**TITLE**

# Physical Activity and Healthy Ageing: The Psychosocial Impact of Digital Music and Movement for Care Home Residents, and the Role of Care Home Staff Wellbeing

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This is a thesis submitted to the Faculty of Health Sciences and Sport, University of Stirling, in fulfilment for the degree of Doctor of Philosophy.

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## Declaration and conflict of interest statement

I, Esther Frema Oyebola affirm that this thesis was written by me except for published parts of the thesis that were co-authored or received contributions from my colleague Len De Nys and supervisors; Prof Anna Whittaker, Dr. Jenni Connelly and Dr. Gemma Ryde. I declare that this thesis has not been submitted to or accepted by any institution for an award and all sources of background information have been duly acknowledged. There was no conflict of interest.

## Credit authorship contribution statement

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**Esther Ofosu:** Conceptualization (equal), Methodology (lead on qualitative and quantitative methods), Investigation (lead on qualitative and quantitative methods), Formal analysis (lead), Visualization, Writing – original draft preparation (equal)**. Len De Nys:** Conceptualization (equal), Methodology (lead on realist evaluation), Investigation, Formal analysis, Visualization, Writing – original draft preparation (equal). **Gemma C. Ryde:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Jenni Connelly:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Anna Whittaker:** Conceptualization, Methodology, Supervision, Writing – review & editing.

### Chapter 4

**Len De Nys:** Conceptualization (equal), Methodology (lead on physical function tests and endocrinologic markers), Investigation (lead on physical function tests and endocrinologic markers), Formal analysis (lead on physical function tests and endocrinologic markers), Visualization, Writing – original draft preparation (equal). **Esther Oyebola:** Conceptualization (equal), Methodology (lead on qualitative research and psychosocial wellbeing markers), Investigation (lead on qualitative research and psychosocial wellbeing markers), Formal analysis (lead on qualitative research and psychosocial wellbeing markers), Visualization, Writing – original draft preparation (equal)**. Gemma C. Ryde:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Jenni Connelly:** Conceptualization, Methodology, Supervision, Writing – review & editing. **Anna Whittaker:** Conceptualization, Methodology, Supervision, Writing – review & editing.

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The work within this thesis has also been presented as lay-friendly research articles and Conference posters.

**Blog posts**

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De Nys, L., **Ofosu, E**., Ryde, G. & Whittaker, A.C. (2022). danceSing Care evaluation – summary of the feasibility study. Stirling 1000 Elders blog post. https://1000elders.stir.ac.uk/2022/09/30/dancesing-care-evaluation-summary-of-the-feasibility-study%ef%bf%bc/

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**Abstract**

Promoting healthy ageing has become a priority in the health sector considering the decline in health and wellbeing associated with ageing, particularly among residents in care homes who are at higher risk of poor psychosocial wellbeing. In improving older adults' wellbeing, physical activity (PA) has been proven to have a positive multidimensional impact, thus, the primary focus of this thesis was to explore the effectiveness of digital music and movement intervention on the psychosocial wellbeing of older adults/residents and evaluate the feasibility of the intervention in care homes. Also, this thesis assessed the wellbeing of care home staff and how it relates to digital music and movement intervention implementation capacity in care homes.

Firstly, a systematic review and meta-analysis of eight randomised controlled trials and five non-randomised controlled trials were carried out to investigate the benefits of PA and the role of its dimensions on anxiety in older adults (65+ years). Results from the systematic review showed significant effects of PA (SMD = -0.41; 95% CI = -0.58, -0.24; p <.00001) on anxiety symptoms. Further analysis revealed significant effects for all PA dimensions but with differences in magnitude of effects.

Secondly, a realist evaluation was used to explore the feasibility of implementing digital music and movement intervention across ten care homes. Out of the 49 older adults recruited, 18 residents completed the baseline and post-intervention surveys on psychosocial wellbeing and a 12-week music and movement intervention of four prescribed sessions. Post-intervention interviews with a sub-sample of residents and focus groups with activity coordinators (ACs) were carried out. Digital music and movement intervention in care homes was found to be feasible but with 60% adherence rate and delivery challenges. Significant changes were reported for anxiety, depression and loneliness but not in fear of falling or quality of life. Qualitative findings emphasised improved mood, physical health and social support for residents and job satisfaction for ACs.

To further evaluate the effectiveness of digital music and movement interventions on the psychosocial wellbeing of residents, a pilot mixed methods study with 34 older adults across four care homes were recruited into intervention and waitlist control groups. The intervention lasted for 12 weeks with three sessions prescribed weekly, but the waitlist control condition was not adhered to during the study. Surveys on multidimensional health markers were conducted at baseline and post-intervention with process evaluation and monitoring throughout the study. A sub-sample of residents and ACs were interviewed after

the intervention. Results showed significant improvements in anxiety, fear of falling and loneliness. Qualitative findings highlighted the benefits and challenges of the intervention and supported findings from the process evaluation monitoring.

Finally, a secondary data analysis of care home staff wellbeing survey that recruited 198 staff was conducted. Staff were grouped according to roles and questioned on psychosocial and physical wellbeing aspects as these were deemed to be linked to digital music and movement intervention implementation capacity in care homes. Results showed staff that provide direct care to residents have poorer wellbeing when compared to staff that do not provide direct care to residents. Poorer wellbeing may be attributed to working conditions and aspects of the role which previous studies indicate can impact delivery of digital muic and movement interventions. Qualitative findings from the survey revealed themes such as work-life balance, job satisfaction and impact of work and made recommendations for improving wellbeing.

Collectively, this thesis supports the importance of music and movement on the psychosocial wellbeing of older adults especially among residents in care homes. Optimising the effects of music and movement on psychosocial wellbeing of residents is dependent on the dose of the intervention, the successful facilitation and implementation of digital music and movement in care homes, and the improvement of care home conditions for staff.

**List of acronyms**

AC - Activity Coordinator

AG – Advisory Group

ANOVA – Analysis of Variance

BPS – British Psychological Society

CCH – Christadelphian Care Homes

CH- Care Home

CMO- Context Mechanism Outcome

Dartmouth COOP – Dartmouth Cooperative

EQ-5D-3L - European Quality of Life 5 Dimensions - 3 Level Version

FES-I – Falls Efficacy Scale- International

HADS – Hospital Anxiety Depression Scale

HPA – Hypothalamic Pituitary Adrenal

ITT – Intention-to-threat

JBI – Joanna Briggs Institute

M – Mean

PA – Physical Activity

PICO – Population, Intervention, Comparator, Outcome

PIS - Participant Information Sheet

RCT – Randomised Controlled Trial

RoB – Risk of Bias

SD- Standard Deviation

SMD – Standardised Mean Difference

ULS-6 – Brief University of California Loneliness Scale

WHO – World Health Organisation

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# Chapter 1: Introduction

## 1.1 The Concept of Healthy Ageing

Ageing is a process that everyone goes through and a natural part of life. It is estimated that by 2030, one in six people worldwide will be aged 60 years or above and this increase is being reported worldwide (World Health Organisation, 2022a). Another projection suggests that the population of older adults aged 65 years and above is estimated to double, from 703 million in 2019 to 1.5 billion by 2050 (United Nations Department of Economic and Social Affairs, 2019) with reports that between 2020 and 2050, the population of older adults aged 80 years and above will triple to about 426 million (World Health Organisation, 2022a). These trends are also being reported in the United Kingdom (UK). According to data from the Office for National Statistics (2018), an estimation made in 2016 showed that by 2066, the population of older adults 65 years and above will increase by approximately 8.6 million (see Figure 1).

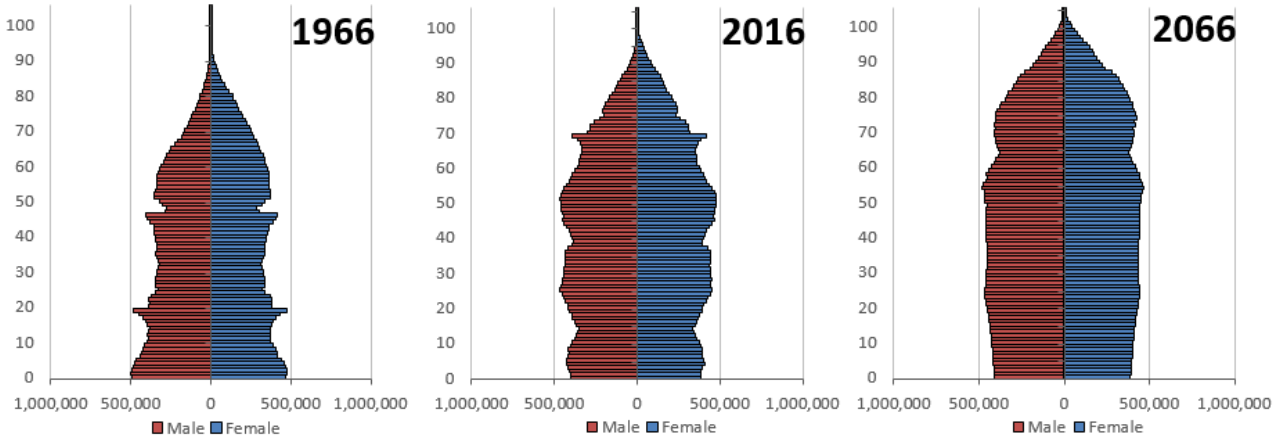


Figure 1: Population pyramids, 1966, 2016, and 2066 (principal projection), UK

Source: Population estimates, Principal population projections, 2016-based, Office for National Statistics

Also, a more recent census has reported the number of older adults aged 85 years and over made up 2.5% (1.7 million) of the UK population in 2020 and this is expected to increase to 4.3% (3.1million) by 2045, with this age group experiencing the fastest growth (Office for National Statistics, 2022). This dramatic increase in the number of older adults reflects a lengthened lifespan as a result of improved sanitation and hygiene, nutrition, housing, control of infectious diseases and other public health measures effects on mortality

rates (Brown, 2015). Although the speed of increase in longevity over recent decades is levelling out, the overall effect of longer lifespans means that a significant proportion of the population is classified as older adults (Office for National Statistics, 2021).

This increasing proportion of older adults comes with challenges and benefits. There are negative implications affecting the nation's economy (finance, labour force, tax), services (housing, transport, health, and social care), society (crime, inclusion), and the individual (wellbeing) (Office for National Statistics, 2018). The ageing population also comes with economic and social benefits. According to King (2008), older adults are needed to age healthily and feel capable as society needs the involvement of older adults to reach its full potential. However, challenges arise when older adults do not age healthily. One major challenge of unhealthy ageing is the cost of health and social care (Fogg et al., 2024). Based on reports from the Office for Budget Responsibility (United Kingdom), health spending increases as the population ages with a sharp surge recorded for late life stages (see Figure 2). The cost of healthcare for older adults is projected to rise considering the rapidly growing aged population and increased life expectancy, unless the increased years are spent in good health (Licchetta & Stelmach, 2016).

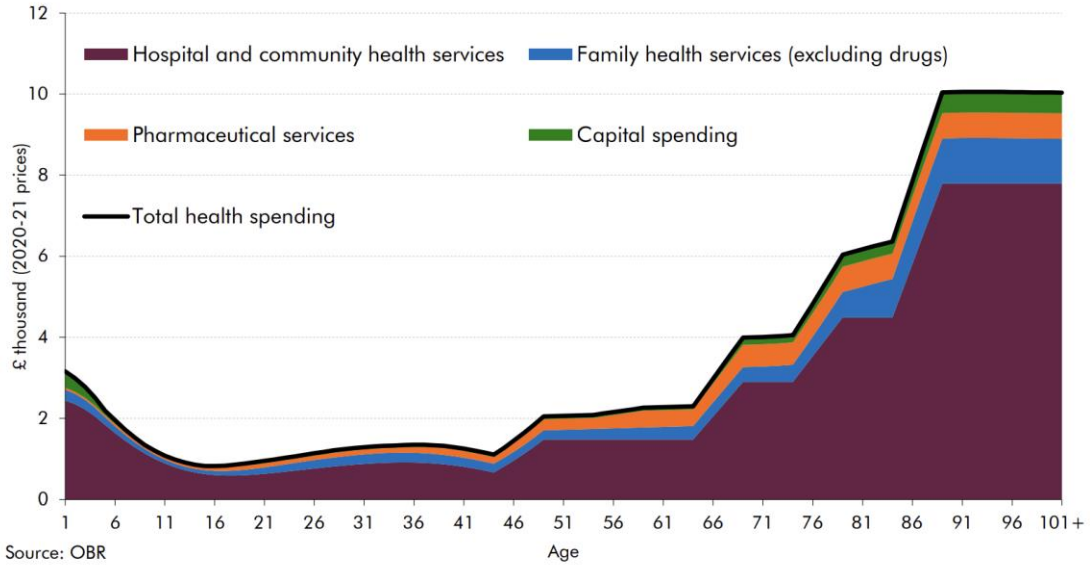


Figure 2: Representative profile for age-related health spending used in long- term fiscal sustainability report projections (Licchetta & Stelmach, 2016).

For this reason, promoting healthy ageing has become one of the prioritised areas of global and national development. This is in line with the World Health Organisation (WHO)'s declaration of a decade of Healthy Ageing (2021-2030) which has been set out to address the perceptions of ageing, promote person-centred primary health care, and long-term

care (if needed) (World Health Organisation, 2020). Also, as part of this 2030 agenda, the WHO seeks to develop communities to create an environment that can help older adults maximise their capabilities. Promoting healthy ageing covers physical, mental, and social wellbeing (Menassa et al., 2023). In one study, older adults were interviewed to get a sense of what healthy ageing meant to them rather than going with the general assumption of what healthy ageing entails (Stephens et al., 2015). From 145 interviews, older adults reported physical comfort, social integration, security, autonomy, and enjoyment (Stephens et al., 2015). Physical comfort, according to the participants interviewed, focused on individualised basic needs (food, accommodation, clothing, and health care) which took into consideration their preferences. Also, older adults explained that social integration and security meant having a sense of belongingness, engaging in social activities, spending time with friends and family, feeling safe in the environment, and knowing that their finances are well managed. Lastly, according to Stephens et al., (2015), autonomy and enjoyment cover the freedom to make choices, engage in pleasurable activities and have unrestricted access to public social services. Similar to findings from Stephens and colleagues, the World Health Organisation defines healthy ageing as developing and sustaining functional ability in older adults that promotes wellbeing where functional ability involves the capacity to move, make choices, build social connections, and meet basic needs in an enabling environment (Cesari et al., 2022; World Health Organisation, 2015). Functional ability in this context incorporates the factors of intrinsic capacity and environment that help people to be themselves and engage in activities that are valuable to them. This is to say, a good balance between individuals' social, physical and mental capabilities can enhance healthy ageing and promote wellbeing in older adults.

Unfortunately, healthy ageing is not always possible due to the decline in health and wellbeing associated with ageing. The possibility of developing a chronic illness and other complex health conditions increases with age and these can lead to a loss of independence and quality of life (Prasad et al., 2012). In 2016, a health survey in England showed that 29% of older adults from the ages of 60 to 64 years had two or more chronic conditions and this estimation nearly doubled for older adults aged 75 years and above (Office for National Statistics, 2018). Being diagnosed with two or more long-term medical or psychiatric conditions which directly or indirectly interact to negatively affect the wellbeing of an individual is known as multimorbidity (National Institute for Health and Care Excellence, 2016). Multimorbidity is very common in the aged population. In a systematic review, about 95% of older adults aged 65 years and above in the primary care setting had multiple health

conditions (Violan et al., 2014). This high prevalence of multimorbidity in older adults was reported in another study carried out in Scotland's primary care sector which saw a multimorbidity prevalence of 81.5% in older adults 85 years and above (Barnett et al., 2012). As one ages, a series of physical, mental, cognitive, and social changes are experienced (World Health Organisation, 2015). Some of these changes have been attributed to a lack of social connectedness, biological, and physiological processes (e.g., decline in immunity and presence of multiple illnesses) (Weyand & Goronzy, 2016). Corresponding to this, the biopsychosocial model of health stipulates that health decline and illness in older age are associated with biological and physical changes but also with psychological, behavioural, and social factors, and these factors combine to result in older adults' vulnerability to onset and progression of chronic diseases (Rook et al., 2011). These changes and decline in functionality negatively affect aspects of older adults' wellbeing (Steptoe et al., 2015).

### 1.2 Components of Psychosocial Wellbeing

Wellbeing in older adults is multidimensional and encapsulates different aspects of people's life (Halleröd & Seldén, 2013). Although wellbeing components include physical, psychological, social and financial aspects; psychological and social factors are evolving as the main determinants of healthy ageing (Kim et al., 2021; Saadeh et al., 2021). Psychological and social aspects of wellbeing (psychosocial wellbeing) focus on the relevance of positive mental health, social connections, sense of belongingness and social participation on wellbeing, such that, older adults with higher psychosocial wellbeing are more likely to live longer and healthier (Holt-Lunstad et al., 2015; Martín-María et al., 2017; Zaninotto & Steptoe, 2019). It is therefore important to acknowledge the contribution of psychosocial wellbeing on the overall wellbeing of older adults. Components of psychosocial wellbeing of older adults that were of interest in this thesis are anxiety, depression, fear of falling, loneliness, and quality of life. The subsequent paragraphs set the premise and rationale for focusing on the psychosocial wellbeing components stated.

*Anxiety and Depression in older adults*

Anxiety and depression are among the most common mental health conditions among older adults and are mostly comorbid (Wolitzky-Taylor et al., 2010). Anxiety is a psychological condition characterised by apprehensive expectation or fear (American Psychiatric Association, 2013b). Other symptoms of anxiety may be affective (nervousness, constant worry, feeling tense and restless) and/or physiological (trembling, rapid breathing

and increased heart rate) (Herring et al., 2010; Stonerock et al., 2016). These symptoms of anxiety are not always negative, in some cases anxiety is a natural emotion or a prompt to incoming danger (Gutiérrez-García & Contreras, 2013). However, anxiety has a negative impact when it is consistent, and the reactions elicited are irrational in comparison to the threat (Gutiérrez-García & Contreras, 2013). The negative impact of anxiety in older adults includes increased risk of mortality (Ostir & Goodwin, 2006; Tolmunen et al., 2014), poor quality of life (Ribeiro et al., 2020), cognition (Wolitzky-Taylor et al., 2010) and physical health conditions such as cardiovascular disease (Celano et al., 2016; El-Gabalawy et al., 2011; Gallagher et al., 2012). There have been variations in the prevalence of anxiety based on differences in locations, age, gender, socioeconomic status, culture and methodological factors such as diagnostic tools and time of prevalence (Baxter et al., 2013). However, as of 2017, the World Health Organisation reported that 3.8% of older adults are affected by anxiety disorders globally (World Health Organisation, 2017). Then again, according to Age UK, this figure is suggested to be higher with 34% of older adults aged 60 years and above reported anxiety symptoms (Age UK, 2020). In terms of years lived with disability, anxiety is the sixth leading cause of disability (Baxter et al., 2014). In a longitudinal study, a high prevalence of anxiety symptoms was recorded amongst 506 older adults aged 75 years and above and increased anxiety was associated with increased risk of death (all cause, cancer and cardiovascular deaths) (Ostir & Goodwin, 2006). Overall, the negative effects of anxiety symptoms and/or disorders are evident (Ribeiro et al., 2020; Wolitzky-Taylor et al., 2010), even though anxiety symptoms are commonly reported among older adults as compared to anxiety disorders (Koychev & Ebmeier, 2016; Wolitzky-Taylor et al., 2010). Anxiety in older adults often goes undiagnosed and this may be due to the masking of anxiety disorders with symptoms of physical disorders or other comorbid illnesses (Koychev & Ebmeier, 2016). Therefore, this thesis focused on anxiety symptoms and/or anxiety disorders.

Depression is one of the major components of psychosocial wellbeing in older adults with up to 7% of older adults experiencing depression (World Health Organisation, 2017). Depression is a mood disorder with symptoms including feelings of sadness, hopelessness, worthlessness, loss of interest in activities, changes weight/appetite and suicidal ideation (Tolentino & Schmidt, 2018). According to the DSM-V, there are six types of depressive disorders namely, (1) major depressive disorder, (2) substance and medication-induced depressive disorder, (3) depressive disorder due to another medical condition, (4) persistent depressive disorder, (5) premenstrual dysphoric disorder and (6) disruptive mood dysregulation disorder (American Psychiatric Association, 2013b). Similar to the negative

effects of anxiety, high levels of depressive symptoms has been associated with low quality of life (Ribeiro et al., 2020). Also, in a cross-sectional study of 7872 older adults, 9.4% reported being depressed and depression was associated with an 80% increased risk of cardiovascular disease (Gallagher et al., 2012). In this study, low mood, sadness, fatigue, reduced appetite, concentration difficulties and lack of motivation were the symptoms of depression constantly related to cardiovascular disease (Gallagher et al., 2012). In addition to these, depression disorders can result in increased risk of cognitive decline (Muhammad & Meher, 2021), suicide (Fernandez-Rodrigues et al., 2022) and poor sleep quality (Becker et al., 2016). As above, depressive symptoms in the absence of a depression disorder diagnosis are commonly reported among older adults and are detrimental to quality of life and wellbeing (Fernandez-Rodrigues et al., 2022; Ribeiro et al., 2020). Consequently, in the present thesis, symptoms rather than diagnosis were the focus.

Some older adults are at risk of experiencing both depression and anxiety symptoms due to a range of factors including cognitive impairment, chronic physical and mental health disorders, adverse life events, lack of social support/connectedness and financial problems (Maier et al., 2021; Zhang et al., 2015). Anxiety and depression are often misdiagnosed or underdiagnosed in older adults due to factors such as older adults' difficulty in communicating symptoms, the side effects of polypharmacy and symptoms that mimic those of other health conditions, though these conditions are the two most common psychological conditions that affect older adults (Allan et al., 2014; Bryant, 2010; Koychev & Ebmeier, 2016). Despite the negative impact, high occurrence and high comorbidity of anxiety and depression in older adults (Beekman et al., 2000; Curran et al., 2020), anxiety is under studied as compared to depression (Byrne & Pachana, 2010; Stonerock et al., 2016).

### *Fear of falling*

Fears about falling in some cases are linked to anxiety symptoms affecting over 50% of older adults in long term care settings (Lach & Parsons, 2013; Pary et al., 2019; Payette et al., 2017). Fear of falling is a lasting concern that leads to individuals avoiding activities they are capable of performing (Chang et al., 2016). This means older adults with a fear of falling are less active resulting in an increased risk of falls, less engagement in physical and social activities, loss of confidence, poor quality of life, frailty, anxiety, depression, and physical weakness (Asai et al., 2022; Birhanie et al., 2021; Curcio et al., 2009; da Costa et al., 2012; de Souza et al., 2022; Li et al., 2019; Van Haastregt et al., 2008). Fear of falling in older adults can be a result of several factors that predispose older adults to this fear. In a scoping

review, 46 articles identified fear of falling to be highly associated with older age, psychological status (anxiety and or depression), gender, previous falls, poor physical performance, cognition and health factors (MacKay et al., 2021). Other studies reported gender differences in the factors that have been associated with fear of falling (Birhanie et al., 2021; Lim, 2016; Wang et al., 2021). For example, in a study by Chang et al., (2016), a high prevalence (63%) of fear of falling was reported for females and diagnosed cardiovascular disease was the common factor associated with fear of falling for this group. On the other hand, medical emergencies, diabetes mellitus, and stroke were factors reported by males to affect their reported fear of falling (46%) (Chang et al., 2016). These are aside from the common factors reported by both groups (older age, insomnia, depression and poor subjective health) (Chang et al., 2016). Other causal factors such as poor vision, reduced capabilities, decreased social contacts, living alone and frailty may create concerns about falling in older adults. The consequences that come with the fear of falling impact the wellbeing of older adults and thus measures such as psychotherapy and environment interventions (such as walking aids and removing floor hazards) have been studied regarding how they help to boost the confidence of older adults and reduce fear of falling (Clemson et al., 2023). However, there have been questions about the efficiency of these interventions as compared to other interventions such as exercise (Gillespie et al., 2012). It has been recorded in a scoping review that about 20% to 39% of older adults have a fear of falling (Whipple et al., 2018) and up to 30% of older adults may fall in a year (Gillespie et al., 2012). Similar to this, a European study showed that about 37% of older adults in the United Kingdom reported moderate to high fear of falling (Korenhof et al., 2023). This prevalence shows how common the fear of falling is among older adults, but effective ways of managing the fear of falling have not been addressed extensively with precise recommendations tailored for older adults in different settings and circumstances (Gillespie et al., 2012; Whipple et al., 2018).

*Loneliness*

Given the noted importance of social as well as psychological and bio/physiological changes in ageing contributing to health in older adults (Rook et al., 2011), it is also important to consider social factors that are particularly relevant to older adults' wellbeing; one such factor is loneliness. About 50% of older adults are at risk of being lonely and an estimated one-third are experiencing loneliness to an extent in the United Kingdom (Fakoya et al., 2020; Landeiro et al., 2017). Loneliness has been defined as "a subjective negative feeling associated with a perceived lack of a wider social network (social loneliness) or the

absence of a specific desired companion (emotional loneliness)" (Valtorta & Hanratty, 2012, p.518). Loneliness and social isolation (tangible absence of strong and supportive social networks) (Taylor, 2020) have been likened together and have a relationship such that they are both characterised by feeling alone but are different (Fakoya et al., 2020). There is an increased risk of loneliness in older adults due to factors like bereavement, living alone, poor perceived health, never married or partnered, and limited social network and activities as reported in a systematic review of 34 longitudinal studies (Dahlberg et al., 2022). Loneliness has been found to increase the risk of depression (Gonyea et al., 2018; Lee et al., 2021), mortality (Luo et al., 2012; Tilvis et al., 2011), cognitive impairment (Boss et al., 2015; Harrington et al., 2023; Zhong et al., 2017), and worsened overall health (Dong et al., 2012). These have made loneliness in older adults a major concern and point to the need for interventions to reduce loneliness to the extent that the United Kingdom has launched a campaign to end loneliness (Age UK, 2011; Taylor, 2020).

*Quality of life*

Quality of life is a concept which covaries considerably with the psychosocial variables already considered above. Quality of life progressively declines with ageing (Ribeiro et al., 2020; Sewo Sampaio & Ito, 2013). There have been variations in the definition of quality of life, definitions include: 1) an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (World Health Organisation, 1997); 2) overall general wellbeing that comprises objective descriptors and subjective evaluations of physical, material, social, and emotional wellbeing together with the extent of personal development and purposeful activity, all weighted by a personal set of values (Walker, 2005); 3) subjective wellbeing or judgments regarding overall satisfaction with life (Motl & McAuley, 2010); and 4) subjective assessment of one's life (Pawlaczyk et al., 2017). The common themes that run through these definitions are subjective wellbeing and life as a whole. Quality of life is multidimensional as it takes into account the physical health, psychological, and social aspects of life (WHOQOL Group, 1998). Some domains and constructs of quality of life include autonomy, role and activity, health perception, relationships, attitude and adaptation, emotional comfort, spirituality, home and neighbourhood, and financial security. Chronic conditions, comorbidity, and disability put older adults at risk of poor quality of life (Forjaz et al., 2015). In older adults, this subject covers aspects of maintenance of independence, autonomy, adaptability, social participation,

and social role function (Van Leeuwen et al., 2020; Walker, 2005). Similarly, good quality of life means healthiness, peace, happiness, harmony, and life satisfaction to older adults (Marques et al., 2014). Therefore, poor quality of life has detrimental effects on the overall wellbeing of older adults thus it is an important construct that has to be considered in promoting healthy ageing.

These psychosocial aspects of ill-being are highly prevalent and common in older adults thus possible approaches and interventions to manage or reduce the risk of these problems should be prioritised and adequately assessed among older adults in different settings to promote healthy ageing.

### 1.3 Psychosocial Wellbeing in Care Home Residents

As mentioned earlier, the global increase in the ageing population and life expectancy, especially in developed countries, means that many older adults will require services and support in later life given the age-related decline in health, capabilities, and in most cases reduced or low social support that comes with ageing (Shvedko et al., 2018). To meet the needs of older adults, long-term care and support come as an option for older adults either in their respective homes or in facilities such as hospitals and care homes. Hospitals may not be the most ideal for long-term care for older adults as a recent study revealed hospitalisation may result in (1) inadequate provision of the holistic care and support required by older adults (2) high cost to the health sector, (3) tendency to reduced physical capabilities, especially mobility and (4) exposure of older adults to infections considering the decline in immunity associated with ageing (Montecino-Rodriguez et al., 2013; Shepperd et al., 2022). For this reason, residential care homes also known as aged-care facilities or long-term care facilities are recommended to house and provide individualised care to older adults.

In the United Kingdom, there are about 17,100 care homes with over 408,000 residents (Munson, 2022). The increasing ageing population in the UK is reflected in the population of residents in care homes. Care homes provide health and personal care, and social support, assist older adults with daily activities, and are categorised into two groups: residential and nursing homes. Residents in nursing homes require around-the-clock medical or nursing care whereas in residential care homes, residents may be more independent and not require constant nursing care (Alldred et al., 2016). Other than the services stated above, care homes also provide other care services including mental health, palliative, end-of-life, convalescent, respite, and rehabilitative care to residents (Munson, 2020). To guarantee that care homes serve their purpose, the Care Quality Commission ensures that the quality of care

given to care home residents are standard and have a positive impact on their wellbeing. The Care Quality Commission has set out standards, guides, and standard operating procedures for care homes nationwide to promote improved care home services (Care Quality Commission, 2023). In Scotland and Wales, the equivalent of the Care Quality Commission is the Care Inspectorate and the Care Inspectorate Wales, respectively.

Residents in care homes just like some older adults in different settings may be considered as a vulnerable group and likely to experience a negative impact on their psychosocial wellbeing with some level of frailty (Alldred et al., 2016). Anxiety (Creighton et al., 2016) and depression (Gleeson et al., 2019; McDougall et al., 2007; Sutcliffe et al., 2007) are two of the most common mental health problems encountered by residents in care homes and are often comorbid (Ulbricht et al., 2019). In some cases, depression and anxiety have been attributed to living in care homes such as the stress of relocation to care homes, loss of independence, and lack of preferred care, attention, and social support (Jongenelis et al., 2004; Polacsek & Woolford, 2022). Anxiety has also been strongly associated with fear of falling (Payette et al., 2017). Fear of falling is highly prevalent among residents in care homes. It is reported that over 50% of residents living in care homes have a fear of falling and are three times more likely to fall than community dwelling older adults (Lach & Parsons, 2013; Logan et al., 2022). This discourages many residents from being physically active thus resulting in poor mobility and quality of life, and increased numbers of falls and dependence (Lach & Parsons, 2013). Loneliness and poor quality of life are other aspects of psychosocial ill-being common among care home residents (Pawlaczyk et al., 2017; Shvedko et al., 2018). For example, the average prevalence of loneliness among care home residents ranges from 35% (severe loneliness) to 61% (moderate loneliness) (Gardiner et al., 2020). All these aspects of psychosocial wellbeing among residents in care homes are interconnected and comorbid (Hoe et al., 2006; Kaelen et al., 2021; Lach & Parsons, 2013; Ulbricht et al., 2019). Consequently, it is possible for one psychosocial variable such as depression to influence the extent to which one might isolate and be lonely which may translate into poor quality of life. Other than the conditions in the care home being risk factors for the poor psychosocial wellbeing of care home residents, other risk factors include negative life events, pain, impairments (especially cognitive and visual), medical conditions, and social isolation (Boorsma et al., 2012; Petrova & Khvostikova, 2021). Due to the multimorbidity of older adults especially among residents in care homes who have higher frailty levels than those dwelling in the community (Collard et al., 2012; Kojima, 2015), interventions to address these factors should be tailored to such populations and their effects adequately evaluated.

## 1.4 Addressing Psychosocial Wellbeing for Healthy Ageing

The increase in the ageing population has become a global concern and can be alarming when the resources and support needed to promote healthy ageing do not correspond with this increase. Identifying potential interventions to promote healthy ageing, specifically psychosocial wellbeing, has received a lot of attention. Several ways of managing the psychosocial wellbeing of older adults have been adopted such as medications (Crocco et al., 2017; Wiese, 2011) and psychotherapy (Pachana et al., 2013). Pharmacology and psychotherapy have been effective in managing mental health problems in older adults, but these methods have come with some downfalls. For example, the use of antidepressants in older adults has been associated with an increased risk of adverse outcomes such as falls, hyponatremia, stroke, fractures, osteoporosis, epilepsy/seizures, attempted suicides, and self-harm (Coupland et al., 2011; Taylor, 2015). Similarly, benzodiazepines which are anti-anxiety drugs have been reported to put older adults at risk of cognitive impairment, falls, and fractures (Bourin, 2010; Lenze et al., 2003; Uzun et al., 2010). Other than these risks, other concerns have been raised including the high cost of health care, the burden on the healthcare sector and the economy (The Lancet Global Health, 2020). It is estimated that the effects of mental health problems (reduced productivity and cost of health care) will cost the world economy $6 trillion per year by 2030 (The Lancet Global Health, 2020). For these reasons, there has been a need to examine other effective options for managing and treating psychosocial issues among older adults which could eventually meet some of the healthcare needs of this ageing population.

## 1.5 Physical Activity for Healthy Ageing

Physical activity (PA) has emerged as one of the most cost-effective and safe ways of promoting psychosocial wellbeing in older adults with little to no side effects (Gammack, 2017). In terms of PA being safe, the World Health Organisation, UK and USA Departments of Health PA guidelines have considered PA safe for older adults and in some cases does not require a medical practitioner's approval before participating (UK Department of Health, 2011; US Department of Health and Human Services, 2009; World Health Organisation, 2020). Physical activity as reflected in this study denotes "any bodily movement produced by skeletal muscles that result in energy expenditure", and exercise as a subset of physical activity has been typically defined as a planned, structured, and repetitive bodily movement done to maintain and improve components of physical fitness (Caspersen et al., 1985, p.126).

This definition has also been adopted by the World Health Organisation (World Health Organisation, 2022b). The World Health Organisation has recommended that older adults engage in at least 150 to 300 minutes of moderate intensity aerobic PA or 75 to 150 minutes of vigorous intensity aerobic PA or an equivalent combination of moderate and vigorous intensity activity throughout the week, for substantial health benefits (World Health Organisation, 2020). For added benefits, the duration of moderate intensity and vigorous intensity aerobic PA may be increased to more than 300 minutes and more than 150 minutes respectively (World Health Organisation, 2020). In addition to this, older adults are advised to participate in moderate or high intensity muscle-strengthening activities engaging all major muscle groups for a minimum of two days a week. Again, it is recommended that for improvement in functional capacity and falls prevention, older adults should do a variety of multicomponent PA that focuses on functional balance and strength training at moderate or high intensity three or more days a week (World Health Organisation, 2020).

### 1.6 Physical Inactivity and Healthy Ageing

Regardless of the evidence on the positive effects of PA, the majority of older adults are inactive or do not meet the PA recommendations (McPhee et al., 2016). In 2019, a survey by Age UK showed that 29% of older adults aged 65 to 74 years were physically inactive, and this rate increased with age (Age UK, 2019). The rate of physical inactivity in older adults from 75 to 85 years and 85 years and above was 47% and 70% respectively (Age UK, 2019). According to the World Health Organisation, physical inactivity increases the risk of death and is the fourth leading cause of mortality (World Health Organisation, 2010). The extent of the impact of inactivity on older adults' physical fitness has been likened to smoking, excessive alcohol consumption, and obesity combined (Lee et al., 2012). Due to the negative consequences of inactivity, less PA is better than none considering PA is safe for both healthy and frail older adults (McPhee et al., 2016; Rodriguez-Larrad et al., 2021). As part of the World Health Organisation recommendations, older adults who cannot do the recommended dose of PA due to health conditions should engage in as much PA as possible based on their capabilities. Bouts of exercise can be effective as well (Ofosu et al., 2023b; Powell et al., 2011). Barriers to PA may be based on social, economic, cultural, and health factors. In four focus groups, older adults discussed barriers to PA which included physical limitations, lack of professional supervision, and lack of information on PA available (Bethancourt et al., 2014). Barriers to PA may differ based on older adults' setting; for example, barriers to PA among older adults living with dementia in care homes. A recent

qualitative study which aimed to explore the barriers to PA in care homes reported main themes relevant to intrapersonal, interpersonal, institutional/ environmental and societal aspects of living in care homes (Gebhard & Mir, 2021). Specifically, sub-themes included 1) physical impairment/bodily sensations while exercising/restrictions from mobility aids, 2) fear of injuries/falls, 3) negative emotions, 4) lack of motivation, 5) inability to remember exercise, 6) individual images of ageing/ageism, 7) lack of support, 8) constraints in care homes - prohibitions, design of outdoor space, uneasiness in care homes and lack of appropriate music (Gebhard & Mir, 2021). Bethancourt and colleagues have emphasised motivating older adults, giving access to affordable, convenient, and stimulating PA, facilitate participation and adherence to PA (Bethancourt et al., 2014). Other factors like the involvement of family and friends, finding PA enjoyable and group-based activities, as described above, may also contribute to increasing PA levels among older adults (Gebhard & Mir, 2021; McPhee et al., 2016).

