoulder or at lower limb to roll
- ⌋ 3 = Requires equipment- to pull to side lying
- ⌋ 4 = Requires verbal prompting to roll, does not pull to roll
- ⌋ 5 = Independent – No assistance or prompting

Supine to Sitting

- ⌋ 0 = maximally assisted, no head control
- ⌋ 1 = Fully assisted by 2 staff but controls head position
- ⌋ 2 = Requires full assistance by 1 staff (trunk and lower limbs)
- ⌋ 3 = Requires minimal assistance with lower limbs or trunk only
- ⌋ 4 = requires verbal prompting
- ⌋ 5 = Independent and safe

Sitting Balance

- ⌋ 0= Sits with total assistance, requires head support
- ⌋ 1 = Sits with assistance, controls head position
- ⌋ 2 = Sits using upper limbs for support
- ⌋ 3 = Sits unsupported for at least 10 seconds
- ⌋ 4 = Sits unsupported, turns head and trunk to look behind and to left and right
- ⌋ 5 = Sits unsupported, reaches forward to touch floor and returns to sitting position

Sitting to Standing

- ⌋ 0 = Unable to weight bear
- ⌋ 1 = Gets to stand with full assistance from 2 staff
- ⌋ 2 = Requires own staff assist
- ⌋ 3 = Requires one staff assist
- ⌋ 3 = Pushes to stand, weight evenly distributed, supervision
- ⌋ 4 = Pushes to stand, weight evenly distributed, may require frame or bar to hold onto once standing
- ⌋ 5 = Independent, even weight bearing, hips and knees extended, does not use upper limbs

Standing Balance

- ⌋ 0 = Assistance required by staff
- ⌋ 1 = Able to stand using air or bar
- ⌋ 2 = Able to stand independently for 10 seconds
- ⌋ 3 = Able to stand independently and turn to look behind their right and left shoulder
- ⌋ 4 = Can reach with their extended arm > 10cm to the left and the right
- ⌋ 5 = Able to bend forwards to pick up any object from the floor safely

Participant ID: Date Collected:

Transfer

- ⌋ 0 = Non weight bearing hoist
- ⌋ 1 = weight bearing hoist
- ⌋ 2 = Assistance required by 2
- ⌋ 3 = Assistance required by 1
- ⌋ 4 = Supervision
- ⌋ 5 = Independent

Locomotion

- ⌋ 0 = Bed/ chair bound
- ⌋ 1 = Wheelchair mobile
- ⌋ 2 = Ambulant with the assistance of 2
- ⌋ 3 = Ambulant with the assistance of 1
- ⌋ 4 = Supervision
- ⌋ 5 = Ambulates independently

Distance walked

- ⌋ 0 = Unable to walk
- ⌋ 1 = 0 to 5 metres
- ⌋ 2 = 5 to 25 metres
- ⌋ 3 = 25 to 50 metres
- ⌋ 4 = 50 to 100 metres
- ⌋ 5 = > 100 metres

Total:

Screening Score:
(Subtotal max, 45 points)

0 – 18 points: Severe mobility impairment
19 – 27 points: Moderate mobility impairment
28 – 36 points: Mild mobility impairment
37 – 45 points: Highest independence

Appendix J: Mini Nutritional Assessment Used to Evaluate Participant Nutrition

Mini Nutritional Assessment (MNA)

Participant ID: Date Collected:

Screening

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

- ☐ 0 = severe decrease in food intake
- ☐ 1 = moderate decrease in food intake
- ☐ 2 = no decrease in food intake

B. Weight loss during the last month

- ☐ 0 = weight loss greater than 3 kg (6.6 lbs)
- ☐ 1 = does not know
- ☐ 2 = weight loss between 1 and 3kg (2.2 and 6.6lbs)
- ☐ 2 = no weight loss

C. Mobility

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

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

- ☐ 0 = Yes
- ☐ 2 = No

E. Neuropsychological problems

- ☐ 0 = severe dementia
- ☐ 1 = mild dementia
- ☐ 2 = no psychological problems

F. Body Mass Index (BMI) (weight in kg)/ (height in m^2) Calculated automatically from your information above)

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

Screening Score:
(Subtotal max, 14 points)
12- 14 points: Normal nutritional status 8-11 points: At risk of malnutrition
0-7 points: Malnourished

Name and Designation:

Total:

Signature:

Appendix K: Feedback Forms Used After Intervention Study

Griffith UNIVERSITY
Queensland, Australia

Massage Pad Program – Resident Feedback form

Project Title: Investigating the effectiveness of cycloid vibration therapy (massage pad) on the quality of life, mobility and nutrition of aged-care residents

Dear Participant, as you have previously participated in our massage pad project, we would appreciate your feedback of your experience as your perspective is valuable. We realise that you have a busy schedule and we most certainly appreciate your time.

This feedback form has been designed to assess your current/past thoughts about the massage pad program. Any comments featuring in our report will remain anonymous.

1. **What were some positive aspects about the Massage Pad Program, if any?**

_____

_____

_____

_____

2. **What were some negative aspects about the Massage Pad Program, if any?**

_____

_____

_____

_____

3. **How did you feel during the Massage Pad Program?**

_____

_____

_____

_____

4. **How do you feel currently now, without the Massage Pad Program?**

5. **What made you want to participate in the Massage Pad Program?**

6. **How can we improve the Massage Pad Program experience?**

Additional Feedback;

Thank you for participating. Your feedback will be a valuable asset to the study. We would like to again remind you that any comments featured in our report will be completely ***anonymous****.*

Appendix L: Interview Guide Used in One-on-One COVID-19 Interviews

Griffith UNIVERSITY
Queensland, Australia

COVID-19 Impacts- Cycloid Vibration Therapy Project

Project Title: Investigating the effectiveness of cycloid vibration therapy (massage pad) on the quality of life, mobility and nutrition of aged-care residents

Dear Participant, as you have previously participated in our massage pad project, we would appreciate your feedback of your experience with the COVID-19 lockdowns as your perspective is valuable. We realise that you have a busy schedule and we most certainly appreciate your time.

This feedback form has been designed to assess your current/past thoughts regarding the recent COVID-19 pandemic. Any comments featuring in our report will remain anonymous.

Main Question

1. **Has the COVID-19 lockdown affected you or your loved ones? If so, how?**

_____

_____

_____

_____

Leading questions

2. **How has the COVID-19 lockdown affected contact between yourself and your loved ones? ~~If so, how?~~**

_____

_____

_____

_____

3. **Has the COVID-19 lockdown affected any services you currently receive at your home? If so, how?**

_____

_____

_____

_____

4. How did you feel during the COVID-19 lockdown?

5. Did the COVID-19 lockdown affect your level of activity at your home? If so, how?

6. Was your nutritional intake affected during the COVID-19 lockdown? If so, how?

7. Were your daily normal activities impacted by COVID-19?

Additional Feedback;