### 1.7 Physical Activity and Psychosocial Wellbeing in Ageing

Frequent PA is shown to improve older adult wellbeing and is therefore considered one of the most beneficial lifestyle choices for maintaining good health (physically, mentally, socially) as we age (Hamer et al., 2013) Although the evidence on the overall health benefits of PA in older adults is quite well developed, in comparison, there has been less emphasis on the collective psychological and social impact on older adults (Daskalopoulou et al., 2017; McPhee et al., 2016). Notwithstanding this, there is considerable evidence on the relevance of PA to the psychosocial wellbeing of older adults. This will be considered below specifically in reference to the psychosocial components of key relevance to this thesis.

*Physical Activity, Anxiety, and Depression in Ageing*

Recent reviews have emphasised the impact of PA on anxiety in older adults (Mochcovitch et al., 2016; Mura & Carta, 2013; Ofosu et al., 2023b; Wu et al., 2022; Zhang et al., 2021). In a systematic review of 13 interventional studies, PA was identified as effective for managing anxiety symptoms with recommendations (six or more weeks of PA, 60 minutes per session for two or more sessions per week) to increase effectiveness (Ofosu et al., 2023b). Consistent with the findings from the systematic review, a cross-sectional study of 200 older adults where 100 older adults that made up the intervention group showed lower anxiety and depression from increased PA as compared to the control group with high scores of anxiety symptoms (de Oliveira et al., 2019). In another study by Teixeira et al., (2013),

140 participants were recruited from residential homes or daycare centres and assessed on their level of PA, anxiety, and depression. Teixeira and colleagues recorded a correlation between PA, anxiety, and depression, meaning participants who reported high participation in PA reported lower anxiety and depression scores (Teixeira et al., 2013). In other cases, the effectiveness of PA on anxiety and depression has been compared to other forms of treatment such as psychotherapy and medication, and PA has been reported to be equally effective (Brenes et al., 2007; Netz, 2017) and, in some studies, more effective (Singh et al., 2023). PA types such as aerobic exercise, resistance training, yoga, walking, tai chi, and dance (Ofosu et al., 2023b; Wshah et al., 2019; Zhang et al., 2021) have been identified to have positive effects on anxiety symptoms and/or disorders. Other studies have also stated that the combined use of PA and other forms of treatment was more effective than psychotherapy or medication alone (Gary et al., 2010; Lavretsky et al., 2011). These studies have focused mostly on community-dwelling older adults and therefore may be limited in generalising findings to older adults in other settings such as care homes bearing in mind effects of PA may vary based on this.

*Physical Activity and Fear of Falling in Ageing*

Fear of falling has been reported to be a barrier to PA participation in older adults (Chandrasekaran et al., 2021). In a study of 1752 older adults in the Netherlands, participants with high fear of falling were less physically active especially when it came to outdoor activities (Wijlhuizen et al., 2007). Notwithstanding, PA is proven to be effective in reducing the fear of falling in older adults. A systematic review of 30 studies including 2878 participants from the ages of 68 to 85 years, showed a small to moderate reduction effect on fear of falling after a PA intervention and no increased risk of falls (Kendrick et al., 2014). Another systematic review of 19 studies found that PA interventions such as tai chi lowered the fear of falling; this is particularly notable because most of the studies were not primarily aimed at reducing the fear of falling except for three out of the 19 studies (Zijlstra et al., 2007). Similar to these findings, low-impact dance was found to reduce the fear of falling in females (Wu et al., 2016). In addition, an RCT showed similar results after a PA intervention – Dance for Parkinson's – such that improvements in multidimensional outcomes including fear of falling were recorded for the intervention group in comparison with the control group (Ventura et al., 2016). Importantly, not only does PA have an impact on the fear of falling but also on the risk of falls and on reducing the frequency of falls (Gillespie et al., 2012). PA is

beneficial whether or not interventions are specifically aimed at reducing fear of falling or fall risk in community dwelling older adults (Zijlstra et al., 2007).

*Physical Activity and Loneliness in Ageing*

There is limited evidence on the effects of PA intervention on social outcomes such as loneliness, especially in older adults who have an increased need for significant social contact (Masi et al., 2011; Shvedko et al., 2018). However, some evidence has suggested that PA helps to ameliorate loneliness in older adults (Ofosu et al., 2023a; Rodriguez-Larrad et al., 2021). In a study conducted in a nursing home, a significantly decreased perception of loneliness was recorded in residents who had engaged in moderate-intensity multicomponent exercise for six months as compared to residents who received usual care (Rodriguez-Larrad et al., 2021). Engaging in group-based physical activities makes one feel a part of a community and less lonely (Stenner et al., 2020). Reduced social isolation and loneliness were also observed among older adults who were members of a fitness programme (Brady et al., 2020). This again supports the assertion that being a part of a PA group without actual participation also reduces loneliness by creating a sense of belongingness. Similarly, a survey aimed to establish the association between PA levels and loneliness recorded that moderate to high PA correlated with a lower likelihood of loneliness and social isolation (Musich et al., 2022). Mostly, the effect of PA on loneliness is largely seen in group-based physical activity (Sebastião & Mirda, 2021) even though individual PA participation is effective (Schrempft et al., 2019). However, it has been argued that group-based PA is more beneficial than individual (Burke et al., 2006). This may be based on the shared needs and interests of participants engaging in group-based PA which can subsequently be associated with social connectedness, support and functioning (Burke et al., 2006; Shvedko et al., 2018; Wurz et al., 2015). In a systematic review, there was a significant small positive effect for group PA settings but not for individual or mixed settings (Shvedko et al., 2018). Engaging in PA in the company of others doing the same activity not only reduces loneliness in older adults but also helps motivate older adults to engage in PA and increase PA adherence (McPhee et al., 2016; Ofosu et al., 2023). For group-based PA interventions, the exclusive benefits of loneliness, social connectedness and support remain inconclusive as it is not definite if these effects are as a result of PA alone or from the presence of a group.

*Physical Activity and Quality of Life in Ageing*

Satisfaction with life and health status which are components of quality of life have a positive correlation with PA participation This implies that regular PA contributes to

improved quality of life (Yerrakalva et al., 2023). Similarly, positive relationships between PA and domains of quality of life such as health-related quality (Acree et al., 2006; Yen & Lin, 2018), independence in daily living (Lepsy et al., 2021), functional capacity and general health perception (Scarabottolo et al., 2019) in older adults have been reported. Positive effects have also been reported on the activities of daily living subscale on the Parkinson's Disease Questionnaire-39 scale for a dance intervention group of older adults with Parkinson's disease (Ventura et al., 2016). This pilot study further showed improvements in these areas of quality of life: mobility, activities of daily living, emotional wellbeing, stigma, social support, cognition, communication, and bodily discomfort for the intervention group that signed onto the Dance for Parkinson's programme as compared to the control group (Ventura et al., 2016). Similar results have been reported for the effects of PA interventions on the quality of life in older adults (Brustio et al., 2018; Rodriguez-Larrad et al., 2021; Wei et al., 2022). This was further supported by survey data collected during the Covid-19 pandemic, where individuals who were able to be moderately or highly physically active during lockdown and social distancing restrictions showed better quality of life scores (Tomaz et al., 2022).

### 1.8 Physical Activity and Other Aspects of Wellbeing in Ageing

Other than the benefits of PA on the selected components of psychosocial wellbeing, PA is known for its importance on the overall wellbeing of older adults. For example, PA is reported to have a positive impact on sleep and stress management (Andréa et al., 2010; De Nys, Anderson, et al., 2022). In terms of the physiological benefits of PA, it is well-known that PA has a significant impact on physical function (Arrieta et al., 2018; Chou et al., 2012; Henskens et al., 2018; Kim et al., 2023; Pedersen et al., 2016). For example, in a randomised controlled feasibility trial of frail residents in care homes, six weeks of resistance training greatly improved physical function, frailty, capacity, and strength as well as positive wellbeing benefits reported in qualitative interviews (Swales et al., 2022). Corresponding to this was a study that showed positive effects on physical fitness in nursing home residents (Rodriguez-Larrad et al., 2021). Also, PA is important in managing chronic and medical conditions which eventually increases life expectancy and reduces morbidity and mortality (McPhee et al., 2016; Pedersen et al., 2016; Wshah et al., 2019). According to the Centers for Disease Control and Prevention, PA reduces the risk of obesity, cardiovascular diseases, cancer, dementia, and type 2 diabetes (Centers for Disease Control and Prevention, 2023). Likewise, the risk of osteoporosis, and cardiovascular and metabolic diseases are lowered by

regular PA such as walking, sports, and resistance exercise (McPhee et al., 2016). Moreover, PA improves cognitive abilities in older adults, and this has gained a lot of attention as cognitive impairment is common in old age. This supported the claim that frequent PA improves cognitive functioning in older adults (Busse et al., 2009; Kumar et al., 2022). Some improvements in neurocognition because of PA have also been recorded (Kimura & Hozumi, 2012; Kirk-Sanchez & McGough, 2013; Vedovelli et al., 2017). Positive effects of PA on appetite mechanisms (control of hunger and satiety) which also change with ageing have also been reported (Hubner et al., 2021). Taken together, the findings described above strongly support that PA has multidimensional positive effects on wellbeing.

### 1.9 Music and Movement as a Form of Physical Activity

Music has been described as a meaningful and creative leisure activity that refreshes and boosts self-expression, positive health and wellbeing irrespective of sociocultural differences, health and age (Dahms & Haesner, 2018; Iwasaki et al., 2010). The importance of music goes beyond psychosocial wellbeing and is known to have cognitive and physical impact (Creech et al., 2013; Hallam et al., 2011). Music can arouse emotions, bring back memories and in most cases elicit physical reactions in the form of movements (Burger et al., 2012). Music has a universal natural association with movement, and this is said to be the kinetic effect of music (Burger et al., 2012; Sievers et al., 2013). This association is a result of music stimulating the motor regions of the brain resulting in motor reaction to the rhythm (Chen et al., 2008). Also, the emotions from music have been said to influence motor learning thus making repetitive movement to music easier and more efficient (Bonassi et al., 2023). Music-induced movement may include feet tapping, head nodding or moving the whole body in various postures and these could be influenced by individual factors (personality, preference) (Luck et al., 2010) , music features (breath strength, pulse clarity) (Burger et al., 2010) and emotional content of music (Burger et al., 2012).

Music and movement have been considered as one of the innovative ways of engaging in PA through dancing which is mostly complemented with music (Wshah et al., 2019). As part of dancing, rhythmic motor coordination, balance, memory, affection, acoustic stimulation, musical experience, and social interaction all come to play in addition to the movement which makes it a form of physical activity (Kattenstroth et al., 2013). Movement to music, which includes dance is safe, simple, accessible, and can be easily modified to include, seated components or standing with support therefore suiting the individual physical capabilities of older adults as compared to other structured forms of exercise (BUPA, 2011).

Older adults enjoy dance activities as it is not only a form of exercise but also a fun social activity (Bungay et al., 2020). Further, dancing can be done in different settings (community dwellings, hospitals, care homes,) and usually does not need any specialised equipment (Bungay et al., 2020; Douka et al., 2019; Keogh et al., 2009; Ofosu et al., 2023a). Dancing has multidimensional benefits for the wellbeing of older adults. Some of these include improved medical conditions, exercise capacity, physical function, quality of life in healthy older adults (Keogh et al., 2009) and older adults with health conditions like Chronic Obstructive Pulmonary Disease (Wshah et al., 2019), hypertension (Conceição et al., 2016) and arthritis (Marks, 2005). Dancing has been found to have anxiety-reducing effects among older adults (Vaccaro et al., 2019). Again, dance among older adults with or without cognitive impairment was related to improved cognition, falls efficacy i.e. perceived ability to carry out activities of daily living without losing balance or falling (Soh et al., 2021), physical function, depression, and activities of daily living (Brustio et al., 2018; Ventura et al., 2016; Wu et al., 2021). For example, a six-month dance intervention enhanced cognition in community dwelling older adults (Kattenstroth et al., 2013). Similarly, community dwelling older adults reported increased physical function and quality of life following a 16-week dance intervention (Brustio et al., 2018). Hospitalised older adults also saw improved mobility, social interactions, confidence, and general wellbeing as a result of dance activities (Bungay et al., 2020). Several studies have also investigated the impact of dance showing improvements in balance, stability, and fall efficacy (Fernández-Argüelles et al., 2015; Filar-Mierzwa et al., 2017), cognition (Kattenstroth et al., 2013; Kimura & Hozumi, 2012), quality of life and functional capacity (Douka et al., 2019; Hui et al., 2009; Sampoon et al., 2019), blood metabolism, bone mineral density, and performance of daily activities (Wu et al., 2016); all in community dwelling settings. In addition, key findings from a systematic review on the psychosocial importance of dance in care home residents showed improvements in (1) emotional and affective states, (2) behaviour, (3) socialising and communication, (4) care staff job satisfaction, and (5) cognition (Guzmán-García et al., 2013). Similar to the effects of dance in older adults from different settings (community dwelling and hospitals), dance interventions are known for their multidimensional effects on the wellbeing of residents in care homes (Guzmán-García et al., 2013; Ho et al., 2022; Meng et al., 2020; Salihu et al., 2021; Vankova et al., 2014). The multifaceted benefits of dancing on older adults' psychosocial wellbeing make it a particularly suitable PA intervention for older adults. Potentially the benefits of dance as a physical activity intervention can be expanded to

specifically target psychosocial wellbeing among older adults who are care home residents. Currently, although there have been studies conducted among older adults as described above, these interventions were mainly delivered in person which implied that the absence of instructors was a possible barrier to the intervention delivery. This highlighted the need for creating and evaluating other dance intervention delivery methods, especially during the Covid-19 pandemic.

### 1.10 Digital Physical Activity and Healthy Ageing

Digital interventions are programs that use digital platforms to provide information and support decision-making, behaviour and emotional change for different health outcomes (Bailey et al., 2010). Digital interventions have been shown to be effective in improving health outcomes and behaviours including self-management of chronic conditions, mental health and healthy behaviour promotion (Alkhaldi et al., 2016; Bailey et al., 2010). According to the World Health Organisation, digital interventions, services, and applications in health have been classified based on 1) health system challenges, 2) digital health interventions and, 3) digital services and application types in order to explore the diverse ways in which digital technologies support individual and healthcare system needs (World Health Organisation, 2023). Digital PA can be considered as a digital health intervention that addresses the multidimensional health needs of people. Digital health interventions could further be designed for healthcare providers, health management and to support personnel (Soobiah et al., 2020). The plausible advantages of digital health interventions over face-to-face health interventions have included easy accessibility, opportunities to tailor the content of the intervention to align with individual needs and preferences and empowering individuals to manage their own health outcomes (van Orden et al., 2022; World Health Organisation, 2023; Yardley et al., 2015). These advantages compensate for the common structural and attitudinal barriers in healthcare such as cost, time, stigma and accessibility (Duan et al., 2021; Erbe et al., 2017; Kwan et al., 2020). However, the leverage that digital health interventions have over face-to-face interventions does not override the effectiveness of face-to-face interventions which may involve more direct social connectedness (Kambeitz-Ilankovic et al., 2022; Steele et al., 2009).

Physical activity (PA) has emerged as one of the most cost-effective and safe ways of promoting psychosocial wellbeing in older adults with little to no side effects (Gammack, 2017). In terms of PA being safe, the World Health Organisation, UK and USA Departments of Health PA guidelines have considered PA safe for older adults and in some cases does not

require a medical practitioner's approval before participating (UK Department of Health, 2011; US Department of Health and Human Services, 2009; World Health Organisation, 2020). Physical activity as reflected in this study denotes "any bodily movement produced by skeletal muscles that result in energy expenditure", and exercise as a subset of physical activity has been typically defined as a planned, structured, and repetitive bodily movement done to maintain and improve components of physical fitness (Caspersen et al., 1985, p.126). This definition has also been adopted by the World Health Organisation (World Health Organisation, 2022b).

Over the years digital means of PA delivery have moved from telephones and analogue monitors to include and embrace the emergence of new softwares, devices and applications such as smartphones and laptops (Goode et al., 2012; King et al., 2007). Older adults were considered less accepting of internet-related activities as a result of functional limitations and difficulty with changing lifelong habits and attitudes but this assertion has changed over the years (Irvine et al., 2013; Mehra et al., 2020). According to Age UK, between 2011 and 2016, there was a 41% increase in the usage of internet among older adults above 65 years (Age UK, 2016). Also, the Office for National Statistics reported a substantial rise in the recency of internet use from 52% (2011) to 83% (2019) among older adults with age ranging from 65 to 74 years (Office for National Statistics, 2019). Similarly, the rate of internet usage increased from 20% in 2011 to 47% in 2019 for older adults aged 75 years and above (Office for National Statistics, 2019). The increase in technology use and digital services among older adults relatively peaked during the Covid-19 pandemic (Li et al., 2021; Sixsmith et al., 2022). This rate of acceptance of technological and internet approaches among older adults points to the possible efficiency of digital PA. Digitally delivered PA has been largely investigated on its importance, facilitators and barriers in the older adult population before the onset of the Covid 19 pandemic (Bossen et al., 2013; Irvine et al., 2013; Mehra et al., 2020). In a systematic review of 20 studies, eHealth interventions delivered via computer or handheld devices such as smartphones, tablets and personal digital assistants prompted physical activity in older adults (Muellmann et al., 2018). In the same way, five studies included in a systematic review on the use of mobile health applications as a means of PA intervention showed an increase in PA and fitness and a decrease in sedentary time among older adults (Yerrakalva et al., 2019).

Even though participation in PA did not always meet the recommended guidelines, the Covid-19 pandemic and restrictions heightened PA inactivity worldwide (Oliveira et al., 2022). A longitudinal study in the UK revealed that older adults' PA decreased during the

Covid-19 lockdown especially from September 2020 to January 2021 (Elliott et al., 2022). Although community-dwelling older adults' PA levels were negatively affected (Nygård et al., 2022), a significant decrease in PA engagement among older adults in institutionalised homes was reported (Frahsa et al., 2020). The pandemic also had negative effects on the wellbeing of older adults (Cocuzzo et al., 2022; Kaelen et al., 2021; Nygård et al., 2022). To promote PA during those times, the relevance and suitability of digital PA interventions post-pandemic were noted. During the Covid restrictions and lockdowns, many existing activities were forced to be carried out online including PA, and this explains the surge in digitally delivered PA interventions during and after the pandemic (Parker et al., 2021; Schneider et al., 2022). Digital PA has been found to be equally effective as in-person delivered PA (Joseph et al., 2014). Also, digital PA delivery can have fewer limitations because it is accessible and convenient although some studies have reported older adults found it difficult to engage with online resources and digital tools for reasons such as a lack of computer and internet skills (Coley et al., 2019; Van Middelaar et al., 2018) or digital poverty (lack of access to technology or Wi-Fi) (Choi & Dinitto, 2013). Contrary to this, other studies have reported that online interventions were well accepted among older adults (Berman et al., 2009; Lavoie & Dubé, 2021; Ofosu et al., 2023a; Tomasino et al., 2017). Exploring the effects and feasibility of online PA among older adults have received research attention, however, most studies have focused on PA such as walking and cycling (Bickmore et al., 2013; Boekhout et al., 2018; Rowley et al., 2019; van Dyck et al., 2019; Volders et al., 2020). Few studies have examined other forms of PA such as dancing. Therefore, there is a need to extensively assess the feasibility and psychosocial effects of not just digital PA but also dance as a form of PA. Further, dance accompanied by music may be particularly acceptable among residents in care homes because it stimulates emotions, memories and affection (Kattenstroth et al., 2013). It would also be important to examine its feasibility and effects in a care home setting, particularly the psychosocial effects, due to the high prevalence of psychosocial issues such as anxiety noted among older adults who are care home residents, as described above.

### 1.11 The Role of Residential Care Homes and Staff in the Provision of Physical Activity for Healthy Ageing

It is evident that care homes are expected to provide care and support to improve the health and wellbeing of residents (Care Quality Commission, 2016). However, this is not always achieved (Malmedal et al., 2009). To meet the needs of the increasingly aged care

home population and provide quality care to residents, all stakeholders of the care home sector must work together and effectively. Stakeholders including policymakers, care home staff (administrators, managers, carers, nurses, chefs, activity coordinators, and cleaners), other caregivers (residents' families and friends), and residents themselves have a role to play in ensuring person-centred care is delivered to residents (Stocker et al., 2018). A qualitative study revealed that residents were not always involved in the decision-making of the medical care given to them leading to reduced autonomy and care dissatisfaction (Garcia et al., 2016). In that study other stakeholders (family members, administrators, nurses, and physicians) were interviewed on their views on resident involvement in medical care decisions the responses showed that a holistic approach to care delivery will be more beneficial with all entities involved (Garcia et al., 2016). This includes consideration of the mental health and social needs of residents in addition to physical health needs. These factors are important if PA interventions including digital PA interventions are to be successfully used to improve wellbeing among care home residents.

A key factor that may influence the successful implementation of physical activity interventions for psychosocial health in care homes is the involvement of care home staff in intervention delivery. However, this can be challenging due to the multiple demands on care home staff and the resulting burden. For example, a recent study reported a high psychosocial burden and workload on nurses working in care homes, especially during the Covid-19 pandemic, and this was largely related to the shortage of staff, poor working conditions, and ineffective communication between management and other care home staff (Hering et al., 2022). Recommendations from this study reported providing social support, creating a sense of community, holding regular team meetings/check-in sessions, and involving staff in the decision-making were strategies to manage and support the challenging duties of care home staff (Hering et al., 2022). This points to the importance of involving stakeholders in managing, planning, and delivering care to residents, including the provision of activities to enhance physical activity.

In addition to stakeholders' involvement, the wellbeing of care home staff has to be prioritised equally to maximise the quality of care and activities delivered. Caring for residents with diverse and complex needs can affect the physical and mental wellbeing of care workers, especially under poor working conditions including low pay rates, long working hours, and little to no training or promotion prospects (Islam et al., 2017). Studies have emphasised the impact of stress among care home staff and how this reflects on the quality of care provided (Edvardsson et al., 2008; Pitfield et al., 2011). One systematic

review showed a high prevalence of stress among care staff, although the included studies were not rated as high-quality because they were either small or used measures with questionable psychometric properties (Pitfield et al., 2011). However, others have shown that the wellbeing of care home staff has a relationship with the wellbeing of residents and the care delivered (Brodaty et al., 2003; VonDras et al., 2009). For example, Edvardsson and colleagues reported that where staff job strain was high, there was a significantly high prevalence of negative behavioural symptoms among residents (Edvardsson et al., 2008). Also, recent evidence suggests that due to the difficulty in caring for residents in care homes and the poor working conditions, the care home industry records high levels of absenteeism, staff turnover, and a low recruitment rate (Devi et al., 2021). In England, care homes with and without nursing care provision saw 39.4% (98,000 workers) and 28.2% (78,000) staff turnover, respectively (Skills for Care, 2022b, 2022a). The highest turnover of 34.6% was recorded for care workers in care homes without nursing in 2021/2022 and this was estimated to be about 56,000 care workers leaving their jobs in the past 12 months (Skills for Care, 2022b). For care homes with nursing staff, registered nurses had the highest turnover in the past year with a rate of 44.9%, followed by care workers with a rate of 43.7% (Skills for Care, 2022a). A common theme in most studies reporting low job satisfaction among care home staff was the pay rate. Even though in the UK there has been an increase every year in the pay rate in the care sector, the rise generally was unable to keep pace with high inflation, especially between the years 2020 and 2022 (Skills for Care, 2022b, 2022a).

In particular, the Covid-19 pandemic also had a major impact on the wellbeing of care home staff. Care home staff, particularly carers, reported high working demands and these affected their overall wellbeing from physical, mental, and social wellbeing (Gray et al., 2022; Hanna et al., 2022; Hering et al., 2022; Kaelen et al., 2021). In a recent systematic review of 14 papers between March 2020 to 2021, care home staff reported experiences of anxiety, post-traumatic stress disorder, and depression along with common themes such as poor working conditions, lack of skills and knowledge, fear of contagion, feeling undervalued and abandoned evident from qualitative studies (Gray et al., 2022). The wellbeing of care home staff worsened during the Covid-19 pandemic; however, few studies have reported on care home staff wellbeing following the pandemic when lockdown, restrictions and safety measures were reduced and eventually removed from care home settings (Beattie et al., 2023; Gray et al., 2022; van Diepen et al., 2023).

In summary, the typical causes of poor care home staff wellbeing have been poor working conditions and the demanding nature of the care job. These have resulted in high

levels of absenteeism, staff turnover, low motivation to work, decrease in quality of care provided and low recruitment rate of staff (Devi et al., 2021). These causes and consequences of poor wellbeing among care home staff negatively impact the facilitation of PA interventions in care homes. For example, a feasibility study making up a later part of this thesis reported barriers to implementing digital music and movement interventions in care homes in relation to the role of care home staff to be shortage of staff, absenteeism, high staff turnover, limited organizational support and high workload burden (Ofosu et al; 2023a). Potentially there are ongoing wellbeing issues among care home staff which may influence the capability to deliver meaningful activities to enhance the wellbeing of residents, including the delivery of digital PA interventions. As well as carer wellbeing being important in its own right, the potential additional impact on care recipients via the quality and nature of meaningful activities offered to them emphasises that it is important to examine the wellbeing of care home staff after the pandemic to highlight the challenges still lingering and aspects of wellbeing which may impact the capacity to implement digital PA interventions successfully in care homes.

### 1.12 Summary of Existing Literature and Rationale for this PhD Thesis

As ageing is inevitable and people are living longer, it is important to focus on healthspan, i.e., the period of life spent in good health, not just the delaying of mortality (Whittaker et al., 2018). As described above, one of the ways to promote ageing healthily is by engaging in PA. In addition to physical effects, PA is known for its effects on psychosocial wellbeing. There is extensive literature and reviews on the effects of PA on depression in older adults, but much less research on anxiety and related concepts, particularly on the effectiveness of PA to reduce anxiety in older adults aged 65 years and above. This is an important gap to fill because of the high prevalence and its impact on the quality of life in older adults.

For PA interventions, examples of PA such as resistance training, and aerobic exercise have been widely studied for their benefits in older adults but gentler PA and movement combined with music and its effects on older adults' psychosocial wellbeing have not been adequately studied. Such interventions have used other forms of technology in the past, but the Covid-19 pandemic has highlighted the need and relative acceptance of digital PA. There is also a need to examine the psychosocial benefits of digitally delivered music and movement to promote healthy ageing specifically in the care home setting as most of the research interventions regarding PA in older adults have focused on community-dwelling

older adults so the findings may not be directly applicable to different settings or frailty levels.

Further, there is a need to address the wellbeing of care home staff who are responsible for promoting healthy ageing in residents of care homes daily. Care home staff wellbeing and satisfaction at work are reflected in the quality of care provided including facilitation of digital PA intervention, thus the wellbeing of care home staff is crucial when promoting healthy ageing in care homes. The Covid-19 pandemic impacted the wellbeing of care home staff, however, evidence is scarce on the wellbeing of care home staff post-pandemic in relation to their ability to facilitate digital music and movement interventions. Understanding this would be an important step towards supporting staff to deliver effective interventions and activities for quality of life and wellbeing.

### 1.13 Thesis Aims and Outline

*Aims*

This PhD thesis aimed to address the aforementioned needs and knowledge gaps by:

1. Systematically reviewing the literature on the relevance of PA dimensions and their role in reducing anxiety in older adults
2. Assessing the feasibility and potential effects of a digitally delivered music and movement intervention on psychosocial wellbeing among residents in care homes
3. Evaluating the effectiveness of a digital music and movement intervention on the psychosocial wellbeing of residents in care homes in a pilot mixed methods study
4. Exploring the challenges experienced by care home staff and their wellbeing post-pandemic in line with facilitation and implementation of digital music and movement intervention in care homes.

*Thesis Outline*

This research within this thesis comprises one published systematic review (Chapter 2), one published mixed-methods feasibility study (Chapter 4), one published pilot mixed-methods study (Chapter 5) and one care home staff wellbeing report (Chapter 6). Chapter 3 presents the overall detailed Methodology and rationale for the methods underpinning the two intervention studies in more detail, and specifically the contribution of this PhD candidate to these two studies. Chapter 7 presents the overall Discussion and conclusions of this thesis. This thesis forms the contribution of one of two PhD candidates who worked together on the

intervention trials as these involved complex and multiple measures of health including psychosocial and physiological wellbeing. The focus of this PhD, as described above, is the psychosocial aspects of older adults' wellbeing whereas the other PhD focused on the physiological outcomes.

Briefly, the systematic review and meta-analysis in Chapter 2 aimed to explore the benefits of PA on anxiety in older adults and further investigate what PA dimensions maximises the benefits of PA on anxiety. The key findings showed that PA was effective in reducing anxiety symptoms in older adults and specifically PA dimensions i.e., engaging in one type of PA, shorter duration interventions and sessions lasting 60mins, three times a week were found to have greater impact on anxiety in older adults. The feasibility study in Chapter 4 aimed to access the feasibility of implementing a digital music and movement intervention in care homes using a realist evaluation process. Key findings relating to psychosocial and feasibility issues were, (1) implementation of the intervention was found to be feasible in care homes, (2) delivery challenges were associated with the intervention and (3) significant changes were reported for anxiety, depression and loneliness. Chapter 5; a follow-up from Chapter 4, was a pilot mixed methods study focused on examining the effectiveness of digital movement and music resources on psychosocial wellbeing and physical health in residents in care homes. Results from the psychosocial outcomes showed significant effects in anxiety, fear of falling and loneliness whereas results from the interviews highlighted the benefits and challenges in line with the intervention delivery which further informed progression of the pilot study to a full-scale trial based on progression criteria. The secondary data analysis in Chapter 6 assessed the wellbeing of care home staff with focus on staff who deliver direct care to residents. Results from the survey showed that staff in the clinical, care and wellbeing roles reported the lowest wellbeing (happiness, motivation to work, productivity, work-life balance, job satisfaction, overworking, and work-related stress) as compared to the other roles in care homes. Addressing these issues would enable these staff to have better capacity to deliver PA interventions to residents.

Table 1: PhD Timeline

| **Description** | **Timeline** | **Covid-19 Pandemic Phase** |
|---|---|---|
| PhD start | December, 2020 | Social guidelines and restrictions in place. Partial lockdown except for essential purposes. |

| | | |
|---|---|---|
| Systematic review and meta-analysis (Chapter 2) | January, 2021 to November, 2021 | Mainland Scotland full lockdown (January to April). From April, restrictions were relaxed |
| Feasibility study (Chapter 4) | December, 2021 to October, 2022 | Omnicron variant identified. Social guidelines and restrictions partially reinstated. Limited access/visits to care homes. |
| Pilot RCT (Chapter 5) | March, 2023 to December, 2023 | Covid-19 was no longer a public health emergency |
| Care home staff wellbeing study (Chapter 6) | October 2022 to October, 2023 | |
| Writing (Thesis) | January 2023 to April, 2024 | |

Note: The timelines presented above include the periods of conceptualisation, planning, ethics application and approval, data collection, data analysis, writing (manuscripts, reports, thesis chapters) and reviews (peer reviews, supervisors' feedback).

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# Chapter 2: Dimensions of Physical Activity are Important in Managing Anxiety in Older Adults: A Systematic Review and Meta-Analysis

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As part of the focus of this thesis – evaluating the role of physical activity in promoting psychosocial wellbeing in older adults; this systematic review and meta-analysis was carried out to explore the benefits of physical activity on anxiety in older adults and how these effects can be maximised in the older adult population and ultimately contribute to healthy ageing. This systematic review was independently carried out by the author of this thesis with supervision from PhD supervisors (JC, GR, AW) and second screening of titles and abstract by LDN. Results from this study informed the designing of the studies in Chapter 4 and 5.

## 2.1 Abstract

Physical activity (PA) is a known approach for managing anxiety symptoms in older adults. This systematic review and meta-analysis address the benefits of PA and its dimensions (frequency, session time, type, and intervention period) on anxiety symptoms in older adults aged 65 years and above. Searches covered eight databases reporting eight randomised controlled trials (RCTs) and five non-randomised controlled trials (non-RCTs). Meta-analysis of RCTs (SMD = -0.41; 95% CI = -0.58, -0.24; p <.00001) and Fisher's method of combining p values for non-RCTs supported the effectiveness of PA for managing anxiety symptoms in older adults. Sub-group analysis revealed significant effects for all PA types, session times, frequency, and intervention periods compared to control groups, albeit with different magnitudes of effect. In conclusion, although some dimensions of PA contribute to its effectiveness for anxiety, PA intensity and mode required to maximise PA effects remain unclear.

*Key words*: ageing, intervention, intervention period, session time, PA frequency, PA type.

## 2.2 Introduction

Anxiety disorder is one of the most common wide-reaching mental health problems (Baxter et al., 2014). In 2019, the worldwide anxiety disorder incidence and prevalence was estimated to be 45.82 million and 301.39 million, respectively and accounted for 28.68 million disability-adjusted life years lost (Yang et al., 2021). This is to say, substantial years of good health are lost to anxiety disorders. Though anxiety disorders are reported in all age groups, they are increasingly common in older adults affecting between 14% to 17% of the older adult population worldwide (Canuto et al., 2018; Kirmizioglu et al., 2009; Wolitzky-Taylor et al., 2010). Anxiety disorders in the ageing population has become an increasing concern globally. This is not surprising, considering the ageing population with an estimated increase in people aged over 60 years from 1 billion in 2020 to 1.4 billion by 2030 and 2.1 billion by 2050 worldwide (World Health Organisation, 2021).

Older adults are thought to be predisposed to diagnosed and undiagnosed anxiety problems as a result of reduced social support, increased prevalence of chronic disease, loss of independence, fear of death and the loss of self-esteem associated with the process of ageing (Alipour et al., 2009; Boyd, 2008). According to the Diagnostic and Statistical Manual of Mental Disorders (DSM-V), anxiety disorders are characterised by feelings of excessive and persistent worry, fear and apprehension, which can be further classified into generalised anxiety disorder, separation anxiety disorder, selective mutism, specific phobia, panic disorder, social phobia and agoraphobia (American Psychiatric Association, 2013a). These characteristics, though dependent on the type of anxiety, negatively impact on the wellbeing and quality of life of older adults (Olatunji et al., 2007; Vancampfort et al., 2017). The negative effects or symptoms of anxiety are usually as a result of a disproportional reaction to the threat causing it. However, feelings of anxiety are not always negative, but can also be important in protecting one from danger in terms of the fight or flight response making it essential for survival (Gutiérrez-García & Contreras, 2013).

Strategies to reduce the negative symptoms of anxiety have therefore been a valid subject of constant investigation. Pharmacotherapy and psychotherapy have traditionally been used to manage anxiety symptoms and disorders. However, such approaches although commonly used do have disadvantages compared to lifestyle interventions such as physical activity (PA). PA has been defined as any bodily movement produced by skeletal muscles that involves energy expenditure (Caspersen et al., 1985; World Health Organization, 2020a) and typically occurs within four domains: occupational, household, leisure and commuting

activities (Strath et al., 2013). Exercise is a form of PA which is planned, structured and repetitive leading to improvement in physical fitness, whereas sports is a form of PA that is competitive (Caspersen et al., 1985). Examples of PA especially for older adults include walking, yoga, resistance exercise, aerobic exercise, dance and tai chi (Kazeminia et al., 2020). Compared to PA, pharmacotherapy and psychotherapy have been proven to be less efficient and more costly, leading to the emergence and adoption of physical activity (PA) as a means to reduce the negative impact of anxiety symptoms and/or disorders in older adults (Chisholm et al., 2016; Kandola et al., 2018; Olthuis et al., 2016). PA not only has positive effects on managing anxiety symptoms and/or disorders but also wider benefits such as stress relief, improved physical functioning and social wellbeing, and fewer side effects than drug treatments (Heaney et al., 2010, 2011, 2014). As a result of the diverse benefits of PA, the World Health Organisation (WHO) recommends that adults aged 65 years and above should engage in moderate (150-300 minutes) or vigorous (75-150 minutes) intensity aerobic exercises weekly and at least three days of multi-component exercise to achieve added benefits (World Health Organization, 2020b).

Several psychological mechanisms such as self-efficacy and distraction have been proposed to explain the effects of PA on anxiety symptoms and/or disorders (Anderson & Shivakumar, 2013). One proposed mechanism is that of anxiety sensitivity and exposure, such that when an individual is exposed to a feared anxiety-related sensation such as rapid heartbeat in the context of PA, it increases the tolerance for and manages the psychological reaction to similar sensations in the context of anxiety symptoms and/or disorders (Ströhle et al., 2009). PA exposure is thought to explain the negative correlation between anxiety-related sensations and exercise frequency (Broman-Fulks & Storey, 2008; Smits et al., 2008).

Numerous studies have been conducted in line with the anxiolytic effects of PA among the general population (Biddle & Asare, 2011; Dale et al., 2019; de Souza Moura et al., 2015; Herring et al., 2010; McDowell et al., 2019). In a systematic review of 10 studies, a narrative synthesis revealed a positive impact of PA combined with occupational therapy and lifestyle changes in a general population diagnosed with a variety of anxiety disorders (de Souza Moura et al., 2015). In this review, other interventions were combined with PA interventions thus the results reported do not reflect the independent contribution of PA in reducing the impact of anxiety disorders (de Souza Moura et al., 2015). Likewise, a meta-analysis reported that PA interventions, motivational and educational sessions to promote increased PA improved anxiety symptoms in healthy older adults with no known diagnosis of anxiety (Conn, 2010). Also, Conn (2010), revealed weekly and total dose (minutes) of PA

were not associated with reduced anxiety symptoms but moderate to high intensity PA significantly lowered anxiety symptoms. In contrast, Bartley et al., (2013), found no significant effects of PA on anxiety disorders in a meta-analysis of seven trials. The results from this study were deemed to have been affected by control conditions as a significant effect was seen when analysis was limited to studies with non-intervention controls (waitlist or placebo control conditions) but not when controls also received an intervention (such as non-aerobic activity).

This review also focused on people diagnosed with an anxiety disorder and did not capture others who have anxiety symptoms but no formal diagnosis. Again, a recent systematic review in populations younger than 65 years with elevated anxiety symptoms or diagnosed anxiety found PA to be a useful treatment option for anxiety symptoms and disorders in comparison with placebo but no significant difference when compared with other forms of treatment such as cognitive behaviour therapy and medication, regardless of the methodological limitations of the included studies (Stonerock et al., 2016). Whilst there is therefore a vast amount of literature on PA and its importance in managing anxiety symptoms and/or disorders, there is less emphasis on older adult populations. In addition, PA dimensions (frequency, intensity, time (session time (minutes)), type, and intervention period (weeks)) in general populations have been addressed (Conn, 2010) but again there is a paucity of research on how relevant PA dimensions are in boosting the effectiveness of PA in older adults.

Of those studies that have explored the benefits of PA in managing the negative effects of anxiety symptoms and/or disorders in older adults, very few have highlighted the role of PA dimensions (Kazeminia et al., 2020; Mochcovitch et al., 2016). The dimensions of PA are important in planning and assessing its effectiveness (Strath et al., 2013) as well as informing future PA interventions for older adults. Among the few systematic reviews with an emphasis on older adults, regular and supervised exercise reduced anxiety symptoms in older adults with no diagnoses of anxiety disorders (Mochcovitch et al., 2016). Similarly, a recent systematic review stated sports significantly reduced anxiety symptoms in older people in a meta-analysis of 19 studies (Kazeminia et al., 2020). There are several limitations in current reviews investigating PA and its anxiety reducing effects in older adults. These systematic reviews carried out in populations of older adults have focused on the overall effectiveness of PA and not on the dimensions of PA that contribute to its effectiveness (Kazeminia et al., 2020; Mochcovitch et al., 2016). Also, the age range for older adults in studies included in reviews has been inconsistent and has included populations 50 years and

older. According to the World Health Organisation, older adults are considered as 65 years and above (WHO Study Group on Aging and Working Capacity & World Health Organization, 1993). In addition to this, reviews have not captured unpublished studies such as grey literature. Grey literature is described as relevant information produced by government, businesses or academic bodies but not disseminated by commercial publishers (Paez, 2017). Grey literature can be in the form of theses, dissertations, conference papers and reports which contribute to the pool of scientific knowledge and helps to reduce publication bias (Paez, 2017). Lastly, anxiety symptoms such as fear and worry are seen as normal among the aged, thus mostly undiagnosed in older adults (Mochcovitch et al., 2016). This is to say, focusing solely on older adults diagnosed with an anxiety disorder was not a good representation of older adults living with the undiagnosed negative effects of anxiety symptoms.

Consequently, this sets the context for analysing the scientific evidence including grey literature on the effects of PA on anxiety symptoms and/or disorders among older adults aged 65 years and older. The main aim of this systematic review and meta-analysis was to assess the impact of PA on anxiety in older adults aged 65 years and above with existing anxiety which includes, with or without, a formally diagnosed anxiety disorder. The secondary aim of this review was to understand the dimensions of PA best for maximising the effect on anxiety symptoms and/or disorders and to inform the design of future PA interventions.

## 2.3 Methods

This systematic review and meta-analysis were conducted in line with the 27-item checklist PRISMA 2020 statement which guides reporting of a clear and accurate systematic review (Page et al., 2021). The protocol for this review was registered with PROSPERO, protocol number CRD42021253424 on 6$^{th}$ May 2021.

### 2.3.1 Eligibility Criteria

The inclusion criteria for studies were categorised into Population, Intervention, Comparator, and Outcome (PICO). All included studies met the following conditions under each PICO category. The population was older adults aged 65 years and above of all genders and from different settings including community dwelling, outpatients, residential care homes and supported housing or assisted living facilities. PA and/or exercise were the interventions considered. PA and/or exercise interventions were compared with control groups with no physical activity, no exercise or groups receiving usual care. This review and meta-analysis

focused on changes in levels or severity of anxiety symptoms following a PA intervention as the outcome. For the purpose of this review, anxiety is considered as the exaggerated response to a threat that negatively affects wellbeing and presents itself as anxiety symptoms and/or a diagnosed form of anxiety disorder. In addition to the above criteria, designs of included studies were restricted to intervention studies including randomised controlled trials, non-randomised uncontrolled trials, feasibility, and pilot intervention studies. The inclusion of intervention studies only narrowed the scope of this review to best inform future intervention studies. Only studies reported in English were included.

### 2.3.2 Search Strategy

The search for relevant studies was conducted in the following electronic databases; PubMed, CINAHL, PsycINFO, Cochrane Central Register of Controlled Trials, Web of Science and Clinical trials.gov. Grey literature were included hence searches were also made in Google Scholar and Open grey. The reference lists of eligible studies were also searched manually to capture additional studies. Searches were carried out in May 2021 with no limit on the date range of included studies. A search strategy and search terms suitable for each database are included in Appendix A. Search alerts were created for electronic databases which give notifications of newly published studies bi-weekly through email. Search results from databases were imported into EndNote Reference Management (version X9) software. Two reviewers (Ofosu and de Nys) independently screened titles and abstracts using Rayyan software (Ouzzani et al., 2016). Subsequently, full texts of potentially eligible studies were screened by the reviewer (Ofosu) to further check for eligibility. All conflicts at different stages of screening were resolved by the two reviewers through discussions leading to a consensus, with availability of a third reviewer if necessary (Whittaker).

### 2.3.3 Risk of Bias Assessment for Included Studies

In this systematic review, risk of bias for the included studies was assessed. Risk of bias evaluates how authors of included studies carried out their respective studies, analysed and reported results. Similar to the screening process, two reviewers independently assessed the risk of bias of both randomised and non-randomized controlled trials using Cochrane Risk of bias Assessment (RoB 2) tool (Sterne et al., 2019) and Joanna Briggs Institute (JBI) Critical Appraisal Tool (Tufanaru et al., 2017), respectively. The RoB 2 Assessment tool assessed risk of bias of randomised controlled trials (RCTs) under six domains: randomisation process, deviations from intended interventions, missing outcome data,

measurement of outcome and selection of reported results (Sterne et al., 2019). The RoB 2 tool proposes a level of risk of bias for each domain and each reviewer finally made an informed judgement to accept or change the purported risk of bias assessment. Subsequently, an overall risk of bias assessment was made, based on the algorithm mapping responses and judgements under each domain. A 'high' or 'some concerns' risk of bias judgement implied a level of bias in trials consequently reducing the confidence in results (Sterne et al., 2019). A summary of the overall risk of bias of all included RCTs generated from the risk of bias visualisation tool (McGuinness & Higgins, 2020) is shown in Appendix B. The JBI critical appraisal tool for non-randomised experimental studies is a checklist of 9 items that assess manipulation of variables, similarity in comparison groups, presence of control group, measurement of outcomes and statistical analysis (Tufanaru et al., 2017). An overall appraisal was made based on reviewers' independent response to all items to include, exclude or seek further information (see Appendix C for JBI critical appraisal summary).

### 2.3.4 Data Extraction

For each study, extracted data where possible covered reported socio-demographics (age, country, gender, settings), characteristics of participants (sample size, health status), intervention details in line with FITT (Frequency, Intensity, Time- session time/intervention period, Type) principles (Pescatello et al., 2014), mode of PA delivery, setting, comparison group and outcome (measure of anxiety). Data were independently extracted by one reviewer (EO) and the second reviewer (LdN) cross-checked extracted data sheet. There were no conflicts at the stage of data extraction. Change in anxiety reported as a continuous outcome led to the extraction of means/mean change (M), standard deviations (SDs) and p-values. Post-intervention anxiety scores (M±SD) were used in data synthesis. For studies that did not report mean and standard deviations, other quantitative metrics such as medians, interquartile range, standard errors, effect sizes, t or p-values and confidence intervals were used to compute M and SDs (Luo et al., 2018; Wan et al., 2014). Also, the Review Manager (RevMan version 5.4.1) calculator was used to combine outcomes from two or more arms of PA intervention (*Review Manager (RevMan)*, 2020).

### 2.3.5 Data Analysis

For included RCTs, data were analysed using RevMan Version 5.4.1 (*Review Manager (RevMan)*, 2020). A random effects model was used in meta-analyses because studies differed indicating heterogeneity, therefore an overall effect size cannot be assumed

(Borenstein et al., 2009; Higgins et al., 2021). Small, moderate, and large effect sizes were estimated for continuous outcomes using the standardised mean difference (SMD). The SMD approach was adopted since all studies measured the primary outcome - anxiety, using different psychometric scales, hence the need for the standardisation (Higgins et al., 2021). In addition, anxiety was measured as a continuous outcome further informing the calculation of standardized mean differences for the eight RCTs in the meta-analysis (Faraone, 2008). The included non-randomised controlled trials (non-RCTs) included either none or minimal statistical information other than p values and effect direction which resulted in the choice of combining p values as an acceptable method of synthesis visually displayed as an albatross plot as opposed to SMDs (Borenstein et al., 2009b). Further, the included non-RCTs had methodological heterogeneity making meta-analysis inappropriate (Achana et al., 2014; Harrison et al., 2017). P values were combined using the Fisher's method (Fishers, 1932).

### 2.3.6 Investigation of Heterogeneity and Sub-group Analysis

Heterogeneity of studies was presented as a statistical test, generated in RevMan along with forest plots from meta-analysis. The $I^2$ statistic was the measure of heterogeneity given in percentages ranging from: not important (0% - 40%), moderate (30%-60%), substantial (50%-90%) to considerable (75%-100%) (Deeks et al., 2021). Subsequently, a sub-group analysis was conducted to address issues of heterogeneity. In this review, sub-groups compared were categorised under PA frequency (number of sessions per week), time (session time in minutes), type, and intervention period (weeks). These sub-groups are a part of the dimensions of PA which are integral in understanding how PA is assessed for clinical and research applications as well as for determining exercise prescription (Pescatello et al., 2014; Strath et al., 2013). Due to missing data for most studies on the measure of PA used, the intensity of PA as a sub-group comparison was not able to be assessed. Also, mode of PA as a sub-group was modified to PA type, as most PA interventions in included studies combined two or more types of PA or exercise in an intervention. In addition, PA frequency and time (session time) were analysed in one sub-group analysis because there were not adequate studies under each group to qualify for a split sub-group analysis. Lastly, due to considerable heterogeneity between studies regarding the type of anxiety measured or anxiety measure used, and lack of detail regarding type of anxiety assessed in some studies, it was not possible to conduct a meaningful sub-group analysis to assess the impact of different anxiety types/measures.

Sub-groups under each category were: for frequency/session time - low (< 60 minutes of PA, 3 times a week) or high (60 minutes of PA, 3 times a week); for type - single (one type of exercise) or mixed (multiple types of exercises) PA, and for intervention period - short (< 12 weeks) or long (≥ 12 weeks). Sub-groups were categorised based on the most common PA frequency, time (session duration), type and intervention period extracted from included studies.

### 2.3.7 Publication Bias

There was the need to assess publication bias (the possibility of studies with statistically significant results being more likely to be published over studies with non-significant results) in this systematic review. Egger's test was used to assess publication bias (Egger et al., 1997). The presence of publication bias was addressed using the trim and fill analysis. The trim and fill analysis imputes potentially missing studies due to publication bias and provides a bias-adjusted overall effect estimate (Jin et al., 2014).

## 2.4 Results

### 2.4.1 Search Results

An initial 6,106 studies were retrieved, of which 1,541 duplicates were removed. Screening of titles and abstracts further excluded 4,299 studies, leaving 266 studies for full text retrieval and screening. Following full text screening there were 13 included studies (see Figure 3 PRISMA diagram). Among these 13 studies, there were eight RCTs and five non-RCTs. The majority of studies excluded were due to wrong population (participants aged below 65 years), wrong intervention (no PA or exercise), wrong study design (longitudinal, cross-sectional and observational studies), wrong outcome (no anxiety measure), wrong comparison (other forms/types of PA) and others (foreign language, wrong publication type - conference abstracts, and wrong intervention period – acute single bout of PA or exercise). Full text of four studies were not retrieved due to the inaccessibility and non-response from corresponding authors following article requests.

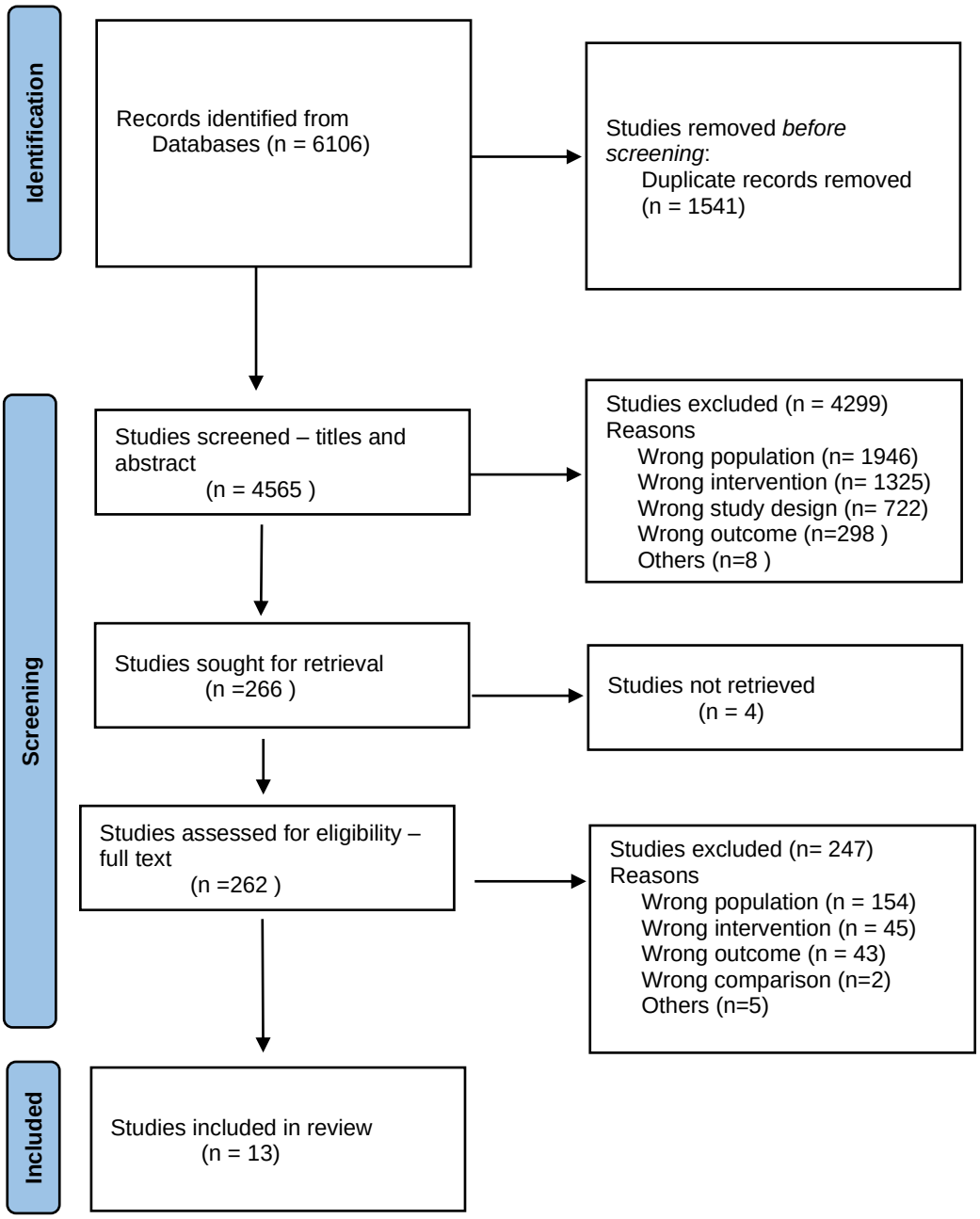


Figure 3: PRISMA flow diagramme of search and screening stages

### 2.4.2 Risk of Bias for Included Studies

Six out of the eight RCTs had an overall low risk of bias in design, conduct and reporting of the studies, whereas the remaining two studies were rated with some concerns in deviations from intended intervention and randomisation process, respectively (see Appendix

B for Cochrane RoB 2 summary). The five non-RCTs were appraised and judged to be suitable to be included in this review, as there was no risk of bias (see Appendix C for JBI critical appraisal summary). Generally, there was no detection of a high risk of bias in method and conduct in any included study.

### 2.4.3 Study Characteristics

*Participants*

A total of 719 older adults (age range 65 to 97 years) were included across all 13 studies. With the exception of one study (Cassilhas et al., 2010) which included only males, the majority of study participants were female (57.3%). Participants from 9 studies were generally healthy with no known or diagnosed medical conditions whereas participants from the remaining four studies were diagnosed with heart failure, dementia and chronic obstructive pulmonary disease (COPD). Participants were recruited from the community, care homes and clinics across the UK (n=3), the USA (n=4), Brazil (n=2), Canada (n=1), Denmark (n=1), Iceland (n=1) and Italy (n=1). Two studies (Pedersen et al., 2016; Sigurðardóttir, 2014) showed up to 39% to 49% drop out due to less interest, lack of time, injuries and pain both related and unrelated to the intervention. The remaining studies showed low to no drop out also as a result of participants' inability to make time, medication use, dislike of intervention, personal circumstances, hospitalisation, death and injuries unrelated to the intervention.

*Intervention characteristics*

Intervention characteristics are shown in Table 1. Studies adopted various types of PA or exercises including resistance or strength training, aerobic exercise, yoga and dance. Eight out of 15 studies incorporated two or more types of PA in the interventions with the remaining five focusing solely on resistance or strength exercise (Cassilhas et al., 2010; Swales et al., 2022; Zanuso et al., 2012) or dance (Vaccaro et al., 2019; Wshah et al., 2019). The frequency varied widely across all studies with PA interventions carried out once or twice per week for a few studies (n=4) and up to three to four times for all others. For intervention period and session time, a minimum period of 6 weeks and a maximum of 24 weeks were recorded with the shortest PA session time (Pedersen et al., 2016) lasting about 12 minutes and the longest (Vaccaro et al., 2019) for 120 minutes in a single session. All interventions, except one (Aguiñaga et al., 2018), were supervised in groups by researchers,

care home staff, certified dance instructors and professionals (physiotherapists, physiologists). That one study was neither supervised nor carried out in a group (Aguiñaga et al., 2018). Nine studies reported the setting of the PA intervention to be participants' homes, research centres, dance school facilities for older adults and health centres. PA interventions for the RCTs were compared with no exercise, waitlist, social games or a healthy ageing video (see Table 1 for full details). On the contrary, non-RCTs were not compared with any other group except for one study (Sigurðardóttir, 2014) that had a 'no exercise' control group.

Additionally, authors recorded adverse events unrelated to the intervention such as injuries, illnesses, hospitalisation and death with the exclusion of one study (Pedersen et al., 2016) where participants reported that trainings (resistance training and team sports) were intense resulting in minor injuries (muscle-tendon soreness) and feelings of pain during the intervention. At the occurrence of any minor injuries, participants were exempted from training until recovery (Pedersen et al., 2016).

*Physical activity measures*

For most studies, PA itself was not measured, rather physical function and fitness were assessed. The few studies (Aguiñaga et al., 2018; Pedersen et al., 2016; Witham et al., 2008; Wshah et al., 2019) in which PA was measured used both objective and self-reported measures such as Godin Leisure Time Exercise questionnaire (Godin & Shephard, 1985) and accelerometers.

*Anxiety measures*

Anxiety was measured in all included studies using self-reported measures. The most common measure used was the Hospital Anxiety and Depression Scale (Zigmond & Snaith, 1983) reported in five studies in different languages (English and Danish). Second to this was the State Trait Anxiety Inventory (Spielberger & Gorsuch, 1983) used to assess anxiety in five studies. The remaining studies used either the Beck Anxiety Inventory (Brazilian adapted version) (Cunha, 2011), Generalised Anxiety Disorder Assessment (Spitzer et al., 2006) or Philadelphia Geriatric Center Apparent Affect Rating scale (anxiety component) (Lawton et al., 1996).

**Table 2: Summary of Extracted Data and Study Characteristics**

| RCTs | N | Age (M/R) | (%) F | Loc | Health status | Type of PA | Duration (pw) | PA supervision | PA Delivery | Measure for PA | Setting | Control group | Measure of anxiety |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aguinaga et al., 2018 | 307 | 70.62 (INT) 71.43 (CON) | 76.87% | USA | Generally healthy | Flexibility, Toning and balance | 24 weeks / at least 15mins | Non supervised | I | Godin Leisure-Time Exercise Question-naire | Home | Healthy ageing DVD | HADS |
| Bonura & Pargman 2009 | 42 | 83.14 | 92.86% | USA | Generally healthy | Chair yoga/chair aerobic/wa-lking | 6 weeks/ 30mins/ 3x pw | Supervised for chair | G & I | NR | NR | social games | STAI |
| Bonura & Tenen-baum, 2014 | 98 | 77.04 | 69.81% | USA | Generally healthy | Chair yoga/chair exercise | 6 weeks/ 45 mins/ 1x pw | Supervised - Yoga instructor | G | NR | Facility for older adults | waitlist | STAI-state subscale |
| Cassilhas et al., 2010 | 43 | 65-75 | 0% | Brazil | Generally healthy | High resistance exercise | 24 weeks/ 60mins/ 3x pw | Supervised - Principal researcher/ Highly specialised auxiliary professionals | G | NR | Psychobio-logy and Exercise Research Center | no high resist-ance training | STAI |
| Pedersen et al., 2016 | 44 | 67-93 | 56.82% | Den-mark | Generally healthy | Team sports and resistance exercise | 12 weeks/12-20mins/3x pw | Supervised - elderly center's staff | G | Triaxial accelero-meter | Elderly center | No exercise | HADS - Danish version |
| Swales et al., 2021 | 11 | 86.09 | 63.64% | UK | Frail | Resistance training - machine based | 6 weeks/60 mins/3x pw | Supervised - researcher | G | NR | Care home | Waitlist | HADS |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Vedovelli et al., 2017 | 29 | 80-97 | 100% | Brazil | Generally healthy | Resistance/ strengthen-ing/walk-ing | 12 weeks/ 60 mins/ 3x pw | Supervised-Physiothera-pist/assis-tants | G | NR | Residen-tial home courtyard | No exercise | Brazilian Adapted Beck Anxiety Inventory |
| Zanuso et al., 2012 | 20 | 74.3 (INT) 67.1 (CON) | 50% | UK | Generally healthy | Strength and resistance exercise | 12 weeks/60 mins/3x pw | Supervised - exercise professional | G | NR | NR | waitlist | STAI- trait subscale |

| **Non-RCTs** | **N** | **Age (**M/R**)** | **(%) F** | **Loc** | **Health status** | **Type of PA** | **Duration (p**w**)** | **PA supervision** | **PA Delivery** | **Measure for PA** | **Setting** | **Control group** | **Measure of anxiety** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Edwards et al., 2008 | 36 | 84.6 | 86.10% | USA | Moderate to severe dementia | Moderate-intensity chair based exercise | 12 weeks/30 mins/3x pw | Supervised-Exercise physiologists and 2 research assistants | G | NR | Nursing homes | NR | Philadelphia Geriatric Center Apparent Affect Rating scale-Anxiety component |
| Sigurðard óttir, 2014 | 27 | 77.85 | 62.96% | Ice-land | Generally healthy | Low intensity aerobic/re-sistance/ strength training | 12 weeks/40 mins/2x pw | Supervised | G | NR | NR | No exercise | Generalised Anxiety Disorder Assessment |
| Vaccaro et al., 2018 | 25 | 71.2 | 68% | Italy | Generally healthy | Dance | 24 weeks/120 mins/4x pw | Supervised-2 senior dance certified instructors | G | NR | Dance school | NR | STAI |
| Witham et al., 2008 | 17 | 81.6 | 29.41% | UK | Heart failure with left ventricular systolic | Aerobic/ endurance/ resistance/ daily functional task | 12 weeks/90 mins/2x pw | Supervised | G | Accelero-meter | Outpatient - Medicine for the elderly clinics/lo-cal heart | NR | HADS |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | dysfunc-tion | | | | | | failure clinic | | |
| Wshah et al., 2019 | 20 | 73.4 | 70% | Ca-nada | Chronic Obstruc-tive pulmonary disease | Dance | 8 weeks/ 60mins/2x pw | Supervised - professional dance instructors | G | Fitbit Charge 2 Physical Activity Tracker | West Park Health Care Center | NR | HADS |

Note: RCTs = randomized controlled trials; non-RCTs = nonrandomized controlled trials; Loc = location; R = age range; INT = intervention group; CON = control group; HADS = Hospital Anxiety and Depression Scale; STAI = State-Trait Anxiety Inventory; NR = not reported; PW = per week; G = group; I = individual; PA = physical activity.

### 2.4.4 Analysis of Included Studies

Meta-analysis was carried out for the eight RCTs to assess the effect of PA on change in anxiety (Figure 4). There was a significant small negative effect that supported the effectiveness of PA in reducing anxiety in comparison to control conditions (SMD = -0.41; 95% CI = -0.58, -0.24; p <.00001). Low or no heterogeneity was recorded ($Chi^2(7) = 6.63$, p = .47; $I^2 = 0\%$).

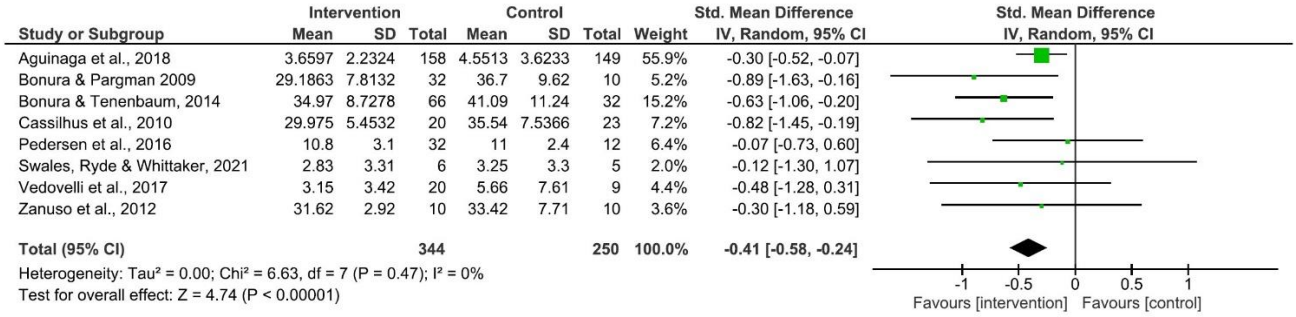


Figure 4:Forest plot of the effect of PA on change in anxiety

For non-RCTs, p-values of all 5 studies were combined using the Fisher's approach (Fishers, 1932) (see Appendix D for summary of pooling p values). Associated with this analysis is an albatross plot (Figure 5) which shows that there was a significant negative association favouring the beneficial impact of PA on the change in anxiety symptoms (Fisher's method (left): 9.36e-04 = -0.000936), with the exception of one study with an insignificant positive association between PA and anxiety (Fisher's method (right): 9.74e-01 = 0.974). Studies represented by points seen to the left of the albatross plot visually displays negative effects from the studies and to the right are the positive effects. In this review, it is clear studies generally conveyed negative effects as majority of the studies (four out of five) are seen to the left of the plot implying a reduction in anxiety symptoms and this plot confirms the results from the Fisher's approach. Also, p values for strong negative results from studies are near zero and p values for strong positive results are near 1 as seen in the plot. However, it can be seen that there is heterogeneity of effect sizes as the points are scattered across the contours and not clustered around an effect size contour.

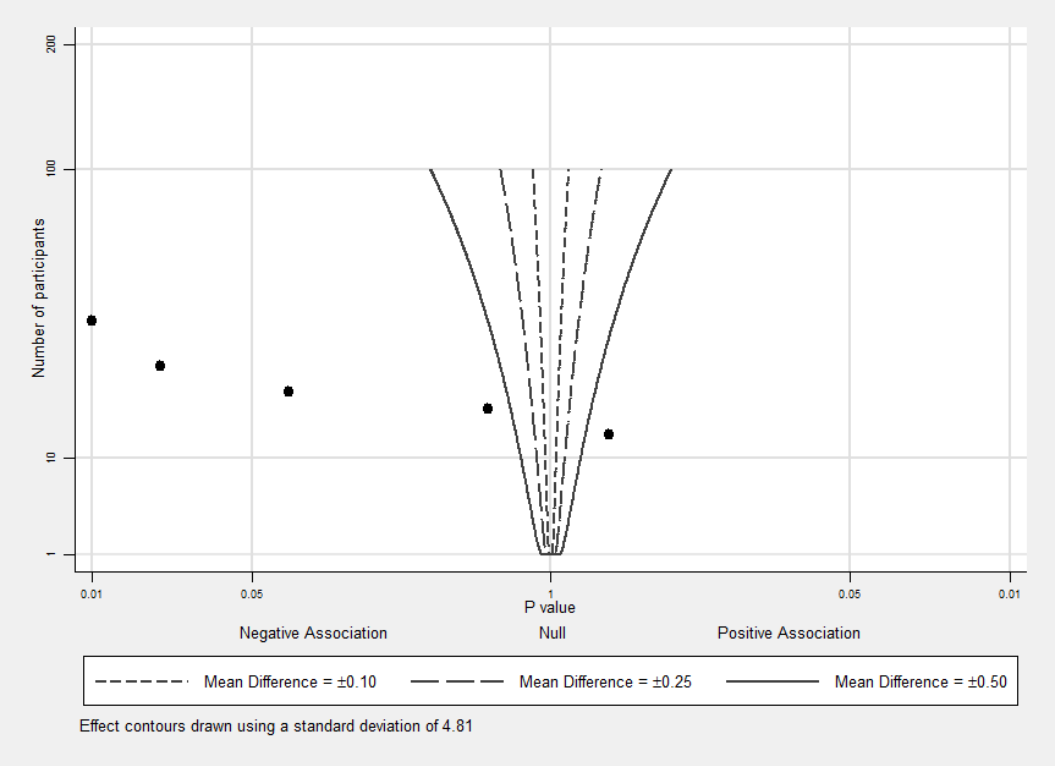


Figure 5:An albatross plot of the effects of PA on anxiety with contours from mean differences

### 2.4.5 Sub-group Analysis

All sub-groups (PA session times and frequencies, type and intervention periods) were in comparison with control groups including no exercise (Cassilhas et al., 2010 ; Pedersen et al., 2016; Vedovelli et al., 2017), waitlist (Swales et al., 2021; Zanuso et al., 2012 ; Bonura & Tenenbaum, 2014), healthy ageing DVD (Aguiñaga et al., 2018) and social games (Bonura & Pargman, 2009).

From the sub-group analysis, PA session times and frequencies lasting less than 60 mins, three times a week had a significant small negative effect (SMD = -0.42; 95% CI = -0.70, -0.15; p = .003) and low to moderate heterogeneity ($Chi^2(3) = 4.53$, p = .21; $I^2 = 34\%$). There was a significant moderate negative effect (SMD = -0.54; 95% CI = -0.95, -0.14; p = .009) and no significant heterogeneity ($Chi^2(3) = 1.58$, p = .66; $I^2 = 0\%$) in the sub-group where the PA session lasted 60mins, with a frequency of three times a week. Therefore, both 60 minutes, three times a week of PA and PA for less than 60 minutes three times a week are effective when compared to the control groups even though there were variations in effect magnitude. Again, no differences ($Chi^2(1) = 0.23$, p = .63; $I^2 = 0\%$) were revealed for impact

on anxiety between the sub-groups of PA time (session time) and frequency (see Appendix E for forest plot).

There was a significant small negative effect of mixed PA type (SMD = -41; 95% CI = -0.62, -0.19; p = .0002) with low heterogeneity ($Chi^2(4) = 4.60$, p = .33; $I^2 = 13\%$) compared to the control groups. A significant moderate negative effect (SMD = -0.56; 95% CI = -1.03, -0.09; p = .02) was seen for one PA type with no heterogeneity ($Chi^2(2) = 1.55$, p = .46; $I^2 = 0\%$). This is to say both mixed and one PA type in comparison with the control groups were effective in reducing anxiety although the effect was larger for one type. There were no significant sub-group differences between mixed and one PA type ($Chi^2(1) = 0.35$, p = .55; $I^2 = 0\%$) (see Appendix F for forest plot), both relating to reduced anxiety.

Long and short PA intervention periods (long = ≥ 12 weeks, short = < 12 weeks) were compared to their respective control groups in a sub-group analysis (see Appendix G for forest plot). The sub-group analysis of long and short intervention period showed a significant small negative effect (SMD = -0.34; 95% CI = -0.53, -0.15; p =.0005) for long intervention period and a significant moderate negative effect (SMD = -0.65; 95% CI = -1.00, -0.29; p = .0004) for the short intervention period sub-group. There was no heterogeneity within individual sub-groups of PA intervention period (long intervention; $Chi^2(4) = 3.19$, p = .53; $I^2 = 0\%$; and short intervention ; $Chi^2(2) = 1.20$, p= .55; $I^2 = 0\%$), however, moderate to substantial heterogeneity was shown ($Chi^2(1) = 2.25$, p = 0.13); $I^2 = 55.5\%$) across both the long and short PA intervention periods. This means there were slight differences in the overall magnitude of impact of short PA intervention periods and long intervention periods each compared to controls on anxiety but both durations were effective albeit with heterogeneity across studies.

### 2.4.6 Publication Bias

The regression-based Egger test (Egger et al., 1997) was insignificant (p=.07), even though the standard funnel plot showed slight asymmetry (Appendix H) suggesting a possible presence of publication bias among other reasons for funnel plot asymmetry (Sterne et al., 2011). A follow up trim and fill analysis [-0.93, 95%CI (-3.2 to 1.36) p= 0.426, $I^2$ =68.2 %] was conducted and the estimates were adjusted in the direction of the Egger's test (intercept = -0.29) which supported the possibility of publication bias as three additional studies were imputed (Appendix H). However, this finding should be interpreted with caution as the Egger's test and funnel plots are more appropriate when the review involves 10 or more studies (Sterne et al., 2011).

## 2.5 Discussion

This systematic review and meta-analysis sought to explore the effectiveness of PA at reducing anxiety symptoms in older adults and the role PA dimensions (frequency, session time, type and intervention period) play in PA effectiveness. PA was found to be effective in reducing anxiety in older adults, with small to moderate effect sizes. In addition to the overall effectiveness of PA, further analysis revealed dimensions of PA such as intervention frequency and session time, type, and intervention period influenced the effectiveness of PA in managing anxiety, such that all PA types, session times, frequency and intervention periods were effective when compared to the control groups but showed moderate differences in effect magnitude. This implies that older adults aged 65 years and above with anxiety; whether formally diagnosed or undiagnosed can manage their anxiety levels by engaging in PA. They might take into consideration how long they exercise, what type of PA they engage in and how frequently they exercise, as effects may be stronger for just one type of PA, shorter duration interventions and PA sessions lasting 60mins, three times a week.

The above findings are not surprising as included studies with the exception of one by Sigurðardóttir (2014) found a significant negative association between PA and anxiety in older adults and these findings are reflected in the results of this review. This potentially supports the anxiety exposure and sensitivity mechanism which is that engaging in frequent exercise helps to manage anxiety-related sensations because bodily responses while exercising are likened to reactions when one is feeling anxious (Broman-Fulks & Storey, 2008; Smits et al., 2008). Thus, frequent exercise compared to none would increase such sensations and might be expected to make people less likely to catastrophize or respond in other negative ways to similar physical sensations associated with anxiety. However, other mechanisms may be responsible for this effect.

Like the present review, recent reviews such as Kazeminia et al., (2020) and Mochcovitch et al., (2016) who looked at effects of PA on anxiety in older adults, but failed to explore the dimensions of PA, support the anxiety-reducing effects of PA. Several factors could account for the effectiveness of PA. As mentioned by Mochcovitch et al., (2016), regular and supervised PA increases the effectiveness of PA, and this can be seen in this present review as 93% of included studies were supervised by either health professionals or researchers. The presence of supervision may have served as a source of motivation to participants and increased PA adherence which can improve the effectiveness of PA. Also, the extensive knowledge trained supervisors have in PA may have contributed to the delivery

of PA instructions during the intervention which could have improved the effects of PA on anxiety. This assumption is consistent with several other studies (Bonura & Pargman, 2009; Conn, 2010; Fennell, 2016; Kasim et al., 2020; Ntoumanis et al., 2017). In contrast, other studies suggest unsupervised PA is as effective as supervised PA (Aguiñaga et al., 2018; Atalay & Cavlak, 2012). However, there were not sufficient unsupervised interventions in this review to be able to compare this in a sub-group meta-analysis.

In addition to this, group-based PA might have contributed to the benefits of PA on anxiety. A good number (n=12) of PA interventions reviewed in this study adopted a group-based mode of delivery. This is in line with findings from Burke et al., (2006) who concluded that, as the presence, contact and/or social support from others such as health professionals, researchers and other participants increases during a PA intervention, so do the beneficial effects of PA. Other studies have also reported similar findings (Burke et al., 2006; Kahn et al., 2002; Komatsu et al., 2017; Smith et al., 2018). However, as stated before there were insufficient RCTs not conducted in a group to meta-analyse and compare this in the present review.

Further analysis revealed moderate effects for PA intervention periods that lasted < 12 weeks, with those lasting longer than 12 weeks reporting a small effect both compared with control groups. This suggests PA intervention periods lasting less than 12 weeks or 12 weeks and more both reduce anxiety in older adults but vary in magnitude of effectiveness. It is uncertain what accounts for this finding, but it may be a result of better PA adherence over a shorter period as opposed to longer period where enthusiasm might decrease with time. This finding may, however, be limited by the poor representation of studies with PA interventions less than 12 weeks included in the sub-group analysis and the moderate to substantial heterogeneity recorded between the sub-groups. PA interventions of 12 weeks or more are widely recommended to be preferred and acceptable intervention time for managing anxiety in older adults and nine out of the 13 included studies supports this assertion.

Notwithstanding this, acute, single bout and short PA interventions have elicited similar positive effects in reducing anxiety in older adults (Bonura & Tenenbaum, 2014; Youngstedt, 2010). In agreement with this finding is a recent systematic review revealing PA intervention periods between three to 12 weeks significantly reduced anxiety as compared to no exercise (Herring et al., 2010). Notwithstanding this, efforts should be made to promote long term engagement in PA and adherence strategies as anxiety is only managed or reduced after PA.

Another key finding of this review was the moderate effect of engaging in one type of PA whereas there was a small effect for partaking in multiple types of exercise, however, both were effective when compared with the control groups. This implies engaging in either one single type or multiple types of PA reduces anxiety symptoms in older adults. It is worth noting that studies categorised under one type of PA largely were resistance training. Anxiety has been related to changes in cortisol and disruption in the hypothalamic-pituitary-adrenal (HPA) axis (Chrousos, 2009; Vreeburg et al., 2010). Similarly, resistance training has also been associated with reducing cortisol levels which can result in improved anxiety symptoms (Agha-alinejad et al., 2013; Strickland & Smith, 2014). Even though there is a paucity in studies drawing a direct connection between anxiety, cortisol levels and resistance training, evidence supporting the anxiolytic effects of resistance training are robust (Cassilhas et al., 2010; Kucharski et al., 2019; Pedersen et al., 2016; Swales et al., 2022). For engaging in multiple modes of PA, despite the small effect reported in the current review, authors have encouraged the combination of different exercises in PA interventions to improve anxiety due to the benefit to other important outcomes such as physical function (Rezola-Pardo et al., 2020; Rogers et al., 2018).

Further, there appear to be limited differences on anxiety with the frequency and session time of PA. From this review, PA lasting 60 minutes three times a week is effective in reducing anxiety as is shorter PA sessions and a fewer number of sessions, but to a greater extent. This finding corresponds with the WHO guidelines on PA and sedentary behaviour. The World Health Organization (2020b), recommends that older adults aged 65 and above should do at least 150-300 minutes of moderate-intensity aerobic PA or 75-150 minutes of vigorous-intensity aerobic PA weekly, plus three days of strength and balance activities to achieve health benefits across a range of outcomes. The WHO recommendations have been accepted worldwide as the benchmark. In addition, there is strong evidence that supports the benefits of more frequent exercise in managing anxiety symptoms and disorders (Cassilhas et al., 2010; Vedovelli et al., 2017; Zanuso et al., 2012). Notwithstanding this, engaging in less than 60 minutes of PA 3 times weekly (below WHO guidelines) has also been shown to be effective in reducing anxiety symptoms. Similar to this finding, Petruzzello et al., (1991) reported that at least 21 minutes of exercise elicited reductions in trait anxiety. In the same way, a report from the United States Department of Health and Human Services supports the efficiency of at least 10 minutes of exercise (Physical Activity Guidelines Advisory Committee, 2018). In association with findings on PA frequency, less emphasis has been placed on this dimension (Yang, 2019). Appropriate PA frequency and session time may,

however, be dependent on the mode of PA (aerobic, resistance, strengthening or balance and stability training) and the capabilities of older adults as the WHO and UK Chief Medical Officer's Physical Activity guidelines and recommendations are in reference to aerobic and strength/resistance exercise (Department of Health and Social Care, 2019; World Health Organization, 2020b). It is worth noting that the lowest combined PA session time and frequency in the present review was 12 to 20 minutes, three times a week (Pedersen et al., 2016), which showed a significant effect for lower intensities in relation to relatively frequent PA, albeit not meeting WHO guidelines, thus PA frequency should be explored extensively along with PA intensity.

### 2.5.1 Strengths, Limitations, and Recommendations

The present review is the first where authors have highlighted the dimensions of PA and the extent to which they affect the effectiveness of PA on anxiety in older adults aged 65 years and above. Other studies have either recruited general populations, older adults below 65 years or have not compared the effectiveness of different PA dimensions (Herring et al., 2010; Mochcovitch et al., 2016). Further, the possibility of ascertainment bias may have been reduced due to the inclusion of grey literature in this review (Sigurðardóttir, 2014). In the same way, there was low to no overall risk of bias for included studies implying results convey actual treatment effects (Higgins et al., 2011). Another strength is the use of a standard procedure to assess the risk of bias in RCTs. This review made use of the Cochrane risk of bias tool which is clear and concise with theoretical and empirical supporting evidence (Jørgensen et al., 2016). Additionally, the inclusion of RCTs reduces the probability of results being affected by confounding variables and biases that arise from placebo effect (Shrier et al., 2007).

There are, however, several limitations; one is that in most included studies the authors did not report how PA was measured or how intense the PA was. For this reason, sub-group analysis was not possible for PA intensity. Therefore, there is the need for future studies that explore the ideal PA intensity that maximises effects on anxiety in older adults and to clearly report how PA was measured. A limitation of the studies included in this review is the high dropout rates reported which may have limited findings of certain studies (Pedersen et al., 2016; Sigurðardóttir, 2014). Based on this, it would be worth exploring the association between PA adherence and its effectiveness in treating anxiety in older adults. Also, the method of analysis (combining p values) adopted for the non-RCTs has its own shortcomings as this does not reveal the magnitude of the effect. However, this method of

analysis was appropriate because studies did not include any more statistical data other than p values. In addition, findings from non-RCTs that showed a significant negative association may have been as a result of an effect in only one study, therefore results should be interpreted carefully (McKenzie & Brennan, 2021). Another limitation was that searches were filtered to include studies in English language which may have led to a possibility of ascertainment bias. This could not have been avoided as translation of studies was not feasible. Further, participants in the included studies were generally healthy with no clinically diagnosed anxiety disorder or known anxiety symptoms except for in one study (Aguiñaga et al., 2018) where a sub-sample of participants with high baseline anxiety scores (≥ 8 on Hospital Anxiety and Depression subscale) were analysed separately. The majority of generally healthy participants may have contributed to the small to moderate effects of PA observed. It is possible that larger effects may be seen in older adults diagnosed with anxiety disorders or high anxiety symptoms as reported in Aguiñaga et al., (2018) and this would be worth exploring in future studies. Lastly, findings from the Egger's test and funnel plot for assessing the presence of publication bias should be interpreted with caution as it is recommended that these analyses should be carried out for reviews with 10 or more included studies (Sterne et al., 2011).

### 2.5.2 Conclusion

This systematic review and meta-analysis presented the impact of PA on reducing anxiety symptoms in older adults aged 65 years and above. It highlights more beneficial levels of dimensions (frequency, session time, type, and intervention period) of PA interventions in achieving greater improvements in anxiety. In view of this, authors of future studies can make use of more appropriate PA frequencies, session times, types, and intervention periods in designing interventions. Incorporating these aspects and more have also been recommended for the accurate reporting of PA and exercise interventions (Hoffmann et al., 2014; Pescatello et al., 2014). Authors may want to consider engaging older adults in one or multiple types of PA over an intervention period of six to 24 weeks or up to 12 weeks lasting up to 60 minutes, three times a week or less as these are effective to achieve reduced anxiety symptoms. It is worth bearing in mind that effects were largest for one type of PA (which was typically resistance training), durations of up to 12 weeks and sessions lasting 60 minutes, three times a week.

Consequently, this review adds to the broad existing evidence on PA and anxiety which can inform healthcare policies for older adults. However, there is still inadequate evidence on the ideal intensity and mode of PA to increase the anxiolytic effects of PA in older adults. Further investigation into how frequently older adults should engage in different modes of PA is also recommended, as this is still inconclusive.

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## Chapter 3: Methods for the danceSing Care Evaluation Projects

This chapter highlights the methodology with its justifications of the two danceSing Care projects reported in Chapters 4 and 5. This chapter also points out my unique contributions and procedures carried out in line with the focus of this thesis.

danceSing was founded in 2016 with the aim of transforming lives by creating a vibrant community that recognises self-expression, joy and connection through music and movement. danceSing is a creative health, wellbeing, and fitness company that offers on-demand online wellbeing resources to the general population. On the danceSing website, wellbeing resources contained pre-recorded music-only sing-along sessions as well as music and movement sessions incorporating classes with an instructor to follow using different types of dance movements including ballet, ballroom, etc, plus on-demand live online session access. This resource was mainly focused on staff wellbeing. In 2021, the danceSing resources were expanded to include a more tailored online music and movement resource designed in consultation with health professionals exclusively for older adults, known as danceSing Care. danceSing care is primarily intended to enhance the wellbeing of older adults, particularly those in care settings such as nursing homes, residential care facilities, or community care environments. The key components of danceSing care include dance/movement, singing, and music all of which are delivered online upon subscription to the online resource. The dance/movement component involves simple, choreographed, or freestyle movements that can be carried out either sitting, standing, or in bed depending on participants' mobility and capabilities. These movements have been categorised into exercises that focus on strength, mobility, flexibility, circulation, conditioning, balance, stability, and posture. All the movement sessions are accompanied by music, however, the music/singing only sessions can be accessed from the "music and radio" or "singing and sound" sections. These sections cover sing-alongs/compilations, guided learning, soundscapes, concerts, 24/7 radio, disco, classical sounds, Roger's reminiscence, meditation, themed and special interest.

A call for collaboration with an academic institution was received via Interface (a programme to match industry with academics) to evaluate the wellbeing effects of the online music and movement sessions delivered by danceSing Care. The danceSing Care programme was considered an ideal opportunity to assess the psychosocial impact of physical activity in older adults in care homes, which was one of the main objectives of this thesis. The danceSing care resource was considered appropriate for this PhD because it offered varied

types of movement, session durations, movement intensities and frequency eventhough there are specific recommendations based on research (De Nys et al., 2024; Ofosu et al., 2023b). This is in line with the FITT (frequency, intensity, type and time) principle that has been reported to be useful in designing and implementing exercise programs to achieve a desired outcome (Adi, 2021; Baschung Pfister et al., 2015). Also, the danceSing care resource corresponds with the theory of music, mood and movement which proposes that music alters mood, acts as a cue for movement and makes PA enjoyable (Murrock & Higgins, 2009). This theory also suggests that the music component as part of a PA intervention positively impacts PA engagement, adherence and potentially leads to improved wellbeing outcomes (Bonassi et al., 2023; Murrock & Higgins, 2009). The present thesis supervisors met with myself and the other student working in this area, prepared a tender for an in-kind exchange of resources (resource and care home access in exchange for research design, conduct, analysis and reporting) to submit to danceSing Care, which was accepted, so the danceSing Care project formed a significant part of this thesis.

The danceSing Care project had two phases. Phase one was a pre-post feasibility study conducted as a realist evaluation of a digital music and movement intervention for older people living in care homes. Data collected in phase one then informed phase two: a pilot randomised controlled trial (RCT) of the digital music and movement sessions carried out in care homes. The care homes recruited for this project were predominantly residential and nursing care homes. These care homes offer a structured supportive environment comprising of appropriate living arrangements (private/shared room/communal areas), individualised care and support (personal/nursing/medical/dementia specialist), wellbeing activities (PA, arts, crafts, outings), catered meals (including feeding where necessary), safety and security all geared towards the overall wellbeing of residents in care homes. The care home staff especially activity coordinators (ACs) also known as wellbeing coordinators played a vital role in this project. ACs assisted researchers with recruitment and data collection, and they facilitated the weekly sessions for 12 weeks in both phases of the danceSing Care project as a demonstrator and activity leader alongside the danceSing care online pre-recorded session. These responsibilities were in some cases supported by carers who also played the role of ACs or vice versa and were overseen by care home managers. As a researcher, I supported the recruitment of residents, led data collection, data analysis and monitoring of the intervention adherence with contributions from my colleague (LDN) and supervisors. The section below describes the methods for the danceSing Care project.

### 3.1 Research Design

Phase one of the danceSing Care project was designed and planned in consultation with an advisory group (AG). The AG consisted of stakeholders involved with this study, including older adults recruited from Stirling 1000 elders (an existing group of older adults engaged with research - https://1000elders.stir.ac.uk/ ), danceSing Care staff (NG, CH, LF and KF), selected care home staff from the Balhousie Care Group and RCH care homes (SH - Head of Operations, LD - Clinical Care Quality Manager, LB- Group Head of Corporate Services, EH- Head of Dementia and Development, AD – Marketing Manager), and the research team (AW, JC, GR, EO, LdN). The AG was set up to discuss and determine the relevant outcomes of interest to all stakeholders, the best measures to address these outcomes, the facilitation of the study, and the necessary resources needed for a successful implementation. These discussions happened over four online meetings using Microsoft Teams. The AG was actively involved in choosing the appropriate standardised surveys, objective stress measures, physical function tests, and interview questions for the older adult population. Two older adults from the AG volunteered to pilot the surveys and interview questions; similarly, care home staff gave feedback on the focus group questions developed for use with carers and activity coordinators.

Phase one adopted a mixed method and realist evaluation approach for evaluating the feasibility of the intervention in care homes for a future RCT. The realist evaluation followed the RAMSES II reporting standards (Wong et al., 2016) and was used in addition to the context (C), mechanism (M), and outcome (O) configuration which is the basis of a standard realist approach to creating a programme theory (Wong et al., 2016) The CMO configuration aims to uncover how a programme works or what influences the effectiveness of the programme (M), conditions in which the programme operates (C) and the results that occur as a result of the programme (O). There was the need to understand under what circumstances the intervention was feasible to inform a future RCT further and interpret the results accordingly, thus the reason for adopting the realist evaluation and CMO configuration. In addition to the realist approach, feasibility outcomes were assessed, and pre- and post-intervention multidimensional health markers (anxiety, depression, loneliness, fear of falling, quality of life, health status, appetite, sleep, and perceived stress). Participants engaged in a 12-week intervention, completed pre- and post-intervention surveys and a sub-sample of four residents were interviewed, and five care home staff engaged in two focus groups. The interviews and focus groups were to address feasibility outcomes which included adherence

(besides the weekly attendance), suitability of measures, and challenges with the facilitation of the intervention in care homes. Due to the Covid-19 restrictions at the time, the initial plan made by the AG for survey measures to be completed in person was changed to include online engagements if possible.

Phase two started as a mixed methods pilot randomised controlled trial with a waitlist control group where participants were randomised into two groups (intervention and waitlist groups). The intervention group took part in the 12 weeks of intervention, whereas the waitlist group was to only have access to the intervention after the post-intervention measures. These were psychosocial surveys (anxiety, depression, fear of falling, loneliness, and quality of life), and physiological outcomes – (1) a survey on stress and sleep, (2) objective measures of stress (cortisol and DHEA), (3) physical function testing (Short Physical Performance Battery and Fried frailty criteria). A waitlist control group was to ensure that other participants could participate in the intervention later, reducing participants' feelings of being left out entirely. For ethical reasons, waiting list control conditions were preferred to no treatment because withholding participants from a possibly effective intervention is considered unethical and could be detrimental (Elliot & Brown, 2002). A red, amber and green progression criteria approach was adopted to gauge the progress of the study into a full-scale RCT based on recruitment, intervention fidelity, attendance, retention rates, and safety data.

The danceSing Care project had ethical approval from the University of Stirling Non-invasive Clinical Research panel; NICR 2021 3735 3607. Phase one was retrospectively registered on 29/09/2022 at ClinicalTrials.gov (NCT05559203). Phase two was registered on 01/11/2022; ClinicalTrials.gov Identifier: NCT05601102.

### 3.2 Participants and Recruitment

Participants included in phases one and two of this project were older adults aged 65 years and above, resident in Balhousie and Holmes care homes, respectively, with the capacity to consent. Participants with cognitive impairment were included as long as they had capacity to consent, understood what the study was about, and any other information presented in the Participant Information Sheet (PIS) (see Appendix J). Also, to be eligible, participants must have been available to complete 12 weeks of movement and music programme. Participants were excluded if they were participating in another study that could influence the current study's findings, had pre-existing health conditions that could interfere with their ability to complete the programme and could not comprehend written/spoken

English. Participants without capacity to consent who relied on personal or nominated consultees were excluded because it was not feasible to get ethics approval from the NHS for engaging with those lacking capacity to consent especially during the peak of Covid-19 restrictions and also the possible lack of capacity for such participants to comprehend what is expected of them in the study. All participants gave informed written consent.

For phase one of the study, recruiting of participants was mainly initiated by the activity coordinators (ACs) in care homes as the research team was not allowed to visit the care homes due to the Covid-19 restrictions at that time. A simplified poster (see Appendix I) detailing basic information about the research in plain language was designed by the research team and distributed across all the care homes involved with the danceSing Care Project. Information on the poster included what the study was about, how long the study takes, voluntary participation, and how to be a part of the study if a resident was interested. However, the recruitment of participants for phase two was done jointly by the research team and the ACs in the respective care homes in person. This was possible because there were no longer Covid-19 restrictions in place by this stage. To improve the recruitment process and better gauge participants understanding and capacity to consent in phase two, eligible participants' capacity to give informed consent was gauged first by the AC, and then by the research team using the British Psychological Society (BPS) Capacity checklist (British Psychological Society, 2010). The BPS Capacity checklist covered areas of (1) enabling capacity- providing the appropriate information, time, and environment for a voluntary decision to be made, (2) diagnostic assessment – checking for any evidence of cognitive impairment and its effects on decision making in line with the research and (3) functional assessment – understanding the research and having the choice of agreeing or refusing to participate. Using the BPS capacity checklist, researchers used appropriate communication when highlighting the research details on the Participant Information Sheet. They ensured that potential participants decided based on their understanding of the research information.

The sample size for phase one was not formally calculated but was estimated pragmatically based on the ten care homes involved and the residents who showed interest in the research, as the research was a feasibility study (Billingham et al., 2013). It was estimated that five residents would be recruited from each of the ten care homes based on the number of residents in the participating care homes and the inclusion criteria presented, but this was not successful in two care homes. In those two care homes, three and four participants were recruited, respectively.

On the other hand, for phase two, the G*power software was used to determine the sample size for the study's outcomes. In calculating the sample size, the statistical test (ANOVA: Repeated measures, within-between interaction) and power of the analysis (*A priori*: compute required sample size) were selected, with $\alpha = .05$, power = .80, Standardised Mean Difference (SMD) = -.27 (anxiety) giving a sample size of 110 and with a 20% attrition rate, this makes the estimated minimum sample size for a full-scale RCT 132. The SMD used for the sample size calculation was based on the effect size from the previous systematic review that showed a significant small negative effect, implying that physical activity reduces anxiety in older adults (Ofosu et al., 2023a). At the recruitment stage of phase two, the researchers aimed to recruit 60 participants considering that some studies have argued that a sample size of 18 to 34 participants for the intervention group of a pilot RCT is acceptable and may potentially result in significant outcomes (Browne, 1995; In, 2017; Lewis et al., 2021) and given that Holmes care group estimated 110 would not be feasible due to the restrictions on not recruiting individuals lacking capacity to consent.

A sub-sample of participants was interviewed at each phase, and care home staff (ACs) involved in the danceSing Care project engaged in focus groups or were interviewed. For interviews, a minimum sample of six participants is recommended (Braun et al., 2016) and it was hypothesised that recruiting the total sample would have resulted in data saturation, thus recruiting a sub sample was considered ideal at both phases. The sample size of participants recruited for interviews for phase one (n=4) was below the recommended number, and this was due to practical reasons such as poor response rate and the severity of cognitive impairment (little to no memory of the intervention). For phase two, seven participants were interviewed, and this was deemed to be an appropriate sample size based on the scale of the study. Also, five ACs were interviewed in phase two and this was a good representation of the ACs from the recruited Holmes care homes. The interviews and focus groups were carried out to report more comprehensible and in-depth results on the feasibility of the intervention and its effects on the multidimensional health of older adults. The qualitative research method was useful because it appropriately answered questions on 'how' and 'why', and experiences and circumstances in which this intervention worked or did not (Busetto et al., 2020). In the same way, a sub-sample of participants was tested on salivary cortisol and DHEAS in phase two, which was the focus of the other PhD student on this project.

### 3.3 Outcomes and Measures

Five standardised questionnaires were used to measure the outcomes of interest to this PhD with anxiety/depression being the primary outcome and fear of falling, loneliness and quality of life making the secondary outcomes. The questionnaires were administered as self-completing or read out to participants to suit the varying capabilities of participants recruited from the care homes. Below are sub-sections of the outcomes and standardised questionnaires used in both phases of the study, except for the EuroQol five-dimensional descriptive system (three-level version) (EQ-5D-3L) which was only used in phase one. The EQ-5D-3L was excluded from the measures used in phase two because some measured domains were overlapping with the outcomes of some measures already included in the survey; for example, anxiety/depression was captured using the HADS and mobility and usual activities recorded from the Dartmouth COOP Functional Assessment Charts. Also, domains such as self-care, pain, and discomfort were not of interest to stakeholders of phase two of the project coupled with the feedback from phase one, which highlighted the questionnaire burden on participants and the need for less burden in phase two, informed the decision to eliminate the use of EQ-5D-3L. The AG selected the above outcomes out of the many psychosocial outcomes because the said outcomes were pertinent issues affecting older adults especially residents in care homes. In the same way, several measures that could address the outcomes selected were presented to the AG and stated below were the chosen measures based on the appropriateness of the items and briefness of the questionnaires.

As part of the survey for the danceSing Care project, socio-demographics included age, gender, relationship status, ethnic group and level of education. Participants were presented with options that covered the wide range of possible responses for each item measuring socio-demographics including a ‘prefer not to say’ option if participants were reluctant to disclose such information.

*Anxiety and Depression*

The Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983) was used to measure symptoms of anxiety and depression in older adults. The HADS scale has been validated (Cronbach’s alpha for HADS anxiety= 0.87, HADS depression = 0.81) in older adults with or without cognitive impairment, therefore was suitable for residents in care homes as the majority of residents in care homes have some level of cognitive impairment (Djukanovic et al., 2017; Gordon et al., 2014). This scale had two subscales that covered

symptoms of generalised anxiety disorders and anhedonia with seven items each (Snaith, 2003). For each subscale, items had a four-point response scale ranging from zero to three, with likely total scores of zero to 21. Scores from zero to eight, eight to ten, and 11 to 21 were regarded as normal, borderline, and abnormal cases of depression or anxiety. Internal reliability in the phase one study sample was 0.81 (anxiety); 0.57 (depression), and in phase two was 0.85 (anxiety) and 0.66 (depression)

*Fear of falling*

Participants' concerns and fear of falling were measured using the Falls Efficacy Scale – International (FES-I) short form recommended by the World Falls guidelines (Montero-Odasso et al., 2022). The FES-I was validated in older adults with a Cronbach's alpha of 0.92 (Kempen et al., 2008). This scale comprised seven items with a four-point Likert scale ranging from one (not at all concerned) to four (very much concerned). An example item on the measure was, 'How concerned are you that you might fall when getting dressed or undressed?' Scores on this scale will range from seven to 28, with scores of seven to eight indicating low concerns about falling when engaging in activities of daily living (social and physical), nine to 13 suggesting moderate concerns, and 14 to 28 showing severe concerns about falling. Cronbach's alpha for reliability of the FES-I in phase one was 0.91 and in phase two was 0.93

*Quality of life and Health status*

The Dartmouth Cooperative (COOP) Functional Assessment Charts assessed the quality of life and overall health status of participants for the past two weeks in areas of physical fitness, activities of daily living, feelings, social activities, and changes in health. This assessment comprises six pictorial charts with titles and questions corresponding to the domains of interest. Responses to items on these charts are illustrated with a simple drawing and scores on a five-point ordinal scale ranging from one (no limitation at all) to five (severely limited) for all items except the change in health item where one and five means 'much better' and 'much worse' respectively (Nelson et al., 1987). The Dartmouth COOP is appropriate for older adults with or without cognitive impairment and has test-retest reliability coefficients ranging from 0.67 to 0.82 (Meyboom-de Jong & Smith, 1990). For phase one study, internal reliability was 0.71 and phase two was 0.80.

In addition to the Dartmouth COOP Functional Assessment Charts, the EQ-5D-3L was used in phase one to measure the quality of life and overall health status. The EQ-5D-3L

measured how participants felt about dimensions of their health while completing the questionnaire across the domains of mobility, self-care, usual activities, pain/discomfort, and anxiety/depression giving participants three response options from no problems to considerable problems. As part of the EQ-5D-3L, a single item with a 0 to 100 scale of how one generally feels about their health presently was included, where 0 implied the worst health state, and 100 was the best. Studies have reported that single item self-rated health question has a strong relationship with mortality and a good predictor of morbidity (Desalvo et al., 2006). The EQ-5D-3L Cronbach's alpha was 0.82.

*Loneliness*

The Brief UCLA loneliness scale (ULS-6) measured participants' feelings of loneliness. This scale evaluated how they felt about companionship, isolation, and belongingness, captured in six items (Neto, 2014). The ULS-6 is a four-point Likert scale from one (never) to four (often), with the possible lowest score of six indicating little to no feelings of loneliness and the highest score of 24 showing increased subjective feelings of loneliness. For example, one item reads, 'Thinking about how you feel right now with 1 being never and 4 being often, how often do you feel you lack companionship?' ULS-6 has been validated in older adults with Cronbach's alpha of 0.82 (Neto, 2014). However, for phase one study, Cronbach's alpha was 0.78 and 0.85 for phase two.

### 3.4 Procedure

For both phases, participants were invited to participate in the study using recruitment material (poster)(see Appendix I). The poster used contained graphics and summarised details on the study, and this was presented in plain language to make it more interactive and improve understanding. At each phase, care home staff (ACs, care home managers and operations managers) received training and briefing sessions from the research and the danceSing Care team. These sessions covered (1) how to assist with recruitment, (2) assessing, facilitating and delivering the intervention, and (3) helping with questionnaire completion (at phase one). In addition to the training and briefing sessions provided, care home staff (ACs) received documented information (starter pack) about the danceSing Care online resource, details covered at the training and contact information of the research and danceSing Care team. Care home staff were also invited to join a private Facebook group that helped to build connections, created a sense of community and served as another means of communication among the care home staff, danceSing Care and the research team.

*Phase 1*

For phase one, interested participants were briefly assessed by the care home staff on their capacity to consent. Participants with the capacity to consent were recruited and presented with the Participant information sheet (PIS) (see Appendix J) online by researchers (EO and LDN) or in person by the care home staff. Due to the Covid-19 restrictions at that time, baseline measures were completed online via a survey link sent to the care home staff, who assisted participants in completing questionnaires. Another option for completing baseline surveys online was through a Microsoft Teams meeting with researchers, where researchers read out items and response options from the measures to participants. Paper questionnaires were used in care homes with poor internet connection. Care home staff assisted participants with completing the questionnaires for such homes. Different options for completing surveys were made available to the care homes to suit the varying situations and contexts in care homes and also not to over burden care home staff.

Participants were then enrolled for 12 weeks of the intervention and recommended to have three movements and one music session each week in phase one; in phase two, two movement and music and one music only session weekly. Reminder emails for attendance forms were sent from AW to ACs and follow up calls were made by EO to the care homes weekly. Follow up calls revealed specific circumstances and feedback from care homes that affected facilitation and adherence to the intervention (see Appendix K for field notes). Weekly attendance (sessions delivered and residents' attendance) was recorded, compiled and sent to AW weekly via email by the ACs from the various care homes (See Appendix L for attendance sheet template). After the intervention period, post-intervention surveys were completed in the same way as the baseline surveys.

Four residents and five ACs were interviewed and engaged in two focus groups, respectively by EO. As Covid regulations were eased after the intervention, in-person interviews were conducted. However, due to the difficulty in mobilising ACs from different care homes, the two focus groups were carried out online. For the interviews and focus groups, a separate Participant Information sheet and consent form were presented to residents in person and sent to ACs via email ahead of the online focus group. Interviews were recorded using a mobile device, and focus groups on Microsoft Teams were recorded with an automated transcription after consent was sought from residents and care ACs.

*Phase 2*

For phase two, researchers (EO and LDN) and ACs jointly assessed participants' capacity to consent, and researchers additionally checked participants' understanding of the study using the BPS Capacity checklist. Participants with the capacity to consent were given a brief face-to-face introduction to the study by EO. Additionally, participants were presented with the PIS, and consent was sought using the consent forms. Recruited participants were assisted by EO and care home staff to complete baseline questionnaires in private areas (empty lounges, bedrooms) to ensure privacy and confidentiality. A random sub-sample was invited by LDN to participate in physical function tests and saliva sampling for salivary cortisol and DHEAS at baseline and post-intervention, but this was the focus of the other PhD student working in this area.

Participants were then allocated to the intervention and control (waitlist) group using the Randomization Allocation Software (1:1 sequence). Participants were allocated ID numbers by researchers, and researchers carried out a computer-generated random assignment sequence using the ID numbers. Researchers, ACs and participants were not blinded to the group allocation after the pre intervention assessments because the participants on the waitlist- control group and ACs had to know who was due to take part in the intervention and when. At the recruitment stage, it was communicated to participants they might be randomised to have the intervention immediately or to be on a waitlist but were assured they would receive the intervention at the end of the 12 weeks. Nevertheless, researchers ensured selection bias was avoided by adhering strictly to appropriate procedures for randomization and allocation.

The intervention group commenced the 12 weeks of online movement and music sessions with two movement sessions and one music session, each lasting up to 20 minutes. For all care homes, the intervention was delivered to a group in the common area such as the lounge which seated most residents in the care home. The number of movement sessions recommended in phase one was reduced in phase two because of findings from phase one. Weekly attendance was recorded by the care home staff using the attendance forms designed by EO (See Appendix L). These were updated from those used in phase one during consultation with care home staff at the initial staff briefing and training meeting to make them as simple to complete as possible. Weekly reminders via emails and phone calls were sent to the ACs by EO at the end of each week, which prompted reporting attendance from the ACs. Similar to phase one, follow up calls by EO gave more information on how the intervention was going and identified care homes that needed additional support.

After the post-intervention surveys (EO) and testing on physical function, saliva cortisol, and DHEAS (LDN), a random sub-sample of residents was invited by EO for interviews to gain in-depth data on the changes recorded after the intervention. A sub-sample of participants who expressed willingness to be contacted for interviews when completing post-intervention surveys was recruited, and consent was sought for interviewing and recording after presenting the participant information sheet. Seven residents and four ACs were interviewed by EO to share their experiences throughout the project, which further assessed the benefits of the intervention to residents and care home staff.

### 3.5 Data analysis

Quantitative data from the danceSing Care project was analysed using the IBM SPSS Statistics version 28.0. Demographic data were summarised using descriptive statistics. For the qualitative data collected by EO at both phases; audio, video recordings, and field notes were transcribed, organised and analysed by EO using NVivo 12. Thematic data analysis from interviews and focus groups was carried out (Braun & Clarke, 2006) to identify relevant themes regarding feasibility and to support potential intervention effects demonstrated in data from the surveys. Thematic analysis was adopted because it serves as a widely accepted robust and systematic method for coding, identification and interpretations of patterns in health and wellbeing qualitative research (Braun et al., 2016; Braun & Clarke, 2014). Also, thematic analysis is flexible and can be applied in analysing different types of qualitative data (both interviews and focus groups data on this project) and does not require strict theoretical framework, making it suitable for various research questions and disciplines (Javadi & Zarea, 2016). Again, this method of analysis allows to highlight in detail key experiences or opinions of participants in their own words which is relevant for exploring the feasibility and effectiveness of an intervention in a complex setting (Braun et al., 2014; Braun & Clarke, 2014; Javadi & Zarea, 2016). Data saturation was not explored as the sample size for interviews and focus groups was below the suggested range for data saturation (9-17 interviews and 4-8 focus groups) due to pragmatic and logistical reasons (Braun & Clarke, 2021; Hennink & Kaiser, 2022). However, there was consistency of messages across the participants resulting in being able to identify clear themes.

For phase one of the study, in addition to this aim of thematic analysis, another objective was to gather information on the challenges and feasibility of the intervention in care homes. Also, pre- and post-intervention scores on the outcomes of interest were analysed by EO using paired sample t-tests.

For phase two, an intention-to-treat (ITT) analysis using repeated measures (time – pre-/post-) 2-sample (intervention/control) analysis of variance (ANOVA) between groups was intended to be carried out to assess the effects of the intervention by comparing baseline and post-intervention change scores between the intervention and waitlist control groups. Instead, an ITT analysis using paired t-tests was conducted by EO to evaluate the outcomes of the study. This ITT analysis took into consideration all the participants randomised to the intervention and control group irrespective of their adherence to the intervention or completion of the study. This approach was considered because it maximised the sample and reduced biases as a result of possible dropouts or low retention of participants which is common in care homes. Reducing these biases provided a more accurate estimate of the effect of intervention (McCoy, 2017). Additionally, a sensitivity analysis was conducted by EO on the complete cases to identify possible differences in results between the ITT and non-ITT analysis. Also, differences based on care home adherence and changes in outcomes scores were evaluated by EO using a between-groups ANOVA. Relationships between the psychosocial and physiological outcomes were assessed by correlation analysis.

Attendance and adherence to the intervention were analysed for the duration of the 12-week intervention as the total number of sessions offered by the care homes, and participant adherence as the number of sessions attended divided by the total number of sessions offered, to reflect the relative number of sessions attended out of what was available to them. As part of analysing attendance for each home, a percentage was calculated from number of sessions offered at each home by the total number of sessions recommended at each phase.

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# Chapter 4: A Realist Evaluation of the Feasibility of a Randomised Controlled Trial of a Digital Music and Movement Intervention for Older People Living in Care Homes.

Published as: **Ofosu, E. F**., De Nys, L., Connelly, J., Ryde, G. C., & Whittaker, A. C. (2023). A realist evaluation of the feasibility of a randomised controlled trial of a digital music and movement intervention for older people living in care homes. *BMC geriatrics*, *23*(1), 125. https://doi.org/10.1186/s12877-023-03794-5

This chapter is the first phase of the danceSing Care programme evaluation. This peer-reviewed publication set out to explore the feasibility of delivering online music and movement interventions in care homes, highlight the conditions enhancing feasibility, and further inform a future randomised controlled trial in the care home context. This chapter was in line with the initial aim of this PhD project to design and implement a physical activity intervention to promote healthy ageing. The collaboration with danceSing Care satisfied the aim to design a physical activity intervention and so I proceeded with testing the feasibility for implementation among older adults, specifically residents in care homes. Even though this chapter was a joint publication with my colleague; LDN, I (EO) was the lead researcher for data collection and analysis of both qualitative and quantitative measures. I also monitored adherence to the intervention through follow-up phone calls. LDN and I contributed equally to writing the article presented in this chapter with supervision from AW, JC and GR throughout the research process. Before this feasibility study in the care homes, usual care in terms of activities was restricted to indoor activities due to the threat of the Covid-19 pandemic at the time. These activities included creative arts sessions like painting, physical activity days, and memorable day celebrations eg., Halloween, in some care homes while other care homes engaged with an online wellbeing resource known as Oomph wellness. Oomph wellness resources covered a wide range of topics such as crafts making, mindfulness, exercise, cooking, games and virtual reality tours. Homes varied in the amount of times residents received these types of activities with some homes running these daily whereas others only once or twice a week.

## 4.1 Abstract

**Background**: Low physical activity in care home residents brings about negative mental health consequences, such as higher levels of depression and loneliness. With advancements in communication technology, particularly during the Covid-19 pandemic, the feasibility and effectiveness of a randomised controlled trial (RCT) of a digital Physical Activity (PA) resource in care homes deserve more research attention. A realist evaluation was used to

uncover influencing factors of a feasibility study implementation to inform how a digital music and movement programme would work and under what circumstances this would be most effective.

**Methods:** Participants were 49 older adults (aged 65 years+) recruited across ten care homes in Scotland. Surveys were administered at baseline and post-intervention comprising psychometric questionnaires on multidimensional health markers validated in older adults with possible cognitive impairment. The intervention comprised 12 weeks of four prescribed digitally delivered movement (n=3) and music-only (n=1) sessions per week. An activity coordinator delivered these online resources in the care home. Post-intervention focus groups with staff and interviews with a sub-sample of participants were conducted to gain qualitative data on the acceptability of the intervention.

**Results:** 33 care home residents started the intervention, but only 18 residents (84% female) completed both pre- and post-intervention assessments. Activity coordinators (AC) offered 57% of the prescribed sessions, with an average residents' adherence of 60%. Delivery of the intervention did not go as planned due to Covid-19 restrictions in care homes and delivery challenges, including (1) motivation and engagement, (2) changes in cognitive impairment and disabilities of the participants, (3) death or hospitalisation of the participants and (4) limited staffing and technology resources to deliver the programme as intended.

Despite this, group participation and encouragement of residents supported the delivery and acceptance of the intervention, with ACs and residents reporting improved mood, physical health, job satisfaction and social support. Improvements with large effect sizes were found for anxiety, depression, loneliness, perceived stress and sleep satisfaction, but no changes in fear of falling, domains of general health or appetite.

**Conclusion:** This realist evaluation suggested that this digitally delivered movement and music intervention is feasible. From the findings, the initial programme theory was refined for future implementation of an RCT in other care homes but future research exploring how to tailor the intervention to those with cognitive impairment and/or lacking capacity to consent is needed.

**Trial registration*:*** Retrospectively registered at ClinicalTrials.gov NCT05559203

**Keywords:** activity coordinators; care homes; digital physical activity; feasibility; realist evaluation; residents.

## 4.2 Introduction

### Rationale for evaluation

The care home resident population is ageing in the UK (Office for National Statistics, 2014), following global trends (OECD, 2021), with residents often being diagnosed with more than one long-term health condition (multi-morbidity) (Gordon et al., 2014). Multi-morbidity increases the likelihood of hospital admission, length of stay and readmission, raising healthcare costs, reducing the quality of life, polypharmacy and mortality (Marengoni et al., 2011; Salive, 2013). While morbidity consistently predicts care dependence, physical multi-morbidity conveys a lower risk than multi-morbidity with mental and cognitive disorders (Bao et al., 2019) This is a significant finding, as about 70% of all care home residents have dementia or other cognitive impairments (Alzheimer's Society, 2022). Further contributing to these issues, the adverse consequences of reduced or low physical activity (PA), or the cessation of exercise, which is common in a care setting, brings about its own negative mental health consequences, such as higher levels of depression (Sackley et al., 2006) and loneliness (Rodriguez-Larrad et al., 2021). Previous research has focused on developing physical activity (PA) interventions in care homes to improve the health of care home residents. With advancements in communication technology, particularly during the Covid-19 pandemic, the feasibility and effectiveness of digital PA resources deserve more research attention.

PA interventions may be an excellent means of improving multidimensional health in older adults (Lazarus & Harridge, 2018). This is evidenced by favourable effects on endocrine profiles implicated in human ageing (De Nys, Ofosu, et al., 2022; Sellami et al., 2019). Further, these have shown improvements in physical health, such as gait speed, balance and performance in activities of daily living (Chou et al., 2012), as well as in cognitive function (Bherer et al., 2013) and mental wellbeing (Windle et al., 2010), such as anxiety (Ofosu et al., 2023) and depression (Strawbridge et al., 2002). Therefore, considerable effort has been devoted to increasing PA and prescribing exercise programmes in older adults, such as the care home resident population (de Souto Barreto et al., 2016). PA interventions, including multicomponent (chair-based) exercises or dancing, have been shown to improve cognitive function, physical and mental wellbeing in this population (Arrieta et al., 2018; Brustio et al., 2018; Cordes et al., 2021; Da Silva et al., 2022; Guzmán-García et al., 2013; Hwang & Braun, 2015; Low et al., 2016).

Increasingly, innovative digital resources have been developed to influence PA in care home residents positively. For successful implementation of digital health interventions designed for older adults, understanding the feasibility regarding organisational and systems readiness and the acceptability of digital interventions are fundamental. Recent systematic reviews showed that digital resources to promote PA in older adults were reported as feasible and well accepted (Diener et al., 2022; Valenzuela et al., 2018). The review by Diener et al. (2022) suggests considering one's physical and cognitive abilities and providing options for individual tailoring of these interventions. It further highlighted that conditions and resources in care homes, such as equipment, physical space, and financial capacities regarding technology, should be considered (Diener et al., 2022). Both reviews (Diener et al., 2022; Valenzuela et al., 2018) emphasised that, although technology-based interventions to promote PA show promising future avenues, more quality studies reporting accurate measures of exercise adherence and effectiveness are warranted.

Further, when designing and testing interventions in the complex situations that care homes reside in, it is crucial to address 'what works, for whom, under what circumstances, and how' (Moore et al., 2015). Few studies consider the role of context, mechanisms and external factors (moderators) affecting the effectiveness of a PA programme. In order to expand and translate the roll-out of effective interventions, more information is often needed about how a programme might be replicated in a specific context or whether trial outcomes are reproducible (Moore et al., 2015). Therefore, a realist evaluation (Pawson & Manzano-Santaella, 2012) was chosen for the present study to understand how a digital music and movement intervention might generate different outcomes in different circumstances. Exploring and identifying the how, why, for whom, to what extent, and in what context interventions work could allow researchers and practitioners to understand how to adapt interventions to a new context (Westhorp, 2014) and further inform decisions about scaling up the programme to deliver to more care homes and influence public health initiatives.

To this end, following the realist evaluation framework, a context (C), Mechanism (M), and outcome (O) configuration (Pawson & Manzano-Santaella, 2012) was identified to explain the role of the complex situation of UK care homes in which PA programmes are to be rolled out (see Table 2). The effects of a feasibility trial (danceSing Care programme) on multidimensional health outcomes were discussed in light of this CMO configuration. Thus, the two overarching aims of this project were: (1) to determine the feasibility of a future mixed-methods RCT of digital music and movement resources in a care home, and (2) to use a realist evaluation approach to evaluate the process, outcomes and influencing factors of the

trial implementation to inform how this programme would work and under what circumstances this would be most effective. With insights into whether and how the outcomes were affected, the initial programme theory will be refined for future implementation in a randomised controlled design in other care home sites.

***Programme theory***

The programme theories, assumptions, and the logic model underpinning the danceSing care programme are shown in Appendix M.

Programme theories are configured as "context-mechanism-outcome" (CMO) hypotheses in a realist evaluation. This explains how and why different outcomes are generated in different contexts. Linked sets of hypotheses are likely to be produced because different mechanisms will be activated in various contexts, resulting in various outcomes. Generally, hypotheses are developed by asking four questions: (1) For whom will this basic programme theory work and not work, and why? (2) In what contexts will this programme theory work and not work, and why? (3) What are the main mechanisms we expect this programme theory to work? (4) If this programme theory works, what outcomes will we see? The basic programme theory was in line with the aim to test the feasibility of an RCT implementing the danceSing care programme in specific UK care homes and measuring psychosocial health markers. This is reflected by the stated realist assumptions (Table 2).

This programme theory could be further subdivided into the following theories:

(1) If the danceSing care resources are delivered to the care homes, the Activity Coordinators (ACs) would consistently deliver the programme to the residents.
(2) If the programme is delivered in the care homes, the residents would want to regularly take part.
(3) If the ACs provide the programme consistently, the participants would experience improved psychosocial health markers. Changes in pre-and post-survey data and qualitative interviews would evidence this.
(4) If the ACs are given enough organisational support such as resources and time, they would be engaged in this programme. This would therefore, establish shared learning and co-production between programme developers, care homes, and researchers.
(5) If the group sessions are adequately and consistently used, residents would feel more engaged in group activities, creating a community. This communal feeling would

increase self-confidence and quality of life and reduce loneliness. This could potentially inspire future usage of the programme's resources.

Further, researchers, stakeholders from the to-be-tested programme, and representatives from the UK care homes where the programme would be implemented developed the focused questions and considered the set of conditions that existed (Context), how these contexts might create change (Mechanism), and what changes would result from the mechanisms (Outcomes). The study's hypotheses were developed based on the assumptions and the focused questions. Therefore, it was necessary to collect information about context, mechanism and outcome and identify features of implementation or organisation that affect whether or not the trial works (Wong et al., 2016). The different CMOs are listed in Table 2. Each row in this table represents the outcome produced by a particular mechanism in a particular context. This was followed by retroduction, a form of logical inference using abductive reasoning to identify the most likely explanations for an observed data set. This retroduction was done by interpreting and analysing the data applying the configured CMO. Finally, these interpretations served as means to make refinements to the initial programme theory for future implementation, as outlined in the discussion section.

**Table 3: Context-Mechanism-Outcome (CMO) hypothesis**

| **Context-Mechanism-Outcome (CMO) hypothesis** | | | | | |
|---|---|---|---|---|---|
| Realist assumption | Focused question | Realist programme theory | Contexts (set of conditions that exist) | Mechanisms (how might these contexts create change) | Outcomes (what changes result from the mechanisms) |
| 1. Collect information about context, mechanism and outcome to evaluate the programme.<br>2. The programme intends to cause a change | 1. What information will be needed and could be collected about contexts? Mechanisms? Outcomes?<br>2. What change (outcome) does the trial intend to create<br>Quantitative: Feasibility, adherence, surveys about psychosocial health markers<br>Qualitative: Interviews and focus groups about acceptability, engagement, delivery and feasibility | 1. Identifies intended outcomes<br>2. Identifies the data necessary to test the programme theory. | Situational<br>High burden of the COVID-19 pandemic on the care home system in Scotland<br>Little time and resources for the staff (already happening before COVID-19)<br>Programme<br>1. Implementation of the danceSing care programme<br>2. Flexibility from research staff and stakeholders from the danceSing care team | Little time and resources for the staff, understaffing, absence or isolation of staff and participants through restrictions<br>Supporting care home staff, boosting feelings of connection and engagement through group training, meetings and welcoming participants in the 'danceSing care family' | Complicate readiness for programme delivery and engagement<br>1. Improve psychosocial health markers of residents<br>2. Improve programme delivery and engagement |

***Specific research objectives***

In line with the overarching aims of this study outlined above, specific research objectives were to evaluate the following topics: (1) Feasibility: was the activity implemented and/or delivered as planned? Were adherence rates at an acceptable level? Were the outcomes adequate and realistic for this programme and setting? (2) Context: What were the potential barriers for care homes or ACs to provide these resources? Were the programme's resources suitable for this setting? (3) Mechanism: what underlying mechanisms made the danceSing Care programme work (or not)? Was it the situational context or the programme context? (4) Outcome: What changes resulted from the mechanisms?

## 4.3 Methods

### 4.3.1 Design

This study combined two evaluation approaches: first, a mixed methods feasibility approach and a realist evaluation approach. Initially, a mixed-methods research approach to a 12-week feasibility trial in care homes with pre- and post-intervention collection of quantitative and qualitative data about feasibility (adherence, safety, adverse events) and participants' multidimensional health. This was to determine (1) an appropriate way to deliver the programme in this setting and (2) the appropriate secondary outcome measures for a future RCT. This was preceded by implementing an expert advisory group (AG). The AG consisted of danceSing Care staff, the research team, representatives from care homes and older adult members of the 'Stirling 1000 Elders' (https://1000elders.stir.ac.uk/, a group of adults aged 60+ who have signed up to participate and engage in research on older adults at the University of Stirling). The outcomes were reported following appropriate CONSORT guidance for feasibility trials (Eldridge et al., 2016). The study was approved by the University of Stirling NHS, Invasive and Clinical Research ethics panel, project NICR 3735 and retrospectively registered at ClinicalTrials.gov, NCT05559203 on 29/09/2022.

Second, the evaluation questions and scope evolved beyond initial questions regarding feasibility throughout the evaluation because the capability of delivering the programme and engaging the residents by the activity coordinators was lower than expected. To uncover the underlying factors that explained the implemented situation (such as relevant context (C), mechanisms (M), and outcomes (O)), we additionally used the realist evaluation methodology based on RAMESES II reporting standards (Wong et al., 2016). Given the difficulties with delivery, any attempts to establish linear, causal relationships between inputs

and outcomes (e.g., by comparing 'pre' and 'post' data) would have been largely meaningless. Thus, using realist evaluation, the CMO configuration was identified to interpret the outcomes according to what happened. Pre- to post-intervention changes in secondary outcome measures were calculated to indicate effect sizes, implement the measures, and test their acceptability before integrating into a larger RCT.

*Environment surrounding the evaluation*

The environment for the evaluation was across ten care homes in Scotland, United Kingdom. All care home operation managers/activity coordinators were provided with the danceSing Care digital resources login details to access weekly pre-recorded movement and music sessions. It was confirmed that all care homes had sufficient technological support to participate in this programme. Before starting the intervention, an in-person training session was organised for care home staff (activity coordinators and operation managers). This training covered general instructions on rolling out the program and addressing any staff concerns about the study, including any IT issues. In addition, a concise information pack was distributed to activity coordinators, including the programme's and researchers' contact details for any questions or problem-solving. All study information was co-designed with the advisory group, who met four times to determine the amount and timing of programme delivery and priorities for and suitability of outcome measures.

### 4.3.2 Participant Recruitment Process and Sampling Strategy

Participants were recruited across ten care homes in the Balhousie Care group in (https://balhousiecare.co.uk/) between December 2021 and January 2022. Inclusion criteria were (1) residents in care homes ≥ 60 years, (2) able to complete 12 weeks of a movement and music program (3) having the capacity to give informed consent. Participants were not eligible if they (1) were currently taking part in any other clinical trial which could potentially have an impact upon or influence the findings of the current study, (2) had pre-existing conditions or concurrent diagnoses which would profoundly impact their capacity to undergo the intervention, even once adaptations have been made (3) inability to understand written/spoken English adequately to participate in the measures and intervention (e.g., due to cognitive or sensory impairment). Care staff were asked to gauge the interest of residents in the programme and were provided with recruitment flyers (see Appendix I). Care staff

informally screened interested participants for eligibility with a simplified version of the information sheet. Following this, the research team contacted the respective care homes, provided full participant information sheets (see Appendix J), and obtained informed written online consent. Where this was not feasible online, care staff ensured the residents consented to the study on paper copies of the consent form provided at the start of the survey pack. In addition, in-person visits to the care homes were planned if Covid-19 restrictions allowed.

### 4.3.3 Programme

The programme was a digital movement and music programme with resources from danceSing Care (https://dancesingcare.uk/). It consisted of three movement sessions and one music session each week, the recommended dose agreed upon between danceSing Care and the Advisory group, each lasting about 20 minutes. Also, the danceSing care resources were designed to suit older adults with physical and cognitive impairments (residents with mobility aids and/or dementia). Movement sessions included chair and standing fitness, which started with a warm-up and finished with stretching exercises (see Appendix N for intervention description). Sessions were managed and supervised by care home activity coordinators.

### 4.3.4 Measures

*Feasibility: adherence and safety*

Care home staff were asked to provide the danceSing care physical activity resources three times per week plus one music session. Participants' adherence was assessed by asking homes to record how many sessions they offered each week and the participants' attendance at each of these using a provided register sheet (Appendix L). This was then calculated as adherence for participants by computing the percentage attended out of the number of sessions offered by the care home. Care home adherence was calculated as the percentage of offered sessions from the recommended 3+1 x 12 weeks. Adherence data were requested weekly via a reminder email with a specific register provided to each care home. This was to indicate attendance at the sessions provided per participant and any additional attendance from non-participants. Researchers logged reasons for withdrawal weekly. Adherence data missing was followed up with phone calls to each home from the research team to help assess any difficulties in delivering the programme. Researchers kept a reflective log of any additional information gathered in this way.

As part of the care home staff workshop before the intervention, activity coordinators were advised to ensure residents engaged in the danceSing care programme according to their capabilities. Adverse events related and unrelated to the intervention were reported weekly by activity coordinators via email or telephone in addition to the adherence reports.

*Socio-demographics and multidimensional health*

The pre-and post-intervention survey recorded basic demographics such as age, gender, relationship status, ethnic group and level of education. Postcodes were not included to compare against the Scottish Index of Deprivation because participants were residents of care homes.

After discussion with the AG, a list of priority and appropriate outcomes for limited efficacy testing in this feasibility study was devised. The key areas included: the number of falls in the past three months, activities of daily living and health, psychosocial well-being (anxiety, depression, stress and loneliness), sleep satisfaction and frailty measures such as physical function, appetite and weight loss. These multidimensional health markers were assessed using standardised questionnaires validated in older adults with mild cognitive impairment. The internal consistency of the measures are reported as the Cronbach's alpha with values $\geq 0.70$ indicating good levels of reliability.

Fear of falling was measured using the Falls Efficacy Scale – International (short form) (FES-I) (Kempen et al., 2008). It is a seven-item scale that measured how concerned participants were about falling during social and physical activities on a Likert scale ranging from one (not at all concerned) to four (very much concerned). It has been validated in older adults with a Cronbach's alpha of 0.92. Total scores ranged from seven to 28, with higher scores indicating severe concern (Kempen et al., 2008).

Two measures were used for daily living and health-related quality of life. The Dartmouth Cooperative (COOP) Functional Assessment charts measured participants' physical fitness domains, feelings, daily and social activities, changes in health and overall health using pictures (Nelson et al., 1987). The European Quality of Life 5 Dimensions 3 Level Version (EQ-5D-3L) (EuroQol Group, 1990) evaluated five dimensions of health (mobility, self-care, usual activities, pain/discomfort and anxiety/depression) with responses ranging from no problems to considerable problems on a 3-point scale, and finally a rating of general health from 0 to 100.

Measures of anxiety, depression, stress and loneliness were used to assess psychosocial wellbeing. Anxiety and depression were measured using the Hospital Anxiety

and Depression Scale (HADS) (Zigmond & Snaith, 1983), a 14-item questionnaire scored on a four-point scale that measures anxiety and depression on two subscales. Each subscale of the HADS has seven items giving a maximum score of 21, with scores ranging from zero to seven considered as normal, eight to 10 as borderline and 11 or more as a significant case of anxiety or depression (Zigmond & Snaith, 1983). The Perceived Stress Scale (PSS) (S. Cohen et al., 1983) measures how participants perceive life situations as stressful. It has ten items with responses ranging from zero (never) to four (very often) and total scores of 0 to 13, 14 to 26 and 27 to 40 depicting low, moderate and high perceived stress, respectively (S. Cohen et al., 1983). Also, the brief UCLA loneliness scale (ULS-6) (Neto, 2014) was used to assess subjective feelings of loneliness on a four-point scale (1-never to 4-often) with six items; the greater the ULS-6 score, the more significant the loneliness. Each of these measures has reported Cronbach's alpha for reliability of > 0.7 (S. Cohen et al., 1983; Ingrid Djukanovic et al., 2017; Neto, 2014).

Sleep satisfaction was measured using the National Sleep Foundation's Sleep Satisfaction Tool (SST) (Ohayon et al., 2018). It is a nine-item scale with a Cronbach's alpha of 0.87 and a high score suggesting greater sleep satisfaction (Ohayon et al., 2018). In addition to the SST, an unstandardised item measured how often participants experience disturbed sleep due to noise outside the room. Participants chose responses from options: "not during the past month", "less than a week", "once or twice a week" and "three or more times a week".

Appetite was assessed using the Simplified Nutritional Appetite Questionnaire (SNAQ) (Wilson et al., 2005), which has a maximum score of 20, where a score less than 14 specifies poor appetite and a Cronbach's alpha coefficient of 0.7.

Participants' weight loss was measured on the weight loss item from the Fried Frailty Scale (Fried et al., 2001). Regarding frailty measures, it was set out to assess physical function through the Short Performance Battery (Treacy & Hassett, 2018), complemented with handgrip strength and Timed Up & Go (Podsiadlo & Richardson, 1991) test to indicate frailty. However, due to the COVID-19 restrictions, it was not possible to visit care homes and undertake these assessments.

### 4.3.4 Procedure

Surveys were completed at baseline and then again in the four weeks following the completion of the intervention. These were either completed online by residents with the help

of the researchers via an online Microsoft Teams meeting or were administered in-person by the care home staff using paper versions. All completed surveys were uploaded onto JISC online survey software (https://www.jisc.ac.uk/online-surveys).

Two focus groups were conducted online in the four weeks following the completion of the intervention lasting on average 55 minutes each. Collectively, five activity coordinators participated in both focus groups carried out on Microsoft Teams and were recorded following informed consent from the care home staff and research team. Four residents from two care homes consented to be interviewed in person. Due to the changes in cognitive impairment of some residents, recruitment for interviews was streamlined to specific care homes and limited to residents with no or mild cognitive impairment. Data from interviews were audio-recorded on a password-secured voice recorder and transcribed verbatim. Semi-structured interviews lasted approximately 12 minutes each. The semi-structured interview and focus group questions covered general participation, adherence, programme outcome and programme delivery. These questions were devised by the research team and trialled and altered with the advisory group (Appendix O for the interview and focus group guide).

*CMO configuration*

The CMO factors were generated via monitoring the care home environment. Weekly phone calls and emails provided qualitative and quantitative data about the ongoing trial adherence and situation in the care homes. The interviews and focus groups conducted post-intervention were adapted according to realist evaluation strategies (Manzano, 2016).

### 4.3.5 Data analysis

Quantitative data, such as primary outcomes of adherence rate, or the secondary survey outcomes, were analysed using the IBM SPSS Statistics version 26.0. The means, mean differences and 95% confidence intervals (CI) were reported for continuous data, and a count (number, %) was reported for nominal data. Pre- to post-intervention scores for secondary outcomes were compared using the paired sample t-test, and Cohen's d was calculated as a measure of effect size and was interpreted as small (d = 0.2), medium (d = 0.5), and large (d = 0.8) (Cohen, 1988). All testing was two-sided with a significance threshold of <0.05. Qualitative data from interview and focus group transcripts were analysed using NVivo (released in March 2020).

The research team then integrated and evaluated the outcomes of the feasibility trial according to the identified CMO configuration. Recurring resources or contexts in which the

programme took place that the residents or activity coordinators described as helpful or influential (or not) were considered as a Context (C) or Mechanism (M). These descriptors generated the overarching themes of the CMO configuration. The researchers then used these interactions as contextual narratives to identify why residents responded as they did. Accordingly, the research team, the AG, and the stakeholders discussed interpretations of actions or events. These interpretations were then tested by seeking data to either support or contradict the statements (either via data on current events or from the interviews and focus groups). Finally, these interpretations were considered when refining the programme theory for future implementation. The discussion section elaborates further on these refinements. Figure 6 shows the process of realist evaluation.

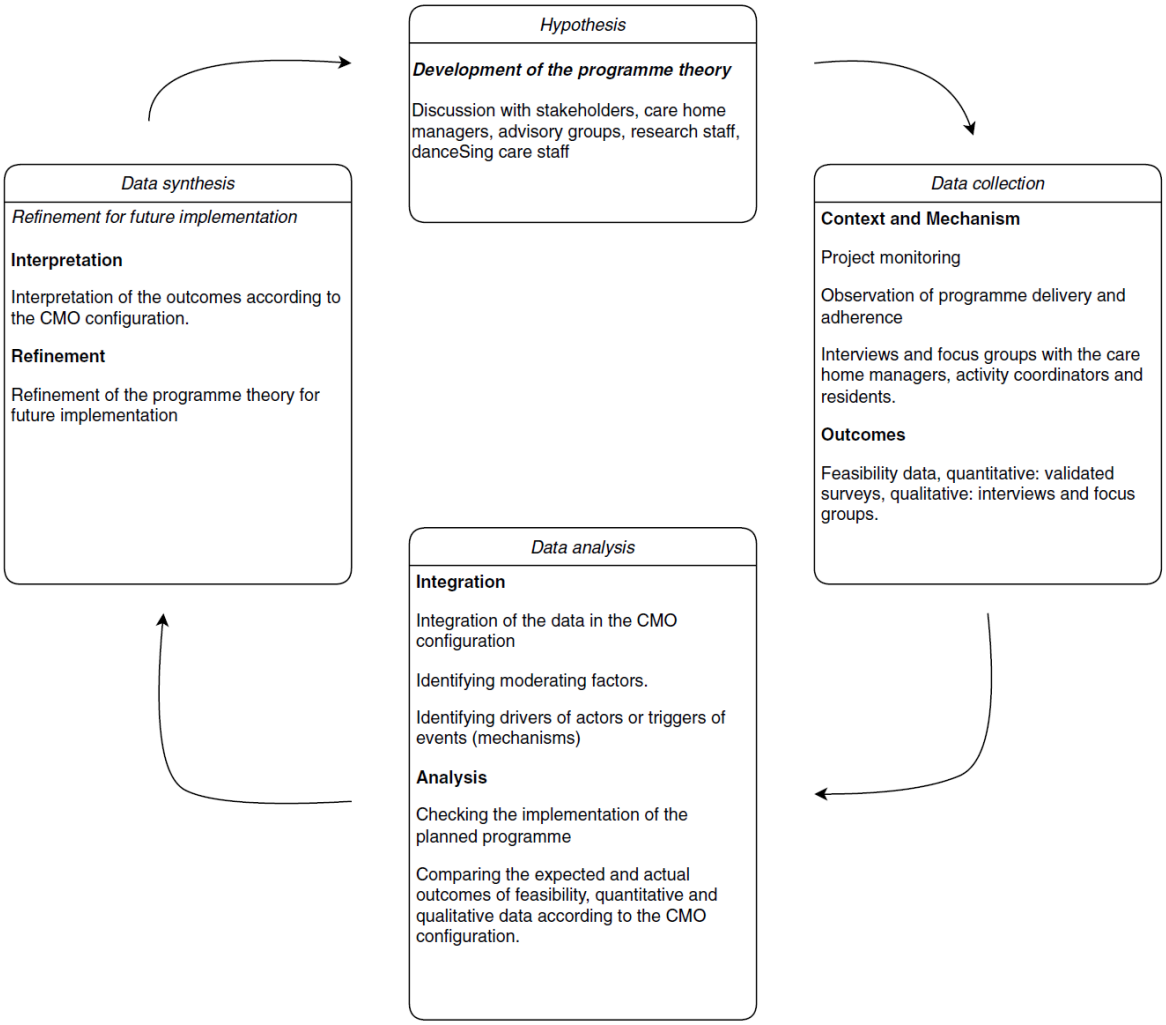


Figure 6: Process of the realist evaluation

## 4.4. Results

The following section consists of five sub-sections, including details of participants, the feasibility of the intervention, delivery challenges, intervention effects and refinement of the programme theory for future implementation. The qualitative and quantitative analysis findings are presented together in each section where data from both were available.

### 4.4.1 Participants

Of the 49 participants approached for recruitment, 47 were enrolled in the study and completed baseline measures, and 33 residents took part in the intervention; a CONSORT diagram of the progress through the study is shown in Figure 7.

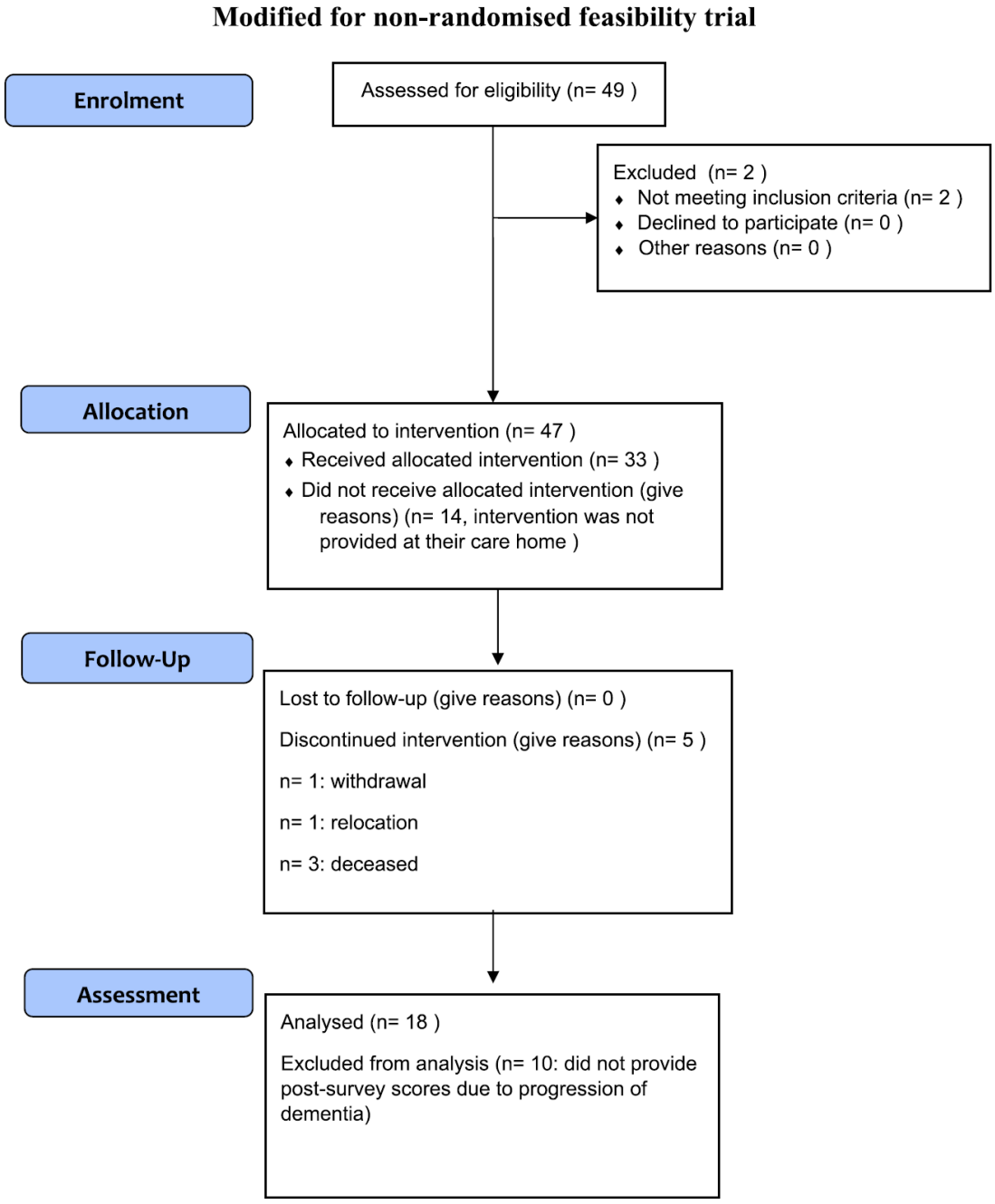


Figure 7: CONSORT diagramme

Most participants were females (84.8%) of White British ethnicity, with 84.9% aged 75 years and over. Most participants were selected from care home units for older adults with dementia. The four residents interviewed were between the ages of 75 and 90, and three were females. Baseline participant characteristics are detailed in Table 3.

**Table 4: Participant Characteristics**

| Characteristic | Description | N(%) | |
|---|---|---|---|
| | | N =33 | N =18 |
| Age group | 60-74 years | 5 (15.15) | 2 (11.11) |
| | 75-84 years | 13 (39.39) | 8 (44.44) |
| | 85 or over | 15 (45.45) | 8 (44.44) |
| Sex | Female | 28 (84.8) | 15 (83.8) |
| Ethnic origin | White - British, Irish, other White | 32 (96.97) | 17 (94.44) |
| | Prefer not to say | 1 (3.03) | 1 (5.56) |
| Relationship status | Single, divorced, widowed | 27 (81.82) | 16 (88.89) |
| | In a relationship/married but living apart | 2 (6.06) | 1 (5.56) |
| | In a relationship/married and cohabiting | 2 (6.06) | 1 (5.56) |
| | Prefer not to say | 2 (6.06) | 0 (0) |
| Highest level of education | No qualifications | 11 (33.33) | 8 (44.44) |
| | Did not complete National 5s/Standard Grades/GCSE/CSE/O-levels or equivalent | 3 (9.09) | 1 (5.56) |
| | Completed National 5s/Standard Grades/GCSE/CSE/O-levels or equivalent (at school till aged 16) | 6 (18.18) | 4 (22.22) |
| | Highers/Advanced Highers/AS-levels/A-levels or equivalent (at school till aged 18) | 6 (18.18) | 2 (11.11) |
| | Undergraduate degree or professional qualification | 1 (3.03) | 1 (5.56) |
| | Prefer not to say | 6 (18.18) | 2 (11.11) |

### 4.4.2 Feasibility of the Intervention

Regarding feasibility, 47 participants from 10 care homes fulfilled the inclusion criteria, consented, and completed the pre-intervention surveys. Seven of these care homes provided the intervention programme, enrolling 33 residents in the intervention. Five dropouts were noted: one due to withdrawal, one relocation and three residents who passed away during the intervention. Care homes delivered 57% of the sessions (193 of 336) over the 12-week intervention period, with an average residents' adherence of 60%. Quantitative adherence statistics are shown in Table 4. Finally, 18 (54.55%) residents had sufficient cognitive ability at the follow-up to provide meaningful post-survey scores as informally assessed by the researchers with assistance from care home staff. Where it became clear that participants had declined in their cognitive ability at follow-up beyond the ability to take part, the post-survey was immediately terminated by the researchers as it was not deemed ethical or meaningful to continue.

**Table 5: Adherence Data**

| | Number Sessions Offered | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Care Home** | **Wk 1** | **Wk 2** | **Wk 3** | **Wk 4** | **Wk 5** | **Wk 6** | **Wk 7** | **Wk 8** | **Wk 9** | **Wk 10** | **Wk 11** | **Wk 12** | **Total** | **% Sessions Offered** | **Average sessions per week (median: 3)** |
| **CH1** | 4 | 4 | 4 | 4 | 0 | 0 | 4 | 4 | 4 | 4 | 4 | 4 | 40 | 83.33% | 3 |
| **CH2** | 4 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 8 | 16.67% | 1 |
| **CH3** | 4 | 1 | 2 | 0 | 4 | 3 | 0 | 1 | 3 | 3 | 4 | 3 | 28 | 58.33% | 2 |
| **CH4** | 1 | 4 | 3 | 3 | 1 | 3 | 4 | 3 | 4 | 3 | 3 | 4 | 36 | 75.00% | 3 |
| **CH8** | 2 | 2 | 2 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 14.58% | 1 |
| **CH9** | 4 | 4 | 4 | 0 | 0 | 4 | 2 | 4 | 0 | 0 | 4 | 4 | 30 | 62.50% | 3 |
| **CH10** | 4 | 4 | 4 | 4 | 4 | 4 | 2 | 4 | 4 | 3 | 3 | 4 | 44 | 91.67% | 4 |
| | **23** | **23** | **19** | **11** | **10** | **14** | **12** | **16** | **15** | **13** | **18** | **19** | **193** | **57.44%** | |

*Note: CH-Care home.* Of the 10 care homes that we identified to start the programme, seven started and completed the 12-week programme

The interviews and focus group data derived five central themes with sub-themes on feasibility. For data integration and analysis, themes on feasibility were linked to the CMO configurations, which revealed sub-themes such as adherence, delivery challenges, modifications and intervention effects, as summarised in Table 5.

**Table 6: Data Integration and Analysis**

| | **Feasibility** | **Context** | **Mechanism** | **Outcome** |
|---|---|---|---|---|
| Specific research objectives | Was the activity implemented and/or delivered as planned? Were adherence rates at an acceptable level? Were the outcomes adequate and realistic for this programme and setting? | What were the potential barriers for care homes or ACs to provide the resources? Were the programme's resources suitable for this setting? | What underlying mechanisms made the programme work (or not)? Was it the situational context or the programme context? | What changes resulted from this? |
| Themes derived from the data integration and analysis | - Adherence | - Delivery challenges<br>- Facilitation resources<br>- Cognitive impairment | - Motivation and engagement<br>- Social support<br>- Job satisfaction | - Qualitative and quantitative data about psychosocial health markers of participants |

***Adherence***

Participation and class size were sub-themes from the central theme of adherence. Care home staff described residents' participation in sessions as 'not as expected' due to several delivery challenges. For example, one care home staff member that struggled to get residents to adhere to the recommended dose of the intervention mentioned:

> *"We (care home) did really struggle, especially at the start, and once the Covid-19 cleared, it got a little bit better for a couple of weeks, and then it slipped back into them not really engaging in it*."

However, overall, the intervention was accepted by residents and this was seen in their participation and records of adherence. The digital intervention was an activity that the residents looked forward to. They referred to it as meaningful and purposeful. Some care home staff made comments like:

> "*Most of our residents participated in all of the sessions. There were a couple of residents that missed a few; they just did not feel like it that day, or they were out with their families and things like that, but all in all, it was a good turnout*."

and:

> "*They (residents) started to look forward to it. You know, they remembered it. It was really great. It was excellent*."

Also, in terms of participation, the number of sessions offered to residents varied across care homes. Some care homes offered more sessions than the recommended dose, whereas others offered fewer. In the focus group discussions, care home staff stated in response to them being able to engage residents in three movement and one music session a week:

> "*I (AC) think we (care home) have done really well. The attendance was quite good. Actually, more residents participated, and we weren't doing this like three times a week, but probably four or five. I think it went great."*

but also:

> *"...I (AC) did probably, I have run it once per week, or maybe twice per week, sometimes in different parts of the care home*."

Class size differed in the various care homes, with some care homes recording an increase in the number of residents participating in the intervention and others seeing a decrease, again due to the challenges of delivering an intervention specifically in a care home setting. Care home staff explained that residents were lost to death, dementia and Covid-19 in comments such as:

> "*Two residents passed away, but we got a new resident, and then it was right up her street like music, dancing and exercise*."

and:

> "*Decrease for me (AC), but again it was like I said, the three residents in particular that their level of dementia got worse, they became unwell and just could not continue with the programme*"

and:

> "*I (AC) think I had the decrease just because we had Covid in the last month, just at the end of the 12 weeks. So that is why I could not really do any dancing and singing with people."*

***Delivery challenges with the intervention***

As mentioned above, difficulties with engagement and delivery were noted early on, and the CMO evaluation was applied. Difficulties noted in the researchers' logs implied a complex underlying situation in care homes vastly affected by e.g., the Covid-19 pandemic, wider policy environment and understaffing (Context). This could affect motivation and engagement to either deliver the programme or attend a session (Mechanism), affecting adherence rates and possibly implicating the psychosocial outcome measures. More details of these emerged in the qualitative adherence data below. However, Appendix K summarises the challenges that came with the delivery of the intervention.

*Motivation and engagement*

One integral part of the feasibility outcomes was delivery challenges which influenced adherence and informed the future modifications for the intervention discussed by the care home staff. The main challenge reported by care home staff was that participants were less motivated to engage in the programme, primarily at the initial stages. Also, participants initially keen to engage in the programme were demotivated when other

participants withdrew or refused to participate. Participants also voiced that they were not enthused to participate all the time. In addition, residents' unavailability due to external visits to the care homes was a challenge. ACs and participants expressed these challenges by saying:

> "*The main difficulty was motivation, but that is really just at the start because once the residents are down and we begin, they are so happy, keen really focused on the exercise and things. So it was a small starting issue, but it did not last very long."*

and:

> *"Some weeks you are in the mood and other weeks you are not. You get in a mood. You know I (resident) am 76 now and some days you just cannot be bothered."*

and:

> "*There were a couple of residents that missed a few; they just didn't feel like it that day, or they were out with their families."*

and:

> "*There was one resident who enjoys exercises every day, she was always keen and motivated, but when it just came down to her participating alone, that was when she stopped. Nobody else was wanting to do it along with her, so she felt that she was on her own. She got less motivated to do it."*

*Health Conditions*

Further, cognitive impairment and disabilities of the older adults was a potential barrier for ACs to provide the resources. One of the concerns raised by care home staff was the challenge of working with older adults with significant cognitive impairment and disabilities. Residents with dementia sometimes looked confused during sessions. Other residents with physical disabilities, such as mobility and hearing problems, did not participate fully in singing or movement sessions. ACs said:

> "*There were three residents in particular that their level of dementia got worse, they became unwell and just could not continue with the programme*"

and:

"*Most residents have got difficulties with mobility, so some of the exercises were not very suitable."*

and:

*"Like I (AC) said, the singing sessions did not go down well with people. They (residents) really didn't participate fully, for example, one resident has hearing problems and could not sing along.*

*Death and hospitalisation*

ACs explained that some participants were lost to death or admitted to the hospital and were unable to continue participation:

*"There was one resident who went to hospital and was admitted to hospital. She was not able participate anymore after that."*

and:

*"We (care home) had two residents who passed away. Also, one was in the hospital for a few weeks as well."*

Moreover, the closure of care homes due to the Covid-19 outbreak disrupted participation in the programme as residents and care home staff were isolated for weeks. For example, an AC said:

*"Our home was closed for about four weeks with Covid-19, so we had residents at all times isolate in their bedrooms. As we were all in bubbles, we did try one to one sessions, but obviously we would have to be in PPE and if they had Covid-19, they were not feeling up to. It was about four- or five-weeks chunk that we were not able really to participate much at all in the programme".*

*Resources for delivery*

ACs highlighted a lack of resources for delivery, including staff shortage and absence, technical problems and limited space for running sessions. As part of the discussions, it was recorded that there was a high staff turnover across care homes. ACs had no replacement care home staff to take up their duties when they were on holidays or isolated due to Covid-19 during the 12 weeks of the intervention. Also, ACs did not get any support from other care home staff. This was due to either the heavy workload on care home staff or a shortage of

care home staff on duty. It was also reported by some care homes that poor internet connection and faulty display screens affected getting access to and viewing the digital intervention. Again, ACs expressed their struggles to set up lounges for sessions as the space is also shared with other residents not included in the study. In line with the sub-theme, 'facilitation resources' ACs put this across by saying:

> *"The internet over here (care home) is not great because we live in the countryside. Our signal is poor, so we have problems with buffering, loading and refreshing the page".*

and:

> *"We (care home) did have a technical hitch for about 3 weeks because we could not get the programme displayed on the TV's. Once the hitch was over, it was easy enough for the programme to go on our screens"*

and:

> *"...but it could have to do with our (care home) setting because they (residents) were in a lounge with other residents that were not participating. It was purely the fact we were short staffed, and the carers were not always there to transfer them into another room to do it."*

and:

> *"We (care home) found it difficult at times and just purely from separating the participants into another room due to staff shortages. We did come up with trouble of staffing."*

*Progressive and future modifications*

During the 12-week intervention, some changes were made by ACs to help residents adapt well to the intervention. Progressive modifications that care home staff found helpful in facilitating the programme included making participation a part of the care home schedule with an allocated time slot, playing music at the start of sessions, and briefing and encouraging residents before the start of sessions. These were expressed as:

> *"Well, I (AC) adopted an early pattern, about the 11:30 mark in the morning once everybody was up. They would have had their morning snack, the coffee and that time before lunchtime was always a good time. Before lunchtime is when I (AC) like to get*

*the group together for activities. Whether crafts, music or live entertainment, it was a good period to get people together".*

and:

"*We (care home) would always put the music on first, to lift their moods and try to get them to engage more in the exercises."*

and:

"*We (care home) definitely found telling them in advance helped, so that they knew it (the intervention) was going to be happening the next day. Also, like I (AC) said, we did the music part first before the exercises to try and lift their mood and hope that more residents would take part.*"

and:

"*I (AC) spend lots of time trying to encourage people. I had to go and speak to them (residents)."*

Additionally, focus group discussions pointed to other alterations and actions that could be made to enhance the feasibility and future implementation of the intervention in care homes, leading to future modifications. It was suggested that the number of sessions be reduced from four sessions a week to two or three sessions a week to recruit residents with low or no cognitive impairment and to play background music during movement sessions. Comments on future modifications included:

"*Yeah, I (AC) would run the programme again, but not for four times per week. It is a little bit too much and you have to do other activities as well, not just sing and dance all the time. I will probably be doing it again once or twice per week. I think it is more than enough."*

and:

"*I (AC) have noticed the music work. It is always better when they can hear songs they are familiar with. I think it would be better if there was louder music at the back in the background*."

and:

"*I (AC) definitely we would maybe choose a different group of people now because we have had different residents come in that I feel would probably be more suitable for it now than the initial ones we started with but certainly we would do it (intervention) again*".

***Intervention effects – Focus groups***

From the qualitative data, perceived intervention effects were reported by both residents and care home staff. Sub-themes were improved mood and physical health, care staff job satisfaction and social support

*Mood and physical health*

It was mainly stated that the intervention improved the mood of residents. In some cases, an increase in residents' physical capabilities was seen:

*"...and then as soon as the session starts their mood just goes up and up, and by the end of it (intervention session), they (residents) are so happy. We have got one lady who quite often would stand up and shake her hips and she was very motivated and excited. So, it was really great."*

and:

"*It (intervention) definitely improves moods. The difference between the start of the session and the end of the session with their moods was quite a big change*."

and:

"*Probably for one resident, I (AC) would say as the sessions went on, she done a little not much, but a little bit more each one so I do not know if that's been physical for her meaning it has made her physically a bit stronger."*

*Job satisfaction*

Care home staff also acknowledged that facilitating the programme gave recognition to them in the care home, gave them a sense of fulfilment and added to their knowledge of physical activity. Some excerpts affirming the importance of the intervention to care home staff were:

"*I think it made us feel good to see them happy and made you think that that you have done a good job. So it is just a feel good thing and makes you go home at night and think I have had a good day*."

and:

"*I have gained loads through this experience, so I have learnt new movements which are safe and easy to follow. It was great to do some stretches in the morning as well for everyone and sometimes other staff would join and enjoy it too*."

and:

"*It has been very beneficial for me. I was able to get to know people (residents) better as well and they (residents) recognise me now. They do recognise me and sometimes they would just follow me. Some residents would just follow me because they know there will be something fun happening*."

and:

"*They look at us (ACs) different from the carers because we have the time to spend with them and have fun with them*."

*Social support*

Residents were happy to work with ACs, built friendships and loved participating in groups. Also, care home staff pointed out that engaging in the programme helped to establish positive resident-resident and resident-staff relationships. Some comments on social support included:

"*I (AC) think just like the social kind of bonding, it has brought us (staff and residents) all a bit closer I think*."

and:

"*They (residents) get really engaged and I think we (care home) have really enjoyed the social part of it as well. Just being with friends and doing something meaningful was great"*

and:

"*When there is a song playing, the carers around also join in and sing a couple of songs with residents and encourage them (residents) to do a couple of movements*."

### *Intervention effects – Survey*

Pre- and post-intervention data from the surveys provided insights into the multidimensional health outcomes of the participants. Significant changes were noted for anxiety and depression (HADS), loneliness (brief UCLA loneliness scale), perceived stress (PSS), and sleep quality (STT). However, given the feasibility nature of this study and the small sample size, more importance should be given to the mean differences and 95% CI and effect sizes (Cohen's d) presented in Table 6 to show that the intervention yielded positive effects across many measures.

**Table 7: Effect of Intervention on Wellbeing Outcomes**

| Variables | Baseline mean | Post-intervention mean | Mean diff | 95% CI | p-value | Effect size (Cohen's d) |
|---|---|---|---|---|---|---|
| FES | 8.17 | 8.72 | -.556 | [-4.199, 3.088] | .752 | -.076 |
| Dartmouth COOP | 16.33 | 15.17 | 1.167 | [-.664, 2.998] | .197 | .317 |
| HADS-Anx | 6.22 | 4.11 | 2.111 | [.373, 3.850] | .020* | .604 |
| HADS-Dep | 6.17 | 3.17 | 3.000 | [1.303, 4.697] | .002* | .879 |
| EQ-5D-3L | 8.00 | 7.72 | .278 | [-.714, 1.270] | .562 | .139 |
| Brief UCLA loneliness scale | 10.61 | 8.94 | 1.667 | [.067, 3.267] | .042* | .518 |
| PSS | 14.72 | 10.56 | 4.167 | [.318, 8.016] | .036* | .538 |
| STT | 27.06 | 33.72 | -6.667 | [-9.174, -4.159] | <.001* | -1.322 |
| SNAQ4 | 16.39 | 16.22 | .167 | [-1.078, 1.411] | .781 | .067 |

Note: *FES* Falls Efficacy Scale International (7-item), *Dartmouth COOP* Dartmouth Cooperative Functional Assessment Charts, *HADS* Hospital Anxiety and Depression Scale, *EQ-5D-3L* EuroQol five-dimensional descriptive system (three level version), *UCLA* University of California, Los Angeles loneliness scale, *PSS* Perceived Stress Scale, *STT* National Sleep Foundation Sleep Satisfaction Tool, *SNAQ4* Simplified Nutritional Appetite Questionnaire

*marks significance $p < 0.05$

### 4.4.3 Refinement of the Programme Theory for Future Implementation

The primary programme theories underpinning the danceSing care programme were described in the Introduction. The outcomes of this study were interpreted according to the CMO configuration as outlined in the process of the realist evaluation (Figure 6). This revealed practical implications for future intervention in this particular care home setting (see Table 7). The four main refinements towards a future intervention were: (1) implementing two or three sessions/week, (2) encouraging participation in the care homes, (3) adding questionnaires of multidimensional health markers complemented with objective measures in a possible future RCT, (4) considering dementia in the care home population. Consequently, refinements to the initial programme theories are offered to aid the future implementation of this digital music and movement resource in wider care home settings.

**Table 8: Refinement of the Programme Theory for Future Implementation**

| Primary and secondary programme theories | Refinement to the programme theories for future implementation |
|---|---|
| (1) If the danceSing care resources are delivered to the care homes, the ACs would consistently deliver the programme to the residents. | - The adherence was best when the programme was given two to three times/week out of the four sessions recommended. Therefore, future studies could implement two to three sessions/week.<br>- For danceSing care staff and researchers, fewer than ten participating care homes would facilitate and speed-up problem solving of any unforeseen barriers regarding the resources, such as tech issues or staffing problems. |
| (2) If the programme is delivered in the care homes, the residents would want to participate regularly. | - Participation could be improved if the danceSing care resources are part of the regular care home schedule, with an allocated time slot, playing music at the start of the sessions and briefing and encouraging residents before the start. |
| (3) If the ACs provide the programme consistently, the participants will experience improved psychosocial health markers. Changes in pre-and post-survey data and qualitative interviews would evidence this. | - Questionnaires evidenced improvements in several multidimensional health outcomes of participants. Indicators of frailty should be complemented with physical function tests. More objective measures such as actigraphs or endocrine measurements could provide additional information about specific health parameters. |
| (4) If the ACs were given enough organisational support (e.g., resources and time), they would be engaged in this programme. | - Wider contexts (e.g., the care home system in Scotland or the COVID restrictions) and organisational contexts (e.g., time and staffing) are out of our control. They are therefore not included in this programme |

| | |
|---|---|
| This would establish shared learning and co-production between programme developers, care homes, and researchers. | refinement. However, before future implementation of the danceSing care resources takes place, tech issues (e.g., internet access or big screens) and staff issues (e.g., a dedicated AC with back-up) could be factored in. |
| (5) If the group sessions were adequately and consistently used, residents would feel more engaged in group activities, creating a community. This communal feeling would increase self-confidence and quality of life and reduce loneliness. This could potentially inspire future usage of the programme's resources. | - Some care home residents who participated had cognitive impairment, influencing the adherence and understanding of measurement tools. Considering cognitive status of care home residents and exploring how to tailor the intervention to those lacking capacity to consent due to cognitive impairment could make findings more generalisable in a future intervention. |

## 4.5 Discussion

The findings of this mixed-methods feasibility study on multidimensional health outcomes of a digital PA intervention using music and movement resources were evaluated through a context-mechanism-outcome (CMO) configuration using a realist approach. This method considered the challenging situation that care homes in Scotland, UK were in during the Covid-19 pandemic, as well as the resources available to the care homes and staff. Consequently, the feasibility of this intervention was established as a component of how the programme would translate into the domain of policy and practice. Discovered delivery challenges were (1) motivation and engagement, (2) cognitive impairment and disabilities of the participants and changes in these, (3) death and hospitalisation of the participants and (4) limited staffing and technology resources to deliver the programme as intended. Regarding the secondary aim of performing limited efficacy testing on multidimensional health markers, ACs and residents commented on improved mood, physical health, job satisfaction and social support, with large effect size values and improvements in the questionnaire scores for anxiety, depression, feelings of loneliness, perceived stress and sleep satisfaction, but no changes in fear of falling, domains of general health and appetite. Due to the feasibility nature of this study and the small sample size, pre- to post-intervention data should be considered preliminary. Overall, these findings tentatively support the recommendation to implement a future RCT, with limitations discussed below. The initial programme theory was therefore refined as discussed below.

### 4.5.1 Refinement of the Programme Theory for Future Implementation

*Refinement 1: Future intervention could implement two or three sessions/week.*

The mean adherence to this 12-week intervention at a dose of 3+1 sessions per week was 57%. This is lower than the findings of a previous systematic review about the adherence to supervised technology-based exercise programs for 12 weeks in older adults, where the expected adherence range would fluctuate from 70% to 100% (Valenzuela et al., 2018). In this study, adherence was best when the programme was given two to three times/week. This is in line with the recommendations of a Taskforce Report about physical activity and exercise for older adults living in care homes, suggesting a frequency of twice a week, with an interval of at least 48h between sessions (de Souto Barreto et al., 2016). The proposed refinement of a future implementation of these music and movement resources would be one or two movement sessions and one music session per week.

*Refinement 2: Encouraging participation in the care homes.*

Participation and engagement are pertinent issues for developing trials and implementing interventions in practice (Yardley et al., 2007). Research staff and danceSing care staff tried to engage the ACs to personally invite the care home residents into the programme and emphasise the multiple benefits of training programmes, as these strategies are suggested to be important to maximise participation in older adults (Yardley et al., 2006).

Further, throughout the intervention, the danceSing Care team attempted to create community groups to join the 'danceSing care family'. However, these approaches need to be adjusted to get more appeal from ACs and residents in the future, for example, having more interaction on social media pages. Finally, to maximise adherence to these music and movement resources, special care should be given to making the sessions habitual in the care home, as adherence to physical activity interventions in care homes tends to taper off in the long run (Nyman & Victor, 2011).

*Refinement 3: Adding questionnaires of multidimensional health markers complemented with objective measures in a possible future RCT.*

The intervention effects on multidimensional health markers should be treated as tentative due to the feasibility nature of the study, i.e., the small sample and the lack of a control group. Nevertheless, the programme effects suggest benefits to participants' health and wellbeing, as evidenced by the large effect size values. A future larger scale randomised-controlled trial would be necessary to confirm this. However, these findings are consistent with the literature on the effects of music and movement resources in older adults, indicating positive changes in mental wellbeing (Arrieta et al., 2018; Brustio et al., 2018; Cordes et al., 2021; Da Silva et al., 2022; Guzmán-García et al., 2013; Hwang & Braun, 2015; Low et al., 2016; Windle et al., 2010). Physical function tests could usefully complement frailty measurement to aid diagnostic accuracy (Clegg et al., 2013; Fried et al., 2001). Further, during ageing, the endocrine regulation of certain hormones gets challenged; e.g., the activity of the adrenocortical cells that produce the major sex steroid precursor dehydroepiandrosterone (DHEA) and dehydroepiandrosterone sulphate (DHEAS) decreases, often alongside a gradual rise in cortisol (stress hormone) release (Chehab et al., 2007; Heaney et al., 2014). Therefore, objective measures of this type could complement health outcomes, such as biomarkers of the hypothalamo-pituitary stress axis (cortisol and DHEAS) (De Nys, Ofosu, et al., 2022).

The qualitative analysis showed reported improvements in ACs' and residents' mood and physical health, job satisfaction and social support. Similarly, in previous qualitative studies, older adults in interviews and focus groups have reported that PA interventions have improved their perceptions of their physical capacity and overall physical health (Lindsay-Smith et al., 2019; Maula et al., 2019; Swales et al., 2022). Previous observations in older adults also found psychological benefits of engaging in physical activity. These benefits include enjoyment and happiness, which comes not only with engaging in physical activity but also with enjoying the company of others in the group and connecting with people (Lindsay-Smith et al., 2019; Maula et al., 2019; Swales et al., 2022). Likewise, previous studies have described that care home staff job satisfaction is associated with high recognition of their contributions to the care home and a sense of belongingness, purpose and responsibility in the care home (Foà et al., 2020; Hirakawa et al., 2019; Moyle et al., 2003). Thus, these qualitative findings correspond with the belief that providing care and support to residents in the care home setting is challenging but exciting and fulfilling to care home staff (Foà et al., 2020; Hirakawa et al., 2019; Moyle et al., 2003). Similarly, conducting research in care homes has been reported to be beneficial to care home staff through training and empowerment (Jenkins et al., 2016).

*Refinement 4: Considering dementia in the care home population*

Although no data about cognition was formally collected in the current study, it should be noted that it was observed that many of the included participants suffered a significant cognitive decline over the course of the programme. This affected participation and, in this instance, significantly reduced the number of post-intervention assessments possible. One previous study showed that residents who accepted technology-based resources were significantly less cognitively impaired than those who did not (Ulbrecht et al., 2012), adding to the relevance of considering and measuring cognitive status and extending recruitment to those lacking capacity to consent, where possible. In addition, the adherence to an exercise session of an RCT with residents having dementia showed similar adherence rates to this study (Henskens, Nauta, Van Eekeren, et al., 2018) . The reason for the differences in adherence rates between residents with and without dementia could be that in people without or with only mild cognitive impairment, the instructions and explanations on exercise and its benefits that are usually used to promote PA (Spittaels et al., 2007) come across more clearly, possibly increasing adherence. This approach is not feasible in the presence of advanced cognitive impairment as individuals cannot process and remember verbal instructions,

highlighting the need for individually tailored activities to functional ability and interest (Hill et al., 2010). However, real-time reinforcement and feedback while exercising could improve adherence and provides an opportunity to monitor performance over time (Valenzuela et al., 2018). This task could be attributed to the ACs in the care homes in a future RCT. Further, studies including care home residents with dementia generally use the Mini-Mental State Examination (MMSE) (Folstein et al., 1975) or similar to screen for cognitive impairment (Henskens, Nauta, Drost, et al., 2018; Thurm et al., 2011). Thus, using a cognitive impairment measure could complement the understanding of the effects of dementia on the feasibility and effectiveness of future interventions. This would not be to screen out residents with dementia as those not able to consent to participate in a research study or complete survey measures might still benefit from participating in the intervention programme itself. This would need careful assessment as well as potentially repeated screening to assess changes in cognitive function across the intervention and repeated consent for measurements throughout such an intervention (Yardley et al., 2007). Further, a fruitful line of future research would be to explore how to tailor the intervention to those lacking capacity with cognitive impairment. A future trial could also extend to recruiting those with cognitive impairment who lack capacity to consent via personal/nominated consultees.

### 4.5.2 Strengths and Limitations

Realist evaluation approaches have been advocated for evaluating complex care interventions (Byng et al., 2005; Salter & Kothari, 2014). This approach steers away from a 'one-size-fits-all' problem-solving approach (Pawson & Manzano-Santaella, 2012). Indeed, it has some clear strengths. It uses a sound methodology to consider multiple actors at play in complex situations and translates this into the world of policy and practice. However, these approaches are relatively new compared to the processes commonly used in feasibility studies evaluating health care interventions, with a less rigorous traditional methodology. Also, emphasis was placed on contextual factors during a period of some Covid-19 restrictions in the care home system in Scotland. Therefore, the present conclusions may be subject to temporal and situational changes in how programmes are implemented. Nonetheless, care was taken to reach optimal data integration at multiple levels (methods, interpretation and reporting) in the most objective ways possible. Also, stakeholders' feedback (via interviews, focus and advisory groups) was integrated during the data analysis. This acknowledges the

importance of the co-production of stakeholders in terms of future programme implementation.

Second, the present study is limited by the small sample size, high attrition, and lack of a control group. However, as this was primarily a feasibility study, an adequately powered RCT design was not implemented at this early stage and would form the next step in evaluating this intervention.

Finally, it should be acknowledged that due to restricting recruitment to those with the capacity to consent means that we cannot generalise the present findings to that sub-population which is a common sub-group of care home residents. However, we did not preclude inclusion in the intervention group from those lacking capacity, and some individuals who did participate had cognitive impairment, although this influenced adherence and understanding of the measurement tools. Ideally, future research would examine how best to specifically tailor this intervention to the sub-group of individuals with cognitive impairment and lack of capacity to consent and then extend recruitment to those lacking capacity via personal/nominated consultees.

### 4.5.3 Conclusion

This realist evaluation of a feasibility study of a digital music and movement intervention in care homes suggests that such an intervention is feasible, at least in individuals with capacity to consent and mild cognitive impairment. The adherence and delivery of the resources are likely to meet greater success when the following features are adopted: (1) implementing two to three sessions per week, (2) encouraging participation by personally inviting the care home residents into the programme or by making the resource a habitual activity and individually-tailoring the activity to the resident's functional/cognitive ability and interest, (3) complementing existing health questionnaires with physical function tests for frailty screening and/or other objective measures of health and wellbeing, (4) measuring and taking into account cognitive impairment of the participants including exploring ways to tailor the intervention to those lacking capacity to consent.

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# Chapter 5: Digital Music and Movement Resources to Improve Health and Wellbeing in Older Adults in Care Homes: a Pilot Mixed Methods Study.

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This chapter is a follow up from Chapter 4; a realist evaluation of the feasibility of a digital music and movement intervention for older people living in care homes. Following the discovery of how feasible digital music and movement intervention delivery was in care homes, the mixed methods pilot study described below took into account results from Chapter 4, managed the intervention delivery challenges as much as possible, and set out to evaluate the effectiveness of digital music and movement resources on wellbeing in residents domiciled in care homes in a different care home organisation to the previous chapter. Results from Chapter 4 highlighted the need for refinements to the intervention before proceeding to future studies. The refinements implemented in this pilot mixed methods study were: 1) reducing sessions from four to three times a week, 2) encouraging participation and resolving intervention delivery challenges like limited staffing and technology resources for intervention delivery, 3) adding physical function and endocrinology health markers tests to the psychosocial outcomes, 4) introducing a cognitive capacity checklist as an additional screening tool for inclusion, 5) recruiting fewer care homes to allow for easier check-ins and monitoring during the intervention, and 6) allocating time for the intervention to be a part of the care home routine. These changes were all implemented to improve participation, adherence and ultimately the wellbeing of residents in care homes.

Wellbeing was not only limited to psychosocial wellbeing but included physiological wellbeing (physical function, salivary DHEA and cortisol) as well as perceived stress and sleep satisfaction. However, these components of wellbeing in this study were led by my colleague LdN, whereas I took the lead on the psychosocial wellbeing measures and qualitative research data. Specifically, I collected data on and analysed psychosocial measures, conducted all interviews and monitored facilitation and delivery of the intervention (follow up phone calls, weekly reminders about adherence registers, occasional visits to care homes). In terms of writing and putting together the submitted manuscript in this Chapter, LdN and I contributed equally with supervision from AW, JC and GR. The published article below is a joint publication and for this reason contains sections on physiological wellbeing as an outcome which is not relevant to this PhD.

## 5.1 Abstract

**Background**: Low physical activity among older adults is related to adverse health outcomes such as depression and loneliness, poor physical function and increased risk of falls. This study was designed to increase physical activity through a digital, group-based, physical activity and music intervention and to examine its effectiveness on social, mental and physical health outcomes.

**Methods:** Participants were 34 older adults (65 years+) recruited across four care homes in Scotland to a pilot study. Surveys were administered at baseline and post-intervention, comprising measures of fear of falling, depression and anxiety, loneliness, sleep satisfaction and quality of life. A battery of physical function tests and saliva sampling for cortisol and dehydroepiandrosterone hormone analysis were also conducted at each time point. Additionally, process evaluation measures (recruitment, intervention fidelity, attendance, retention rates and safety) were monitored. The intervention comprised 12 weeks of three prescribed digital sessions per week: movement to music (n=2) and music-only (n=1), delivered by an activity coordinator in the care home. Post-intervention interviews with staff and participants were conducted to gain qualitative data on the acceptability of the intervention.

**Results:** An average of 88% of prescribed sessions were delivered. Pre- to post-intervention intention-to-treat analysis across all participants revealed significant improvements in anxiety, salivary DHEA, fear of falling and loneliness. There were no significant improvements in health-related quality of life, perceived stress, sleep satisfaction or physical function tests, including handgrip strength. Qualitative analysis highlighted benefits of and barriers to the programme.

**Conclusion:** The digital movement and music intervention was deemed acceptable and delivered with moderate fidelity, justifying progression to a full-scale trial. Although a proper control group would have yielded more confident causal relationships, preliminary psychosocial and biological effects were evident from this trial. To show significant improvements in physical function, it is likely that that a bigger sample size providing sufficient power to detect significant changes, greater adherence, longer intervention and/or higher exercise volume may be necessary.

**Trial registration:** The trial is registered at ClinicalTrials.gov, number NCT05601102 on 01/11/2022

**Keywords:** older adults, physical activity, digital health intervention, anxiety, fear of falling, loneliness, physical function, cortisol, DHEA, pilot study

## 5.2 Introduction

As the demographic shift towards an ageing population accelerates (Office for National Statistics, 2021; United Nations Department of Economic and Social Affairs Population Division, 2022), a transition to care home or supported living facilities may become the most viable option for older individuals living alone and requiring high-level supervision and care (OECD, 2021; Wiener, Anderson, & Brown, 2009). In Scotland, UK, care homes provide 24-hour support and assistance with daily activities, including personal care, medical monitoring, and social engagement, for older adults who can no longer live independently due to physical or cognitive impairments (Director-General Health and Social Care, 2022). These facilities cater to residents with varying levels of need, from those requiring minimal assistance to those needing comprehensive care (Age UK, 2022).

The multifaceted challenges confronting older adults residing in long-term care settings, such as limited mobility, limited independent access to outside facilities/activities and lack of social interaction, present barriers to maintaining physical activity (PA) levels (Sackley et al., 2006). PA has been shown to have significant positive effects on the healthy ageing trajectories of older adults (Daskalopoulou et al., 2017), with favourable effects on the endocrine system (Kraemer et al., 2020; Kraemer & Ratamess, 2005; Sellami et al., 2019), anxiety and depression (Schuch et al., 2016; Stubbs et al., 2017) and physical function (Nusselder et al., 2008; Paterson & Warburton, 2010). With the rise in technological developments, an increasing number of innovative digital PA interventions have been developed for use in a range of populations and settings (Davies et al., 2012; Muellmann et al., 2018). However, research on the effectiveness of digital resources in promoting PA among older adults in care home settings remains limited (Muellmann et al., 2018). This study aimed to address this issue by investigating the effectiveness of a digital PA intervention specifically designed for the health and wellbeing of older adults in care homes with the range of needs and dependencies described above.

Several physiological and psychological challenges are evident in the context of ageing. First, there is a notable change in the functioning of the endocrine system, with the hypothalamic-pituitary-adrenal (HPA) axis being particularly affected, as indicated by changes in the secretion patterns of cortisol and dehydroepiandrosterone and/or its sulphated form (DHEA/S) (Ferrari et al., 2001; van den Beld et al., 2018). This can substantially affect the immune system (Buford & Willoughby, 2008; Butcher et al., 2005; Phillips, Burns, & Lord, 2007). Second, older adults, whether community-dwelling or in care homes, experiencing reduced social support, chronic disease, and decreased self-esteem are at an increased risk of mental health issues such as anxiety and depression (Alipour et al., 2009; Boyd, 2007), which negatively impacts their wellbeing and quality of life (Olatunji, Cisler, & Tolin, 2007; Vancampfort et al., 2017). Finally, a decline in physical function is commonly observed with ageing, increasing older adults' vulnerability to falling, frailty, rising healthcare costs and premature death (Stenholm et al., 2015; Taekema et al., 2012; Tolley et al., 2021). While these challenges can have profound negative impacts on older adults, research has demonstrated that PA can counterbalance these challenges and positively influence healthy ageing by improving cortisol and/or DHEA(S) levels (De Nys et al., 2022), anxiety and depression (Ofosu et al., 2023), muscle mass, strength, and thus physical function, frailty, and quality of life (de Vries et al., 2012; Pedersen & Saltin, 2015; Sherrington et al., 2008; Swales, Ryde, & Whittaker, 2022; Warburton, Nicol, & Bredin, 2006) Therefore, PA interventions are a viable approach to mitigating the adverse effects of ageing on the endocrine system, psychological wellbeing, and physical function in older adults.

However, poor adherence to PA programmes is often reported in institutional settings such as care homes (Nyman & Victor, 2011). To improve adherence, innovative digital PA resources have been developed for delivery to older adults, showing promising results to impact overall health, e.g., by improving quality of life (Chan et al., 2021), muscle mass and physical function (Kraaijkamp et al., 2021; Nishchyk, Chen, Pripp, & Bergland, 2021) and decreasing feelings of anxiety and depression, and dementia (Preschl et al. 2011) (for reviews, see (Davies et al., 2012; Muellmann et al., 2018; Dawson et al. 2023). Digital interventions can improve adherence by providing engaging, interactive, and easily accessible content that can be personalised to meet individual needs and preferences, as suggested by the WHO recommendations (World Health Organisation, 2016). However, although most trials showed a positive trend towards the efficacy of digital interventions, better quality evidence is needed considering the heterogeneity in the measures used across studies and to

address limitations associated with modest sample sizes and relatively short intervention durations. Further research is warranted to evaluate the effectiveness of digital PA resources on physiological, psychological and social dimensions of healthy ageing (Buyl et al., 2020; Tonga et al., 2022). In particular, the evidence for the effects of digital PA resources on steroid hormones in older adults is scarce. For example, several studies have noted a lack of quality evidence for the impact of PA interventions in care home residents on anxiety symptoms, cortisol and DHEA(S) (De Nys, Anderson et al., 2022; De Nys, Ofosu et al., 2022; Ofosu et al., 2023). In addition, there is evidence that conducting PA in a group can enhance the effects of the intervention by enhancing social connectedness and reducing loneliness (Lindsay-Smith et al., 2019; Maula et al., 2019; Swales et al., 2022). Thus, interventions combining the digital delivery of PA with a group exercise setting should be examined.

Music, as a common component of group PA delivery, also warrants attention due to the health benefits demonstrated in studies on dance (Hwang & Braun, 2015; Liu et al., 2021; Sooktho et al., 2022) and music interventions (Dingle et al., 2021). The intervention evaluated in this study combined group participation with multicomponent exercises and added a music and singing aspect because music has been shown to positively impact mood, anxiety, and stress, making it an effective tool for improving mental health outcomes (Dingle et al., 2021; Taylor et al., 2023). Music can also enhance the enjoyment of PA, increasing adherence and compliance with exercise programmes (Clair, 1996; Priest et al., 2004). Additionally, the use of music may help evoke positive memories and emotions, contributing to overall emotional wellbeing through reminiscence (Ellis & Salmoni, 2021). However, the effectiveness of music interventions can vary significantly based on individual preferences and the type of PA (Petrovsky et al., 2015). The intervention evaluated in this study used a combination of digital delivery and in-person support aimed to address the challenges and maximise the benefits of both group PA and music for older adults in care homes.

To this end, a preliminary study tested the feasibility of a digital music and movement resource in care homes (Ofosu et al., 2023b). Key outcome measures were determined by an advisory group consisting of the research team, care home staff, older adult representatives and representatives from danceSing Care, the company that devised the digital intervention based on important health and wellbeing indicators for these stakeholders and informed by the research literature. The study results determined that such a programme was feasible with recommended adjustments for future implementation (Ofosu et al., 2023b). In light of these recommendations, a pilot RCT was designed to investigate whether a 12-week digital music

and movement resource, compared to a waitlist control group, would improve some of the same measures from the original study (anxiety, depression, fear of falling, loneliness, quality of life, perceived stress and sleep satisfaction) in addition to measures that are deemed important in previous literature but not possible to measure during the first study (salivary cortisol and DHEA levels and physical function). The primary outcome measures in this study are the physiological markers, specifically salivary cortisol and DHEA levels, and anxiety and depression. These markers were chosen based on previous literature that highlighted their role in reflecting the stress response, overall endocrine health, and older adult wellbeing, which are indicators of the physical benefits of PA interventions and also where less is known in terms of PA effects than is the case for other e.g., cognitive or depression outcomes in older adults (De Nys et al., 2022; Ofosu et al., 2023a).

The primary aim of this pilot RCT was, therefore, 1) to evaluate the efficacy of a digital movement and music intervention within care home settings and its subsequent impact on a range of health and wellbeing outcomes; and 2) to decide whether and how to proceed with a future definitive randomised controlled trial by interpreting specific progression criteria, following the previous feasibility study.

## 5.3 Methods

### 5.3.1 Design

The danceSing Care evaluation trial was a mixed-methods multicentre pilot randomised (1:1), waitlist-controlled trial (RCT) conforming to the CONSORT reporting guidelines for randomised pilot and feasibility trials (Eldridge et al., 2016). Participants were recruited from care home facilities in central Scotland. Data were collected through salivary endocrine measurements, physical assessments, self-report questionnaires, and semi-structured qualitative interviews. Also, process evaluation measures were monitored throughout the intervention period.

Ethics approval was given by the University of Stirling Non-invasive Clinical Research panel: NICR 2021 3735 3607. This pilot study protocol was registered with the Clinical Trials Register: NCT05601102 on 01/11/2022.

### 5.3.2 Procedure, Setting and Locations

The study occurred at care homes in central Scotland from March to July 2023. Residents capable of giving informed consent were invited to participate in the study after a

brief introduction through posters utilised by care home staff and face-to-face interaction with the researchers. Researchers, with the help of care home staff, recruited residents from four Holmes Care Group care homes selected by the Group executive team as representing homes with at least one activity coordinator or similar staff in post, thus available to deliver the intervention. Recruitment started four weeks before the intervention following a live group training and initiation session for the activity coordinators across the Holmes Care Group, including the homes selected to participate in the research. The study design and protocol were explained at this session, including how the wait-list condition would work, along with how adherence data would be collected weekly. Initially, two homes were recruited, but within a week of attempting recruitment, it became apparent that an additional two would be needed to reach the target sample size (see below). Across the four care homes, participant numbers were not evenly distributed due to the varied population size in each care home recruited, the number of residents with the capacity to give consent, and the overall willingness of participants to be engaged in a study. Participants recruited to both intervention and waitlist control groups (1:1 randomisation across all participants recruited) completed baseline and post-intervention questionnaires with the assessors (LDN & EO) in private areas (empty lounges, bedrooms) in their respective care homes to ensure privacy and confidentiality. The intervention lasted for 12 weeks while the waitlist period for the control group was to be about 14 weeks (12 weeks of the intervention plus two weeks of post-intervention data collection prior to receiving the intervention themselves). Physical function testing and saliva sample collection were in empty hallways and private rooms. A sub-sample of seven participants was interviewed two weeks after completing the post-intervention measures to explore additional in-depth intervention effects not captured in the survey, biological, and physical function testing measures. Five care home staff (activity coordinators and/or carers) who facilitated the online intervention were also interviewed in person to share their experiences throughout the process.

### 5.3.3 Participants

*Eligibility criteria*

Eligible participants were adults aged 65 or older living in Holmes Care care homes following an agreement with the digital music and movement provider. They needed to be capable of completing a 12-week movement and music programme, providing informed consent, and comprehending the research measures in verbal English, as evaluated by care

staff. The care staff were asked to consider the ability of the residents to participate in the study. As the intervention programme is meant to be delivered in care homes inclusive of all residents, no specific physical function cut-off was used as an eligibility criterion other than being able to get out of bed and take part in chair-based exercise as a minimum. The programme was adaptable to each participant's needs, allowing participation either sitting or standing. Cognitive decline experienced during a previous feasibility study (Ofosu et al., 2023b) influenced eligibility, particularly regarding understanding research measures among those with cognitive impairment. Due to time constraints and ethical considerations, addressing capacity-related issues for individuals lacking both consent capacity and understanding of measures was not feasible, although they were still able to take part in the music and movement programme. Eligibility assessment followed the use of the British Psychological Society capacity checklist (British Psychological Society, 2010), and verbal consent was reaffirmed at each interaction by the researchers. Ineligibility criteria included participation in concurrent clinical trials that could affect this study's outcomes, pre-existing conditions significantly impacting their ability to undergo the intervention, and insufficient English proficiency to engage in measures and intervention due to cognitive or sensory impairments.

*Sample size*

G*power was used to determine the target sample size. The statistical test (ANOVA: Repeated measures, within-between interaction) and the power of the analysis (*A priori*: compute required sample size) were selected, with $\alpha = .05$ and power = 0.80. The standardised mean difference (SMD) (= .80) for the cortisol outcomes was used from a previous systematic review (De Nys et al., 2022) to determine the effect size for this study. This revealed a required total sample size of n = 16. To account for a possible 20% attrition, the total sample size was inflated to n = 20. Similarly, the effect size for the anxiety outcome in this pilot RCT was based on an SMD of 0.27 recorded from the previous systematic review (Ofosu et al., 2023). This revealed a required total sample size of n = 110. To account for a possible 20% attrition, the total sample size was inflated to n = 132. However, consultation with the care home management suggested that this sample size would not be pragmatic given the high level of cognitive impairment among residents and, thus, the small number of residents eligible for recruitment. Further, the previous feasibility study showed effects in n = 18 for the psychosocial outcomes, so the target sample in this pilot study was set at 36, based on a general rule of thumb of 30 (Browne, 1995) and accounting for a possible 20% attrition.

Given the feasible sample size, it was determined that individual randomisation (i.e., by participant) would be more pragmatic than cluster randomisation (i.e., by care home), which requires larger sample sizes due to other cluster/site variability (Rutterford et al., 2015).

### 5.3.4 Intervention

Participants were randomly assigned to participate in a digital movement and music programme with resources from danceSing Care for 12 weeks or a waitlist for 14 weeks before participating. This programme consisted of two movement sessions and one weekly music session, each lasting approximately 20 minutes. This was the recommended dose suggested in the refinements made from the preliminary feasibility study (Ofosu et al., 2023b). These sessions were delivered in a group-based setting, with the digital resources displayed on a large screen under the supervision of the care home's activity coordinator in a communal room. The sessions were low-to-moderate intensity, including a warm-up and cool-down period. The resources gave access to different exercise types, such as strength, flexibility and mobility training, chair-based yoga, breath work, and activities to improve balance and stability for fall prevention. Additionally, certain sessions consisted of singalong activity or themed music. Care home activity coordinator(s) led the sessions and received training on engaging participants and using the digital resources from danceSing Care programme trainers. The danceSing care programme could be tailored to accommodate the preferences and needs of the participants, with sessions labelled according to their dementia-friendliness and activity coordinators could select the most appropriate session for those taking part. Instructions were integrated into the digital resource to adapt the exercises for sitting or standing postures during movement sessions according to ability, and the music and sing-along sessions were personalised based on the music preferences of older adults. In line with the recommended methods of reporting intervention designs, a TiDieR checklist is detailed in Appendix P.

### 5.3.5 Outcome Measures

The primary and secondary outcome measures determined by the advisory group and when they were implemented are summarised in Table 8. The primary outcomes were salivary cortisol, DHEA levels, and anxiety symptoms to specifically address gaps identified through review of the existing literature. Secondary outcomes were fear of falling, loneliness, quality of life, stress, sleep satisfaction, physical function and frailty phenotype. Where possible, brief versions validated in older adults with or without cognitive impairment were

used to reduce participant burden. The researchers also piloted the measures on older adults prior to the study start to gauge the level of burden, and during data collection, participants were advised to take a break when they needed to.

**Table 9: Summary Table of Outcome Measures**

| **Baseline measures** | **Source** | **Time point** |
|---|---|---|
| Demographic information | Self-report | Baseline |
| **Primary measures** | | |
| Salivary cortisol and DHEA | Assessor | Baseline and post-intervention. |
| Hospital Anxiety and Depression Scale | Self-report | Baseline and post-intervention. |
| **Secondary measures** | | |
| Questionnaires<br>- Falls Efficacy Scale<br>- Dartmouth Cooperative Functional Assessment Charts<br>- Brief UCLA loneliness scale<br>- Perceived Stress Scale<br>- Sleep Satisfaction Tool | Self-report | Baseline and post-intervention. |
| Physical function tests<br>- Short performance battery<br>- Hand grip strength<br>- Fried frailty phenotype criteria | Assessor | Baseline and post-intervention. |
| **Qualitative data** | Semi-structured interviews | Post-intervention |
| **Progression criteria**<br>- Recruitment rate<br>- Intervention fidelity<br>- Attendance<br>- Retention rate<br>- Safety | Assessor | Post-intervention<br><br>Monitored during and completed after the intervention |

### *Questionnaires*

#### *Demographics*

Standardised socio-demographic questions about age, sex, ethnicity, relationship status and education were included to ensure an understanding of the participant pool and contextualise the findings within the backgrounds of the participants.

#### *Anxiety and Depression*

Symptoms of anxiety and depression were measured using the Hospital Anxiety and Depression Scale (HADS) (Zigmond & Snaith, 1983). The HADS consists of two subscales with seven items, each measuring anxiety or depression on a four-point response scale from zero to three, resulting in a maximum score of 21 on anxiety or depression. Specifically, the anxiety subscale covers symptoms of generalised anxiety disorder, whereas the depression subscale focuses on anhedonia (Snaith, 2003). This measure has been validated in older adults with or without cognitive impairment, making it suitable for residents in care homes (Cronbach's alpha for HADS anxiety= 0.87, HADS depression = 0.81) (Djukanovic et al., 2017). The present study's internal consistencies for anxiety and depression were 0.85 and 0.66, respectively.

#### *Falls*

The FES-I short form (Kempen et al., 2008) validated in older adults (Cronbach's alpha = 0.92) measured fear of falling while carrying out daily activities such as getting dressed or attending social events (Kempen et al., 2008). The FES-I is a seven-item scale with responses on a Likert scale from zero (not at all concerned) to three (very much concerned) and total scores ranging from zero to a maximum score of 21. Internal consistency in the present study was 0.93.

#### *Health related quality of life*

Participants' health-related quality of life across domains of physical fitness, activities of daily living, feelings, social activities, and change in health and overall health status for the past two weeks was measured with the Dartmouth COOP charts (Nelson et al., 1987) which has test-retest reliability coefficients ranging from 0.67 to 0.82 (Meyboom-De Jong & Smith, 1990). This measure has six charts with responses on a five-level ordinal scale ranging from

one (no limitation at all) to five (severely limited) for all items except the change in health item, which is reverse scored so that one and five mean much better and much worse, respectively (Nelson et al., 1987). A high score indicates poorer health-related quality of life, with scores ranging from six to a maximum of 30. Internal consistency in the present study was 0.80.

*Loneliness*

The short-form UCLA loneliness scale (ULS-6) (Neto, 1992) measured feelings of loneliness among participants. The ULS-6 has a Cronbach's alpha for the reliability of > 0.7 and is made up of six items and response options on a four-point scale (1-never to 4-often), where a high score shows increased subjective feelings of loneliness, and scores range from six to a maximum of 24 (Neto, 2014). The Cronbach's alpha in the present sample was 0.85.

*Perceived Stress*

The Perceived Stress Scale (PSS) (Cohen, Kamarck, & Mermelstein, 1983) was used to measure how participants experienced their stress during the past month. It consists of ten items with a five-point Likert scale ranging from zero to four that indicates to what extent people perceived stress (depicting low, moderate, and high perceived stress), resulting in a higher total score indicating higher perceived stress from zero to a maximum of 40. Reliability in this study was 0.91.

*Sleep Satisfaction*

The National Sleep Foundation's Sleep Satisfaction Tool (SST) (Ohayon et al., 2018) was used to measure sleep satisfaction. It is a nine-item scale scored on Likert response scales (one to four) with a Cronbach's alpha of 0.87 and a high score suggesting greater sleep satisfaction, where scores can vary from nine to a maximum of 36 (Ohayon et al., 2018). In the present study, the alpha for reliability was 0.90.

***Salivary cortisol and DHEA***

A one-point saliva sample for cortisol and DHEA concentration measurement was obtained in the morning by a Salivette cotton wool swab (Salimetrics Ltd., UK) (between 10:00 and 12:30). This timing was specifically selected to mitigate the impact of cortisol's diurnal variation, aiming to capture a more stable period after the morning peak (cortisol awakening response), and time of waking was also recorded. This was optional, requiring

consent to opt in. Participants were asked not to eat, drink (other than water), or smoke for two hours before obtaining the salivary samples (Stalder et al., 2016). The field researcher provided detailed verbal and visual instructions on obtaining the samples to help with compliance. Samples were collected at baseline and post-intervention at the same time of day, and each participant's waking time and sampling time were recorded in a participant case report form upon sampling completion due to the potential influence of time since waking on cortisol/DHEA concentration.

Saliva samples were collected in Salivette tubes, centrifuged at 4,000 rpm for 5 minutes, and the supernatant was transferred to Eppendorf tubes (Eppendorf, Hamburg, Germany) for storage at –20 °C until assay. Cortisol and DHEA concentrations were determined using ELISA kits from Salimetrics LLC, USA, following the manufacturer's protocols. Both assays were conducted in one batch, with samples assayed in duplicate with intra-assay coefficients of <10%. The assays utilised a competitive immunoassay method, where the unknown cortisol or DHEA in the sample compete with a fixed amount conjugated to horseradish peroxidase for antibody binding sites on a microtitre plate. After incubation and enzymatic reaction, the hormone concentrations were inversely proportional to the optical density read at 450 nm, with a secondary filter correction at 490 to 492 nm. All procedures were executed with precision to prevent contamination.

***Physical function***

The short physical performance battery (SPPB) (Guralnik et al., 1994) was used to assess physical function among older adults. It comprises three tests: balance, 4-metre gait speed, and a chair stand test to assess leg strength. A score between 0 and 4 is assigned for each test, and the three tests are weighted equally. Therefore, the maximum score is 12 points. The cut-off value used to assess poor physical performance is ≤8 points, according to the European Working Group on Sarcopenia in Older People (EWGSOP) (Cruz-Jentoft et al., 2010). The interrater reliability of the SPPB in older adults is shown to be excellent (ICC = 0.81 to 0.91) (Medina-Mirapeix et al., 2016; Olsen & Bergland, 2017), and test-retest reliability in people with dementia is also excellent (ICC = 0.92) (Olsen & Bergland, 2017).

Grip strength was utilised as a surrogate measure of overall muscular strength, which also predicts health and mortality risk (Gale, Martyn, Cooper, & Sayer, 2007). An analogue hand-held dynamometer (JAMAR 5030J1, Sammons Preston) was used to measure the hand grip strength of the dominant hand, taking the best score of three attempts with 20 seconds

rest between the attempts (Bohannon, 2008). The test-retest reliability of grip strength in older adults is good (ICC ≥.85) (Wang & Chen, 2010).

The Fried frailty phenotype assessment was used to evaluate frailty (Fried et al., 2001) and is well-established and validated (Bieniek, Wilczyński, & Szewieczek, 2016). It considers five criteria: (1) unintentional weight loss measured through the question 'In the last year, have you lost more than 10 pounds unintentionally (i.e. not due to intentional dieting or exercise)?' (1 point if present), (2) walk time measured across a 4.57 (15-foot) distance and stratified by gender and height (1 point if above the specified cut-off), grip strength as described above and stratified by gender and BMI (1 point if below the specified cut-off), (3) physical exhaustion measured through two questions from the CES-D (Radloff, 1977) asking about feelings or behaviours related to depression in the past week. Participants were asked to reflect on the past week and indicate how often they felt a certain way. They ticked the box in the section corresponding to the frequency of their feelings, with options ranging from "Rarely or none of the time" to "Most or all of the time". The provided statements, such as "I felt that everything I did was an effort" and "I could not get going," are indicative of depressive symptoms or feelings (1 point if present), and (4) energy expenditure through the MLTAQ (Taylor et al., 1978) assessment of leisure-time PA and used in conjunction with weight and kcals per activity, (1 point if below the threshold: <383 Kcals/week for men and <270 Kcals/week for women). Positive criteria thus score 1 point, dividing participants into three categories. Scores range from 0 (not frail), 1-2 (prefrail), to 3-5 (frail).

***Interviews***

The researchers devised the semi-structured interview guide (Appendix O) in consultation with the study advisory group and focused on the general overview of what participants and activity coordinators thought of the programme, acceptability of the intervention and any benefits they derived, or barriers experienced. The interest of participants and activity coordinators in being interviewed was gauged during the baseline data collection and occasional check-in visits to care homes. Based on this, seven residents across three care homes and five activity coordinators from all four care homes agreed. Participants were presented with the participant information sheet and consent forms which included permission to audio record the interview on a password-secured device. Interviews lasted approximately 12 minutes with 15 to 25 questions, including follow-up questions that probed further into responses. To explore residents' general thoughts and perceived benefits

of the intervention questions such as; “What did you think about the danceSing Care online activities?” and “In what ways have the danceSing care activities impacted your wellbeing?” were used. Additionally, some questions were posed to evaluate potential progression of the intervention. For example, residents were asked “Would you like to continue participating in the danceSing care activities?”. For activity coordinators, the line of questioning was mostly based on the progression criteria/facilitating the intervention and perceived benefits of the intervention to residents and staff. Questions like: “Did residents do complete sessions after starting? If not, why not?” and “Did you manage to engage residents in the 2 Music and Movement + 1 Music sessions a week? If not, why not?” and “What do you think was the impact of danceSing care activities on residents’ wellbeing?” to prompt in-depth responses to support and expand on the quantitative data collected on the benefits and progression of the intervention.

***Delivery outcome - Progression criteria***

This trial employed a traffic light or Red Amber Green (RAG) approach, with red indicating major problems requiring urgent attention, amber indicating minor problems requiring attention, and green indicating no concern (Eldridge et al., 2016). The criteria were developed in consultation with the advisory group (Table 11). This extended the preliminary realist evaluation that thoroughly documented the feasibility of the delivery and the acceptability of this intervention. The group further assessed the feasibility of specific trial objectives, inclusion and exclusion criteria, and outcomes (Ofosu et al., 2023b). Thus, the criteria of this trial were based on recruitment, intervention fidelity, attendance, retention rates, and safety. Data were reviewed against the progression criteria, and the research team held regular meetings to discuss progress and concerns.

*Randomisation*

For the allocation of the participants, the Randomization Allocation Software (Saghaei, 2004) was used for sequence generation in a 1:1 sequence by individual participants. Two researchers enrolled and assessed the participants in the study and allocated ID numbers to each of them. The random allocation sequence was concealed from the researchers at baseline testing as the principal investigator generated the assignment sequence of ID numbers. Details about the intervention and waitlist control allocation groups, including attendance sheets with names of the participants receiving the intervention to enable ease of

matching prior to pseudo-anonymisation, were provided to the activity coordinators to return attendance sheets at the end of each week via email.

*Blinding*

Blinding the group allocation is not possible when participants are allocated to an intervention versus waitlist-control group. The researchers taking the measurements were blinded to the allocation of the participants at baseline assessment, but this was not possible at post-intervention assessment. However, the researchers strictly followed approved protocols and guidelines, ensuring the handling of saliva and physical function measurements and questionnaire assessment was as standardised as possible across participants and time points.

### 5.3.6 Data Analysis

*Intention to Treat analysis of questionnaire, physical function and saliva assay outcomes*

Baseline clinical and demographic characteristics were summarised and reported using descriptive statistics. Quantitative data from primary and secondary outcomes were collected, and intention-to-treat (ITT) analyses were performed in IBM SPSS Statistics (version 28.0) to examine the effects of the intervention and the waitlist comparison control group on the primary study outcomes. As stated *a priori* in the protocol, the intention was to conduct an ITT analysis using repeated-measures between within-groups ANOVA with pre- and post-intervention as the repeated measures and intervention versus waitlist control as between-group variables. However, discussions while collecting follow-up data and through interviewing activity coordinators made it evident that the randomisation protocol had not been adhered to at all sites, resulting in participants in both groups receiving the intervention simultaneously. As a result, a true control group was not established. Consequently, an ITT analysis was conducted on pre-post-intervention change on the whole sample. As a sensitivity analysis, a per-protocol analysis was conducted on the sample with available data, i.e., complete cases only, not ITT.

Estimated effect sizes  based on Cohen (1988) criteria (Cohen, 1988), means, mean differences and their precision (95% confidence interval (CI)) were calculated for continuous data and a count (number, %) for nominal data.

*Ancillary Analysis*

To explore if adherence to the intervention had an impact on the wellbeing outcomes, adherence rates for each of the care homes were compared on the change scores across all questionnaires, physical function and physiological metrics by conducting ANOVAs. Adherence rates were grouped as low, moderate, and high for this analysis.

*Intervention fidelity and attendance*

Intervention fidelity was analysed for the duration of the 12-week intervention as the total number of sessions delivered divided by the intended number of sessions (3 per week). Participant attendance was analysed as the number of sessions attended divided by the total number of sessions delivered. The raw fidelity and attendance data were multiplied by 100 to calculate percentage adherence.

*Qualitative analysis of interviews*

Based on the research objectives, a thematic analysis (Braun & Clarke, 2006) was performed on the qualitative data to identify, analyse, organise, and communicate themes emerging from the interviews. After each interview, one researcher (EO) reviewed the audio recordings and field notes. Audio recordings were transcribed using the Microsoft Word audio recording-to-text feature. Transcripts were cross-checked against the audio recording and all personal details of participants and care homes were anonymised. Anonymised transcripts were then exported into NVivo (version 12) where key words, phrases and quotes relevant to the aims of this study were identified. Themes were then coded from the keywords and phrases found to be consistent throughout the interviews. Themes labelling was mostly in line with components of the progression criteria. The coding process and themes were reviewed independently by another researcher (LDN) to ensure the thematic analysis process was thorough and themes accurately represented the data collected. Thematic analysis was done independently, but the themes derived were deductive, given they were linked to the progression criteria; thus, the qualitative results have been presented in association with the progression criteria.

## 5.4 Results

### 5.4.1 Participant Flow

Initially, 37 participants were identified by care home staff as eligible and approached for recruitment from February 2023 to March 2023. The follow-up was completed in July 2023. Thirty-four participants were recruited (seven from each care home except one care

home that had 13 participants) and randomised into 17 in the intervention group and 17 in the waitlist control group. Care Home 1 therefore had eight intervention and five control participants; care home 2 had three and four; care home 3 had four and three, and care home 4 had two and five intervention and control participants, respectively. Figure 8 shows the participant flow. In the intervention group, all 17 participants received the intervention. However, one died, and one withdrew, resulting in 15 participants with complete data for the intervention group. Unfortunately, the randomised waitlist control group design was not adhered to. As the interventions took place in the communal living rooms where the waitlist-control group was also present, this group at times, also received the intervention. Further, two participants passed away, one left the care home, one lost the capacity to consent, and one withdrew (n=12 with complete data for those randomised to be waitlist controls). There were no other missing survey data except for the UCLA Loneliness scale, which one participant chose not to complete. Additionally, four participants did not undergo the physical function tests, and 16 either opted out or could not provide saliva measurements. Therefore, the dataset included 27 participants with pre-post data and 34 for ITT analysis. The subsequent analyses reported here are full sample pre- and post-intervention comparisons. Non-adherence to the delayed delivery of the intervention to the waitlist control group was not evident during the collection of adherence/attendance registers because the attendance of participants on the waitlist was not recorded on the weekly attendance register. This only became apparent in post-intervention data collection and discussion with activity coordinators when arranging testing sessions and interviews.

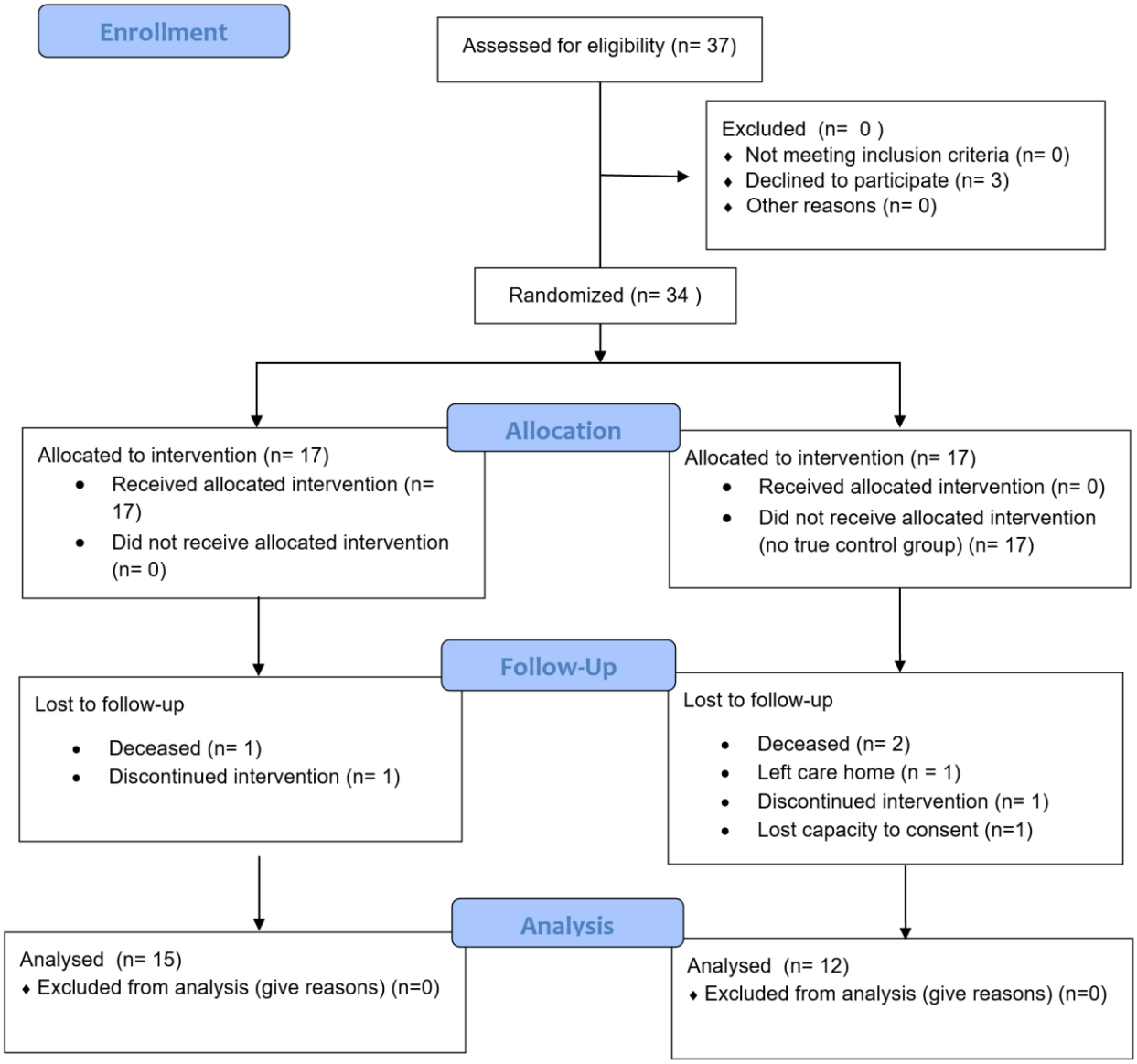


Figure 8: CONSORT flow diagramme

***Baseline data***

Baseline demographics and clinical characteristics for each group are presented in Table 9. Chi-square tests (for categorical data) revealed no significant differences in these characteristics. Most participants were female (59% in the intervention group and 82% in the control group). All participants identified as White: British, Scottish, Welsh, English, Irish, or other. The most common educational attainment was no qualifications (38%).

**Table 10: Baseline Characteristics per Group Based on Randomisation**

| Variables | Mean (SD) / n (%) | | p |
|---|---|---|---|
| | Intervention group (n = 17) | Waitlist control group (n = 17) | |
| **Age group** | | | .31 |
| 65-74 | 3 (18) | 3 (18) | |
| 75-84 | 10 (59) | 6 (35) | |
| 85 or over | 4 (24) | 8 (47) | |
| **Sex** (Female) | 10 (59) | 14 (82) | .13 |
| **Ethnic origin** (White) | 17 (100) | 17 (100) | 1.00 |
| **Relationship status** | | | .25 |
| Single, never married | 4 (24) | 2 (12) | |
| Single, divorced or widowed | 9 (53) | 14 (82) | |
| Living apart | 2 (12) | 1 (6) | |
| Cohabiting | 2 (12) | 0 | |
| **Highest level of education** | | | .09 |
| No qualifications | 8 (47) | 5 (29) | |
| Completed National 5s/Standard Grades/GCSE/CSE/O-levels or equivalent (at school to age 16) | 5 (29) | 4 (24) | |
| Highers/Advanced Highers/ AS levels/A-levels or equivalent (at school to age 18) | 4 (24) | 1 (6) | |
| Did not complete National 5s/Standard Grades/GCSE/CSE/O-levels or equivalent | 0 | 4 (24) | |
| Completed post-16 vocational course | 0 | 1 (6) | |
| Undergraduate degree or professional qualification | 0 | 2 (12) | |

### 5.4.2 Primary and Secondary Outcomes

Table 10 presents the ITT results of all participants' within-group analyses of pre- and post-intervention change. For salivary cortisol and DHEA, there was no significant change in salivary cortisol or the cortisol:DHEA ratio, however, salivary DHEA levels showed a significant increase [$t(17) = -5.25$, $p < .001$]. For anxiety symptoms from the HADS, a significant anxiety reduction was observed [$t(33) = 2.78$, $p = 0.01$].

For the secondary outcomes, significant improvements were observed in loneliness [$t(32) = 2.50$, $p = .02$], and fear of falling [$t(33) = 2.11$, $p = 0.04$]. However, no significant

changes were observed in depression scores, health-related quality of life, perceived stress, sleep satisfaction, the SPPB total or individual scores, handgrip strength, or Fried Frailty phenotype.

**Table 11: ITT Analysis of All Outcome Variables**

| Variables | n | Baseline mean | Post-intervention mean | Mean difference | 95% CI | p | Effect size (d) |
|---|---|---|---|---|---|---|---|
| Cortisol (ug/dL) | 18 | 0.30 | 0.40 | -0.10 | [-.34, .15] | .41 | -0.20 |
| DHEA (pg/mL) | 18 | 1455.40 | 2359.21 | -903.81 | [1267.26, -540.36] | <.001* | -1.24 |
| Cortisol:DHEA | 18 | 0.00028 | 0.00029 | 0.00001 | [-.00011, .00018] | .61 | 0.12 |
| HADS-Anxiety (0-21) | 34 | 6.00 | 4.50 | 1.50 | [.40, 2.60] | .01* | 0.48 |
| FES (0-21) | 34 | 5.29 | 3.47 | 1.82 | [.07, 3.58] | .04* | 0.36 |
| Dartmouth COOP (6-30) | 34 | 15.97 | 14.85 | 1.12 | [-.41, 2.64] | .15 | 0.26 |
| HADS-Depression (0-21) | 34 | 6.44 | 6.03 | 0.41 | [-.62, 1.44] | .42 | 0.14 |
| Brief ULS (6-24) | 33 | 12.27 | 10.64 | 1.64 | [.30, 2.97] | .02* | 0.44 |
| PSS (0-40) | 34 | 12.94 | 11.56 | 1.38 | [-.84, 3.61] | .22 | 0.22 |
| STT (9-36) | 34 | 29.61 | 30.57 | -0.96 | [-2.79, .86] | .29 | -0.18 |
| SPPB total score (0-12) | 30 | 4.67 | 4.67 | 0.00 | [-.73, .73] | 1.00 | 0.00 |
| SPPB balance (0-4) | 30 | 1.87 | 1.70 | 0.17 | [-.36, .70] | .52 | 0.12 |
| SPPB gait speed (sec) (0-4) | 30 | 2.17 | 2.37 | -0.20 | [-.45, .05] | .11 | -0.30 |
| SPPB chair stand (0-4) | 30 | 0.63 | 0.60 | 0.03 | [-.25, .32] | .81 | 0.04 |
| Handgrip strength (kg) | 30 | 15.73 | 16.00 | -0.27 | [-1.30, 0.76] | .60 | 0.10 |
| Frailty total score (0-5) | 30 | 2.63 | 2.63 | 0.00 | [-.20, .20] | 1.00 | 0.00 |

*Note: FES: Falls Efficacy Scale International (7-item), Dartmouth COOP: Dartmouth Cooperative Functional Assessment Charts measure of health-related quality of life, HADS: Hospital Anxiety and Depression Scale, ULS: UCLA Loneliness Scale PSS: Perceived Stress Scale, STT: National Sleep Foundation Sleep Satisfaction Tool. * significance $p < 0.05$*

***Sensitivity analysis***

As described above, a sensitivity analysis per protocol on those retained in the study and thus provided data at baseline and post-intervention (n = 27) was conducted. The summary results in the same format as for the ITT are presented in Appendix Q. In brief, the primary and secondary outcomes largely remained consistent between the ITT and sensitivity analyses. However, there were slight differences in the effect sizes for anxiety, fear of falling, and loneliness, with the sensitivity analysis showing slightly larger effect sizes for these outcomes than the ITT analysis.

### 5.4.3 Exploring Progression to an Actual RCT – Mixed Methods

The outcomes of the progression criteria, which were recruitment, intervention fidelity, attendance, retention rates, and safety, are found in Table 11 with a fuller explanation of the meaning of the criterion in a fuller version in the Appendix R.

**Table 12: Progression Criteria**

| Progression criteria | Grading | Score | Scoring method | Meaning | Recommendation |
|---|---|---|---|---|---|
| **Recruitment rate** | Green | 94% | Number of participants recruited (34) divided by target (36) | Slightly lower than expected but feasible | Extending the recruitment period, implementing additional recruitment strategies, increasing advertisement, utilising referrals, and modifying the design to include those without the capacity. |
| **Intervention fidelity** | Amber | 88% | Number of sessions delivered (127) divided by planned | Moderate intervention fidelity | Strategies to enhance fidelity: integrating the intervention into the weekly care home routine, promoting adherence to the randomisation, clear guidelines and training for activity coordinators, and |

| | | | | | |
|---|---|---|---|---|---|
| | | | sessions (144) | | tracking adherence throughout. |
| **Attendance rate** | Amber | 72% overall range: 56-89% | Number of sessions attended divided by total sessions available | Moderate attendance rates with some concerns | Continuous monitoring to identify potential barriers, providing additional support or reminders to improve attendance. |
| **Retention rate** | Green | 94% | Number of participants retained (32) divided by total participants (34) | High retention rates with no immediate concerns | Ongoing efforts: proactive communication, offering incentives or support, and ensuring clear expectations and benefits of participation. |
| **Safety rate** | Green | None | Number and severity of adverse events reported | No concerns | Continuous monitoring to identify and manage potential adverse events. |

**Recruitment Rates**

The recruitment rate of 34 participants falls slightly below the target sample size of 36. The categorisation as green indicates that while the recruitment rate was slightly lower than anticipated, it is still considered feasible to attain the desired sample size through additional recruitment efforts.

**Intervention Fidelity**

The activity coordinators in the care homes demonstrated moderate fidelity to the intervention protocol, with some deviations identified in frequency and randomisation. The overall average session delivery rate among the care homes was 88% (127 sessions out of the intended 144 sessions, three sessions each week over 12 weeks) over the intervention period.

However, some variability was noted between care homes: one care home delivered 97% of the intended sessions, a second care home provided even more sessions than intended (119%), while a third and a fourth care home provided only 78 and 58% of the sessions. Overall, this indicated moderate fidelity. Adherence statistics are shown in Appendix S.

The variability of adherence among care homes could have resulted from some barriers encountered during the facilitation of the intervention. From interviews with the activity coordinators (facilitators of the intervention), circumstances in the care home context made delivery of the recommended weekly sessions difficult and, in some cases, impossible. For some care homes, the barriers included a staff shortage, creating additional responsibilities for all staff, poor internet connection and scheduling of the intervention as part of the busy routines in care homes.

For example, activity coordinators said:

> *"No, the three sessions a week didn't hold very well, but that wasn't because we didn't want to do it, it was because of certain circumstances. We couldn't do it. Holidays, people being off sick, staff shortages and things like that. We have to help out wherever we can and, so if we're not able to do the activities we (activity coordinators) could be put on care and kind of things like that and so that stopped us from doing it, but we always try to manage to do at least once or twice a week. We thought that's better than nothing"*,

and,

> "*The Wi-Fi in here was really shocking and we had someone come out to try and fix it. We bought those Wi-Fi boosters. We bought them for all over here. It's just [the] building. That was hard. Unless we had someone that had their hotspot from their phone, it constantly cut out. It constantly froze. So that was one of the most difficult things*",

and,

> *"It was time factor for me. Getting everybody together. If they had visitors in, I had to wait till their visitors went and then get them together. And I tried to organise, like a set time, but then when the visitors come in, the visitors are important, so we had to wait longer and longer, but I would say that, and fitting it in around our other activities was the only thing".*

In addition to contextual barriers, activity coordinators also reported poor engagement from participants and influenced weekly sessions' delivery and frequency. For some participants, poor engagement was due to cognitive impairment. For others, it was poor physical health, individual preferences, low motivation, and enthusiasm towards the intervention. To explain the challenges, activity coordinators said:

> *"I think for some of them, it was as a result of their dementia or things like that. They have a shorter attention span and sometimes when they're sitting there, they will all of a sudden not realise why they're there. We have (Participant A) in particular who would always say, "what am I doing here? What am I doing here?" but after we'd explained to her about a good few times what we were doing, she calms down. So some of them were just like that",*

and,

> *"It depended on the mood of the day. You could get one resident that is absolutely amazing one time and then on another day they just don't want to do anything",*

and,

> *"I think some of them (participants) did enjoy the programme and some didn't. I think we struggled with the movement sessions. There were a few of them that didn't really want to do any kind of dances or a lot of the movements, but they loved the singing ones, they absolutely loved them"*

One participant also said,

> *"Well, I'm just not as able as I was. I think it's a struggle to me now, even getting up and about. It just changed overnight. I like to do it but sometimes I'm just not able, like last night, I just wasn't well at all."*

Despite the deviations in frequency per week, it is noteworthy that once a session was conducted, the activity coordinators adhered to the planned intervention components, including duration and intensity. This suggests a level of commitment to maintaining fidelity within the delivered sessions. Also, from the interviews, activity coordinators reported that the intervention has gradually been integrated into the care home routine and expressed interest in its continuity. The statement below from one activity coordinator showed positive acceptability and satisfaction with the intervention:

*"We are going to continue using it, we are going to continue it as much as we can. I mean if we don't get it all the time, if we're only able to maybe do the once or twice a week or even if it only goes down to one, it's still going to get done. It's part of the curriculum now, so it's going to stay".*

However, it is essential to re-emphasise that none of the care homes followed the waitlist control group randomisation process as instructed in the protocol, indicating low fidelity in that aspect.

To improve adherence and participation among participants, activity coordinators adopted mechanisms that made facilitation easier in their respective care homes, irrespective of the difficulties at the onset and the challenges during the intervention period. For some care homes, the activity coordinators joined in the sessions to help motivate and maintain enthusiasm. For other care homes, it was adding it to the schedule and telling visitors ahead of time when sessions would start. In line with this, activity coordinators said:

*"Sometimes, not always, it was easy to get them back to continue the sessions. We just kind of started dancing with them and kind of danced them back towards where they were. It was kind of sneaky but we liked it",*

and,

*"I think when we (activity coordinators) are up moving about more instead of sitting and doing the exercises they're more inclined to get involved. Even though I'm sweating at the end of it, they're more inclined to enjoy it. I think they get a good laugh out of it",*

and,

*"Well, I spoke to some of their families, and they said don't worry about it just come and get her (participant) if she's to go to that (intervention session). It'll be fine and so the families were really good",*

and,

*"Probably like doing it with them. I wasn't like just letting them do it by themselves I was actually involved and liked engaging with them".*

**Attendance of Participants**

Although the intended controls received the intervention, the activity coordinators provided no data on these participants' retention or attendance rates. Therefore, the data provided below, and in Appendix S, consists of the residents initially randomised in the intervention group. The mean participant attendance rate out of the possible total number of sessions delivered, thus available to them in one care home, was 82%. In another care home, it was 60%; in the third care home, it was 89%; and in the fourth care home, it was 56%. Attendance of participants was influenced by several factors, including personal, social and the intervention design as described above. In addition, the interviews from both residents and activity coordinators revealed that participants' engagement in the programme was motivated by their personal history and the memories the intervention brought back, the conversations it started and the opportunity to do something different. Participants said:

*"Well, it's easy dancing, so you can do that. I quite liked getting a bit of fun out of it",*

and,

*"I liked the singing, I liked us all singing together and people up dancing",*

and,

*"It was past the morning and it was something to do, something to listen to rather than just sitting up here doing crossword. It brought us all together and we all got up, we danced and it was a good atmosphere. I thought it brought everybody together and so it was a good change from just sitting in here doing nothing",*

and,

"*I used to be a singer. I am good at singing and so I was happy to join the programme*"

In support of how ~~well~~ participants accepted the intervention, activity coordinators said:

*"I must admit they liked Alan the singer. When we put that up, they get really involved in. The exercises they've done but not with the same gusto as the singing",*

and,

*"Oh definitely, because sometimes they'll come and say, "what time are we doing that thing at the day"? They don't say danceSing. It is good that they looked forward to it",*

and,

*"…because even when they're dancing with you, they start chatting away to you as well, and when they're doing certain songs, they'll say, "I did this such a time". They remember when they've heard a song, which is kind of cute. The songs brought back good memories".*

Participants in these care homes demonstrated a commitment to completing the intervention or following the protocol as instructed. With attendance rates at 72% overall, the relatively high adherence rates suggest that participants actively engaged in the intervention activities as intended, increasing the likelihood of achieving the desired outcomes.

**Retention Rates**

During the 12-week intervention period, one participant of the intended intervention group discontinued the intervention. This signifies that most participants retained throughout the study. The retention rate of 94% signifies a high retention rate showing most participants were engaged and committed to the study.

Other than engagement, commitment and other factors that influenced participant attendance, the high retention rate in this study can also be attributed to the perceived impact of the intervention on their physical and psychosocial wellbeing. Participants and activity coordinators described the benefits of the intervention as boosters that fuelled participation and continuity throughout the intervention period. Specifically, one participant said:

*"I think I am getting a little bit stronger. The fear is going away, and I want to try things"*

Also, activity coordinators explained the impact of the intervention by saying:

*"It was good. It was good because they (participants) improved a lot. Like, I had one resident downstairs, if she's not doing something, she's overthinking. When she wasn't in the programme, she was overthinking but because she distracted herself with the dance and singing, it made her happy because she was quite depressed. So, it was good for some residents obviously. It distracted them from overthinking by doing something else and by moving about. So, I think it's a really good programme",*

and,

*"It helped them to move a lot more and obviously coming down and socialising in a group",*

and,

> *"It was good. It was getting a lot of them together including those that weren't involved in the research. It was good to see everyone being engaged and taking part in the programme. It brought them together",*

and,

> *"Well, they were a lot happier, they were upbeat, they had a laugh… And they spoke about it afterwards. They were very enthusiastic, put it that way",*

**Safety Rates**

Throughout the intervention period, no significant adverse events were reported among the participants. This indicates a favourable safety profile, with no adverse events of significant concern observed during the study.

**Ancillary Analyses**

ANOVAs were conducted between the care homes based on adherence rates, at the request of the care home organisation, to explore whether adherence (as a proxy for dose) influenced outcomes. Groups were classified as: low (58%), moderate (78%), and high adherence (97% and 119%). There were no significant differences between adherence groups) on change scores for any of the study outcomes, except for the Dartmouth COOP health-related quality of life scores [$F(2,33) = 4.52$, $p = 0.02$]. *Post-hoc* tests revealed no change in quality of life pre-to-post-intervention in the low adherence group whereas both the moderate ($p = 0.01$) and high ($p = 0.04$) adherence groups significantly differed from the low group and showed slight improvement in this score.

## 5.5 Discussion

The primary aim of this pilot RCT was twofold: 1) to evaluate the efficacy of a digital movement and music intervention within care home settings and its subsequent impact on a range of health and wellbeing outcomes; and 2) to decide whether and how to proceed with a future definitive randomised controlled trial. The main findings revealed increased salivary DHEA levels and reduced anxiety, loneliness, and fear of falling. The study's qualitative insights also provided a deeper understanding of the intervention's progression criteria. Participants expressed enjoyment and appreciation for the opportunity the intervention

provided to come together, fostering a sense of community and shared experiences. However, the implementation of the intervention faced challenges, including time constraints due to care home routines, understaffing, and technical issues like unreliable Wi-Fi connections. The trial's analysis was complicated by care homes' non-adherence to the waitlist control condition, resulting in all participants receiving the intervention simultaneously.

The increase in salivary DHEA levels observed aligns with studies highlighting the positive effects of PA on older adult's endocrine function, specifically the improvement of DHEA levels even in small samples (De Nys, et al., 2022; Heaney, Carroll, & Phillips, 2014; Zouhal et al., 2022). Such increases have been associated with improved immune function, enhanced cognition, and reduced risk of chronic diseases of older adults (Kroboth et al., 1999; Maninger et al., 2009; Phillips et al., 2010). The lack of significant change with PA in cortisol levels contrasts with previous literature showing that PA improved cortisol output (Anderson & Wideman, 2017; De Nys, Anderson, et al., 2022; Duclos & Tabarin, 2016; Fragala et al., 2011). However, this could be explained by this study's lack of statistical power and/or the fact that training intensity should exceed 60% $VO_2$ max to impact the HPA axis (Caiozzo et al., 1982; Hill et al., 2008) and the current digital PA intervention was of low to moderate intensity. It is also suggested that the exercise effects on the HPA axis differ from person to person and depend on the person's personal choice of PA, needs, values and circumstances (Bouchard, Shephard, & Brubaker, 1994; De Nys, et al., 2022; Kubzansky, Kawachi, & Sparrow, 1999). Objective metrics such as heart rate monitors could provide more accurate insights into the programme's intensity, enabling the activity coordinator to tailor the programme in real-time to the participant's needs.

Further, a single daily measurement of saliva was opted for, a decision driven by practical and financial constraints. While a single sample in the morning is often and reliably used to assess diurnal secretory activity to assess within-subject variations over a certain period in an older population (Kraemer et al., 2006), this approach does not comprehensively reflect the intricate diurnal fluctuations of cortisol nor account for inter-individual day-to-day and intra-individual variations, especially within a smaller sample (Coste et al., 1994; Pruessner et al., 1997). Future studies could integrate multiple measurements across consecutive days to gain a more nuanced understanding of cortisol dynamics and its relationship with DHEA (Segerstrom et al., 2014).

There was reduction in anxiety symptoms post-intervention, reinforced by qualitative findings of participants experiencing diminished 'fear'. This aligns with literature emphasising the benefits of PA on mental health parameters, specifically anxiety (Ofosu et

al., 2023b; Stonerock et al., 2015). PA has been shown to reduce anxiety symptoms through multiple mechanisms: improved brain circulation, increased release of endorphins, and enhanced self-efficacy (Petruzzello et al., 1991). The care home environment, where residents might often feel confined or limited in their autonomy (Moilanen et al., 2021), could heighten feelings of anxiety. Thus, interventions that encourage movement and social interaction might offer considerable benefits in reducing such feelings.

The non-significant present findings for depression symptoms contrast with some previous studies. While numerous studies have highlighted the antidepressant effects of PA (Barbour, Edenfield, & Blumenthal, 2007; Blumenthal et al., 2007), the results did not indicate a significant change in depression levels post-intervention. It is worth considering the intervention's duration, intensity, or the specificities of the current cohort, which may account for the lack of observed change (Ofosu et al., 2023). Previous research suggests that psychological benefits may be observable even with low doses of PA such as once per week over a relatively short period (Ofosu et al., 2023). Our previous study showed some positive effects on anxiety, depression, loneliness, perceived stress and sleep satisfaction over 12 weeks with 3 × music and movement and 1 × music only sessions per week as the recommended dose (Ofosu et al., 2023b), and the present study showed effects for loneliness, anxiety and fear of falling with just 2 × music and movement plus 1 × music only sessions per week. It is therefore possible that longer or more intense PA would be necessary to influence depressive symptoms, or that effects would be more likely to emerge for those with higher levels of symptoms at baseline. Although changes in anxiety were statistically significant, in this cohort, the baseline mean scores for both anxiety and depression fell within the "normal" range. This could imply that participants had relatively low levels of these symptoms to begin with, making significant reductions more challenging to achieve. This supports the hypothesis of a potential floor effect contributing to the absence of a significant change in depression scores (Djukanovic, Carlsson, & Årestedt, 2017). Additionally, the aetiology and chronicity of depressive symptoms in a care home population might be multifactorial (Milne, 2016), requiring interventions beyond PA and music.

One interesting finding was the disparity between psychological wellbeing improvements and the lack of significant changes or substantial effect sizes in physical function tests and frailty markers. The significant improvements in wellbeing markers echo the idea that psychosocial factors, such as social engagement in group-based PA, play a critical role in older adults' mental health (Holt-Lunstad et al., 2015; Sebastião & Mirda, 2021). On the other hand, the lack of improvements in physical function and frailty was

surprising, given substantial evidence of the benefits of PA on physical function and frailty in other research (Dugan et al., 2018; McPhee et al., 2016; Mollinedo Cardalda et al., 2019; Morucci et al., 2022; Paterson & Warburton, 2010). This intervention might not have improved these measures due to the limited duration, frequency and intensity of the programme. Additionally, the reduced sample size for these specific measures likely impacted the ability to detect significant changes, highlighting the need for larger sample sizes in future studies. However, the programme did provide a range of low-to-moderate intensity types of PA including strength, flexibility and mobility training, chair-based yoga, breath work, and activities aimed at improving balance and stability for fall prevention. This variety meant the consistency of the intervention was variable across care homes, given the choice available. However, previous research has shown that different types of physical activity yielded varied effects on frail institutionalised older adults' cognitive state, functionality, and general health (Mollinedo Cardalda et al., 2019), thus supporting the activity approaches in the present intervention. Others have reported a correlation between regularly completing activities ranging from low intensity walking to more vigorous PA and resistance exercise and reduced risks of functional limitations, disability, and cognitive impairments in older people (McPhee et al., 2016; Paterson & Warburton, 2010). Given this, future implementations of the present intervention as well as newly developed interventions need to employ a range of strategies to ensure overall PA increases, including both aerobic and strength and balance aspects of PA. Alternatively, the lack of effects on physical function may be due to a range of factors such as the lack of control group, small sample size, or sensitivity of the measures. Further, the time needed to observe changes in frailty markers may be longer than that for psychological markers, potentially requiring more extended intervention periods to detect significant results. Although positive effects on frailty and physical function have been observed in PA studies as short as six weeks in similarly small samples, these studies typically involved more intensive resistance training with three strength-building sessions per week and increasing intensity (Swales et al., 2022). This suggests that it is not just the duration of an intervention that influences whether physical frailty effects are observed, but also the type and intensity of PA (Skelton et al., 2005).

Feedback from the participants highlighted the added value of the music and dance components. These elements have been successfully integrated into previous intervention programmes for older adults, improving balance, physical function, muscle strength and endurance (Hwang & Braun, 2015; Liu, Shen, & Tsai, 2021; Rodrigues-Krause, Krause, & Reischak-Oliveira, 2019; Sooktho et al., 2022; Vordos et al., 2017). Concurrently, the

profound emotional resonance of music, with its capacity to evoke cherished memories and stimulate dopamine release, has been previously identified as a powerful tool for enhancing mental wellbeing (Bromberg-Martin, Matsumoto, & Hikosaka, 2010; Dingle et al., 2021; Jakubowski & Eerola, 2022; Menon & Levitin, 2005). This was also noted during the interviews, where participants highlighted their enjoyment of the music components, suggesting these played an essential role in the positive outcomes observed. Beyond their direct benefits, the music and dance elements may also have acted as motivators, potentially increasing participation and commitment to the programme, as studies in older adults have found that adding music to PA can increase enjoyment and, as a result, participation in PA programmes (Clair, 1996; Priest, Karageorghis, & Sharp, 2004). This, along with the social interaction of group activities, can enhance mental, emotional, and physical health (Tse et al., 2023). Reminiscence, through familiar songs and dance, can evoke positive memories and emotions, further contributing to emotional wellbeing (Schlorff et al., 2022). These elements could potentially lead to better adherence and more significant outcomes (Ofosu et al., 2023b). This approach justifies the need for a future full-scale RCT to explore the broader applicability and benefits of such interventions in care settings. However, this would need to incorporate testing of the separate effects of reminiscence-based music on top of group-delivered PA, to fully elucidate the extent to which this component contributes additively or synergistically to the overall positive effects on health and wellbeing observed in the present study.

The qualitative analysis revealed recurrent barriers and facilitators influencing intervention efficacy, mirroring findings from other studies, such as logistical challenges and staff enthusiasm (Hoben et al., 2017; Nocivelli et al., 2023). Participant feedback emphasised the acceptability of the programme. However, some suggested tailoring for enhanced engagement, such as using motivational facilitators to make the programme fun and sociable with relevant short-term benefits, aligning with previous findings (Devereux-Fitzgerald et al., 2016), or strategically incorporating the programme part of the weekly care home schedule, with advance notice of session commencement times. Organisational culture in care homes and activity coordinators' support levels critically impacted intervention fidelity, underscoring the need to foster a conducive organisational environment (Caspar et al., 2020; Nakrem, 2015).

### 5.5.1 Strengths and Limitations

This study has several strengths, such as adopting a mixed-methods approach, lending depth and granularity to the insights, and facilitating a holistic understanding of the intervention's impact and implementation. Further, the use of progression criteria as guidelines helped identify potential challenges and develop solutions to improve the quality and feasibility of the intervention (Mellor et al., 2023). However, it is important to acknowledge certain limitations. The control group's non-adherence to the waitlist condition caused a deviation from the protocol and compromised the ability to make direct comparisons, forcing reliance on within-group analyses. This provides a strong rationale for using cluster-randomisation in a future RCT and adjusting the sample size accordingly. Further, while not uncommon in these settings, recruitment challenges may have introduced a selection bias and produced underpowered results. Therefore, effect sizes are presented alongside p-values and it is recommended to interpret these results cautiously. Nevertheless, the consistency of the observed outcomes in ITT and sensitivity analyses makes the results more reliable. However, the variance in effect sizes between the two analytical approaches for specific outcomes underscores the significance of accounting for participant adherence and attrition in future research. This variance emphasises that participant engagement and adherence factors may moderate the intervention's potential benefits. Further, the study's scope was limited to 12 weeks. A more extended observation period might provide deeper insights into the sustainability and long-term effects of the intervention. This concern was also raised in a preliminary systematic review regarding the effects of PA on cortisol and DHEA(S) in older adults. However, adopting a longer duration was out of scope for the present study due to the duration of initial commitment Holmes Care agreed to and limited timing of the PhD projects this was part of.

### 5.5.2 Future Directions to Progress to an RCT and Future Research

This study emphasises the potential benefits of PA interventions in care homes, especially when enriched with music and dance components. The study's application of the Red Amber Green (RAG) progression criteria offers valuable insights for future trials. The recommendations about recruitment, programme fidelity, attendance and retention rate and safety are outlined in Table 11. However, several critical future directions should be emphasised. First, the experience with non-adherence from the control group underscores the significance of robust protocol adherence mechanisms. Future studies should prioritise establishing strict guidelines and transparent communication channels between researchers and involved care home staff. Regular audits, complemented by frequent check-ins, can

ensure the consistent application of the study protocol across care homes, which would be possible with a fully powered and staffed clinical trials unit-supported RCT. Alternatively, as suggested above, cluster-randomisation could be used.

Second, the care home staff play an integral role in the successful deployment and fidelity of interventions. Hence, ongoing training, mentorship, and support are of paramount importance. Future studies should focus on comprehensive initial training sessions followed by regular refresher courses and workshops, although programme instructors did have several strategies in place to encourage engagement and provide support, such as an initial training session, 'connect and reflect' sessions and an in-person visit with social media footage, motivational e-mails, and a private Facebook group. Implementing fidelity checklists and conducting video reviews of sessions can also help in monitoring and maintaining the intervention's consistency and integrity. Third, the ancillary analyses showed that adherence levels in care homes significantly affected the Dartmouth COOP health-related quality of life scores, demonstrating improvement only in moderate and high adherence groups, contrasting with a stable score in the low adherence group. These findings accentuate the importance of future studies adhering to the prescribed three sessions per week or more to maximise intervention benefits. Further, gathering information on participants' comorbidities might have provided further insight into variation in the intervention's effectiveness and why certain outcomes positively changed, and should be measured in future studies. Finally, the reassuring safety profile, high participant attendance and retention rates observed pave the way for subsequent larger-scale RCTs sufficiently powered for exploring the intervention's efficacy. Although the study design utilised a generalised approach to the digital movement and music intervention, the responses among participants highlighted the potential benefits of personalisation. Future research should consider methods for individualised customisation, ensuring that interventions are tailored to each participant's unique needs, preferences, and physiological responses. Employing adaptable digital platforms, offering a range of activities within the digital PA sessions or interactive features that encourage personalised engagement could facilitate this customisation.

### 5.5.3 Conclusion

The study contributes insights into implementing digital PA (music and movement) interventions in care homes. Preliminary significant findings over time emphasise the programme's positive influence on resident wellbeing, as evidenced by enhanced salivary DHEA levels, reduced anxiety and other wellbeing markers. Specific recommendations

regarding recruitment and programme fidelity strategies were made to proceed to a subsequent full-scale RCT. For recruitment rate, additional efforts such as extending the recruitment period, intensifying recruitment efforts, and modifying the design to include those without the capacity to consent can be considered to achieve the required number of participants. Regarding intervention fidelity, strategies to enhance adherence to the planned frequency and randomisation process were proposed, including making the intervention part of the weekly care home routine, providing clear guidelines, and training for activity coordinators. Addressing identified barriers through additional support and allocating a dedicated 'exercise room' were also recommended. Further, more proactive adherence tracking could help in early identification and address any deviations from randomisation protocols. These results underline the potential for this digital PA intervention to shape subsequent research and the practical application of similar interventions in care settings, fostering a more multi-dimensional and evidence-driven approach to care home interventions.

**Afterword**

Successful implementation and facilitation of digital music and movement interventions in care homes required the commitment of staff as mentioned in the above Chapters 4 and 5. For this reason, staff were supported throughout the research process as much as possible. The support offered to staff e.g., delivery training, impacted the staff confidence in facilitating the intervention, created an avenue for social interaction with other staff and residents, boosted staff job satisfaction and intrinsic motivation to care for residents. The importance of staff support was translated into how residents accepted, participated and adhered to the intervention. It is recommended that future research involving digital intervention implementation in care homes provide adequate support to staff in facilitating the intervention. Potentially, it could be explored as to what level of support staff would like or need in addition to that planned as part of the intervention.

## 5.6 References


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# Chapter 6: Care Home Evaluation of Workplace Wellbeing

From the danceSing Care studies presented in Chapters 4 and 5, the role of care home staff, especially carers, nurses and activity/wellbeing coordinators in facilitating interventions in care homes was evident. Notwithstanding this, the responsibility of supporting intervention delivery was a challenge to the care home staff involved in both danceSing Care studies as reported from the qualitative data. The studies reported this challenge was predominantly because of the poor working conditions in the care homes. The main challenges included shortage of staff and limited resources which resulted in working excessive hours, taking up tasks not aligning with roles and difficulty with working effectively and efficiently. Not only did these challenges affect the delivery of the intervention but also impacted staff stress levels and job satisfaction. For this reason, the wellbeing of care home staff was of interest and to explore aspects of wellbeing that could potentially affect the delivery of interventions in care homes by staff that are directly involved with providing care to residents.

This chapter presents a brief version of a full report conducted for the Christadelphian Care Homes organisation to assist with their staff wellbeing review conducted during the post-Covid recovery period in 2022. The survey covered broad areas of psychosocial, physical and financial wellbeing among a wider group care home staff, however, this brief report focused on the psychosocial and physical wellbeing of care home staff who were deemed to have greater impact on the delivery of interventions in care homes (clinical/care and wellbeing) in comparison with other roles (administration/management and general/others). Secondary data were analysed, and a full report was written independently by EO with supervision from AW. The full report can be provided on request from the author.

## 6.1 Executive Summary

The wellbeing of care home staff has not always been prioritised by the care sector even though they are faced with challenges associated with the demanding nature of the job and caring for residents. This study aimed to extensively explore components of the wellbeing of care home staff in different roles (administration/management, clinical/care, wellbeing, general/others) that pertain to the implementation and facilitation of digital music and movement intervention across eight locations of the Christadelphian Care Homes and ways to improve it. This study covered areas of wellbeing including happiness, motivation to work, productivity, work-life balance, job satisfaction, overworking, and work-related stress/

impact of work. A total of 198 care home staff were recruited and completed the survey online in 2022. Questions in the survey included multiple choice and open-ended questions for a more in-depth evaluation of wellbeing. Data were collected by the care home Human Resources (HR) department and analysed by researchers (EO & AW) at the University of Stirling. Results from this study showed variations among staff groups in reports of wellbeing. Overall, the staff in the clinical/care and wellbeing roles reported low levels of wellbeing across all the areas. Findings also highlighted possible ways to improve wellbeing as suggested by care home staff. These included, improving working conditions (recruitment of new staff, staff appreciation, organised work routines, appropriate allocation of tasks, and relevant training) and implied adopting a more tailored approach to support staff and care delivery. The wellbeing of care home staff is paramount in the quality of care delivered to residents (implementation and facilitation of music and movement intervention), thus, should be an area of priority with further exploration of changes over time.

## 6.2 Introduction

In the United Kingdom, the majority of residents in care homes have some level of cognitive impairment and/or physical health conditions (Islam et al., 2017). Providing holistic care to this population requires the collective effort of care home staff in different roles such as managers, administration, nurses, carers, kitchen and maintenance staff but mostly staff in roles that provide direct care to residents (Backman et al., 2023; Gilster et al., 2018; Hunter et al., 2016). However, working in care homes has been described as challenging, affecting the wellbeing of staff and the quality of care delivered (Giebel et al., 2022; Islam et al., 2017). Challenges experienced by care home staff may vary worldwide depending on factors such as resources available, location, policies, and practices of care facilities. However, most research studies have reported similar challenges across different care home settings including: 1) high workload, 2) staffing issues-high turnover, shortage of staff, 3) limited resources and support, 4) poor pay and benefits, and 5) emotional and physical demands (Cohen-Mansfield & Meschiany, 2022; Cousins et al., 2016; Johannessen et al., 2020; van Wyk et al., 2017). Care home staff responsible for delivering care to residents with complex needs experience increased responsibilities and workload which are usually a result of high turnover and high resident-to-staff ratio (Dhaini et al., 2016). In terms of limited resources and support; poor administration and management, poor care home setting (disorganised and disturbed atmosphere), lack of functional resources (such as internet access and recreational rooms), relevant training and wellbeing support have been linked to a more taxing delivery of care to

residents (Backman et al., 2023; Gold et al., 2017; Islam et al., 2017; Kupeli et al., 2018; van Diepen et al., 2023). Also, several care home staff have expressed concerns about poor wages, no sick pay or compensation and incentives which are associated with financial stress and high turnover (Sharma & Xu, 2022; Wang et al., 2019). In addition, working with older adults exposes staff to emotionally and physically demanding situations. This includes residents' decline in health, complex needs, agitated behaviour and end of life stages which potentially contribute to the compassion fatigue and emotional burnout commonly expressed by care home staff (Albers et al., 2014; Costello, Walsh, et al., 2019; Kupeli et al., 2018; van Wyk et al., 2017).

These challenges negatively impact the psychosocial and physical wellbeing of care home staff. In a recent systematic review, studies showed that care home staff reported high stress levels, burnout, emotional exhaustion, and low mental health-related quality of life; all associated with staffing numbers inadequacy, health conditions of residents, lack of support, and poor care home environment and management (Costello, Walsh, et al., 2019). Similar to the systematic review, a study by Woodhead et al., (2016) revealed there was a relationship between high work stress, higher emotional fatigue, more depersonalization, and less personal achievement. Also, a national survey in Wales showed that the longer staff worked in residential care, the worse effect it had on their physical health (Islam et al., 2017). Similarly, in Switzerland, back pain was associated with high workload and was a major health concern for care home staff (Dhaini et al., 2016). Even though there are limited studies exploring the psychosocial wellbeing of care home staff prior to the Covid-19 pandemic, the onset of the Covid-19 and its adverse effects, especially in care homes, increased the awareness and investigation into the wellbeing of staff (Giebel et al., 2022; Gray et al., 2022a; Hanna et al., 2022; Riello et al., 2020; Van Houtven et al., 2021). For example, during the pandemic, a study carried out in a care home in Spain, with most participants being nurses, reported clinical depression, anxiety, stress and insomnia (Martín et al., 2021). Poor wellbeing of care home staff also reflects in the social life of staff based on their work-life balance. Among the few studies is a cross-sectional study of primary healthcare workers that highlighted the interference of work in personal lives resulted in work-life imbalance and was linked to higher stress (Putri et al., 2023). Moreover, another study reported care home staff experienced social isolation during the pandemic due to the lockdown restrictions and social distancing which subsequently led to changes in their social lives outside and at work (Giebel et al., 2021; Gray et al., 2022a).

Despite the challenges and complaints that arise from working in care homes, some care home staff express high job satisfaction (Hebson et al., 2015). Working in care homes is deemed to be a rewarding job and altruistically motivated and this accounts for the high job satisfaction among care home staff (Mittal et al., 2009; Ofosu et al., 2023; Rakovski & Price-Glynn, 2010). In line with job satisfaction in care homes, a national survey of nursing assistants showed a significant difference in staff motivated by caring for residents versus those motivated by other reasons (pay rates) and that staff motivated by caring were more satisfied with their job (Rakovski & Price-Glynn, 2010). Not only do individual factors contribute to job satisfaction, but also organisational factors such as leadership, work culture, social capital (active and dynamic relationship among people) and organisational slack (actual or possible resources that serve as a buffer to an organisation during external changes and internal adjustments) (Chamberlain et al., 2016).

Care home staff providing direct care to residents may be at a higher risk of poor wellbeing (Gilster et al., 2018). For this reason, most studies exploring the wellbeing of these staff have focused on carers, nurses or nursing aides and wellbeing/activity coordinators. Even though the wellbeing of staff in these roles is important, it is also important to acknowledge, measure and compare the wellbeing of staff (administration/ management/ general and other) that indirectly contribute to both the quality of care delivered in care homes and to the wellbeing of staff that provide direct care (Hunter et al., 2016). It is crucial for the wellbeing of care home staff to be evaluated and compared due to its impact on the care delivered to care recipients, but also its potential effect on tailoring support provision, productivity, engagement and revenue of the care organisation (Allan & Vadean, 2021; Krekel et al., 2019).

Overall, there is limited research on the multiple aspects of wellbeing (psychosocial and physical) among care home staff either providing direct care or services to staff or managing and maintaining care homes, especially after the Covid-19 pandemic which raised awareness of the potential negative effects on the wellbeing of health and care workers (Gray et al., 2022a; Hanna et al., 2022; Martín et al., 2021). Anecdotal evidence suggested that some care organisations coped better with the pandemic than others with a less detrimental effect on care staff wellbeing. However, actual data was required to support this view. Consequently, the present study is an analysis of secondary data provided by Christadelphian Care Homes (CCH) in 2023 based on a wellbeing survey devised and run in October 2022 by the HR staff within the organisation as a baseline benchmark of staff wellbeing for the organisation post-Covid-19. HR managers used existing online recommendations of typical

staff wellbeing questions to explore key aspects of wellbeing among their employees because of the raised awareness of wellbeing issues among care staff resulting from the pandemic. These questions were not derived from existing psychometrically validated questionnaires and did not use standardised scoring throughout but did allow exploration of various aspects of staff wellbeing. The full report with results broken down by all roles and by care home is available on request from the author and was commissioned by CCH through their Trustees board. The brief report in this Chapter provides the key findings for aspects deemed relevant to the delivery of physical activity to care home residents; it also specifically analyses the results by the two main job role groupings relevant to the delivery of physical activity i.e., care/clinical and wellbeing roles in comparison to the administration/management and general/other roles. This report summarises the survey findings and makes practice recommendations based on the data and the relevant academic literature. Finally, this report makes recommendations of best practice for future surveys' around care home staff wellbeing. As the survey was exploratory to establish a baseline for wellbeing across the organisation, there were no hypotheses regarding levels of wellbeing or differences across job roles.

## 6.3 Methods

### 6.3.1 Participants and Procedure

The care home evaluation of workers' wellbeing was an online questionnaire hosted in Google forms and sent as a link to all care home staff (n = 550) within CCH via their work emails on 19th October 2022 and remained open for two weeks and two days for voluntary completion. This study measured care home staff wellbeing through survey (open eneded and multiple choice questions). This secondary data analysis was ethically approved by the University of Stirling Ethics Panel (GUEP  2023 13532 9429).

### 6.3.2 Measures

Thirty-eight items made up the care home staff wellbeing scale including 11 open-ended questions that were follow-up questions to some items. Quantitative items were rated on various scales including ratio/interval/ordinal Likert-type scales. For the present analysis, the quantitative data focus was on items relevant to the delivery of physical activity to residents and so included: happiness, work-life balance, productivity, overworking, motivation to work and work-related stress while the qualitative data were collected from

follow-up questions in line with the quantitative items (see Appendix T for the full set of questions included in the survey). Happiness was reported over two time periods (within the last week and last six months) and in terms of how staff feel about their job roles. Happiness was rated on Likert scales ranging from 1- not at all happy to 10-very happy or 1- very unhappy to 5 – very happy. Work-life balance was measured on two items in the quantitative survey with focus on work-life balance rating from 1-poor to 5 -brilliant and changes in work-life balance over the past 12 months (got worse, stayed the same, improved). Productivity, overworking, motivation to work and work-related stress were measured on one item each on ordinal Likert scale with ratings such as 1- never to 4- everyday or 0- no and 1- yes. Items were scored and analysed individually due to the different scales and components of wellbeing measured. The open-ended questions gave participants the chance to further explain a previous response or detail aspects of wellbeing that were of interest to this study. The focus of the wellbeing components and corresponding items in survey were devised by care home management staff based on wellbeing complaints from staff, high staff turnover and low morale.

### 6.3.3 Data analysis

The Statistical Package for Social Sciences software (IBM Corp v29) was used to analyse the quantitative data whereas the qualitative responses were explored using thematic analysis of the written text. Basic descriptive statistics and frequencies were conducted, and any differences across job roles were examined via ANOVAs for continuous outcome variables, e.g., ratings from 1-10, and chi-square or Kruskal-Wallis tests for categorical answers e.g., yes/no or ordinal responses, e.g., never to everyday. Across the different roles staff worked, some individuals identified themselves across multiple roles, so these were combined into the predominant category, for example, if someone identified as working in care and wellbeing, this was classified as care; clinical was classified jointly with care; general, housekeeping, kitchen, maintenance/garden, and multiple were grouped together into general/other roles; hairdressing was grouped with wellbeing; and administration was grouped as administration/management. Minor differences in degrees of freedom reflect occasional missing data. Qualitative data from the open-ended responses were analysed by coding responses and generating themes and sub-themes through thematic analysis for all role groups (Braun & Clarke, 2006). Results for each survey item are presented by all role groups and then by specific roles.

## 6.4 Results

### 6.4.1 Quantitative Findings

198 care home staff participated in the care home evaluation of workers' wellbeing across eight care homes under the Christadelphian Care Homes group which represents 36% of the staff available at the time. Participants in this study were staff from different roles occupying roles from administration/management, clinical/care, wellbeing, and general/other roles (Figure 9). The highest response (n=121) was from staff in the clinical/care role.

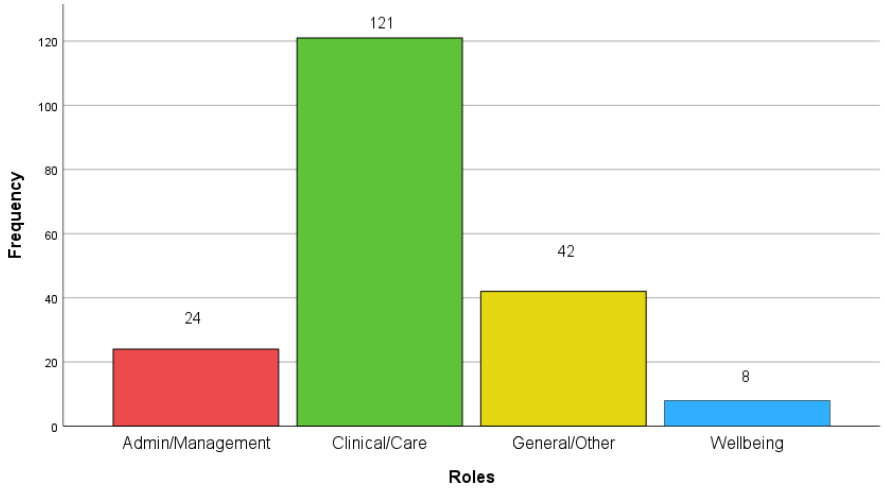


Figure 9: Frequencies of different roles

***Wellbeing of staff***

For the focus of this brief report, four continuous variables were analysed firstly based on descriptive statistics. Below is Table 12 which shows the number of responses for the respective items (N), the minimum (min) and maximum (max) possible response values, average expressed as the mean and dispersion of scores as standard deviation (SD).

**Table 13: Descriptive Statistics for Continuous Variables**

| Wellbeing component | Items | N | Min. | Max. | Mean | SD |
|---|---|---|---|---|---|---|
| Happiness | Overall, how happy have you felt within the last week? (Not at all happy - very happy) | 198 | 1 | 10 | 6.18 | 2.27 |
| | How happy have you felt within the last 6 months? Not at all happy - very happy) | 197 | 1 | 10 | 6.20 | 2.07 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | How do you feel about your role overall? (very unhappy - very happy) | 198 | 1 | 5 | 3.78 | 0.83 |
| Work life balance | How would you rate your work-life balance? (Poor - brilliant) | 198 | 1 | 5 | 3.38 | 1.01 |

For the selected categorical variables, descriptive statistics included number of responses (N), mean, mode – discrete number that occurs most frequently in the dataset and median (Mdn) – middle number or a value in the sample (see Table 13 for descriptive statistics for categorical variables).

**Table 14: Descriptive Statistics for Categorical Variables**

| Wellbeing component | Items | N | Min. | Max. | Mean | Mdn | Mode |
|---|---|---|---|---|---|---|---|
| Work-life balance | Would you say over the last 12 months your work life balance has..(got worse, stayed the same, improved) | 198 | 1 | 3 | 0.01 | 0 | 0 |
| Productivity | Feel productive (never, once or twice a month/week, everyday) | 196 | 1 | 4 | 3.44 | 4 | 4 |
| Overworking | Feel overworked (never, once or twice a month/week, everyday)* | 196 | 1 | 4 | 2.73 | 3 | 4 |
| Motivation to work | Do you look forward to coming to work most days (no, yes)* | 198 | 0 | 1 | 0.70 | 1 | 1 |
| Work-related stress | Over the last 12 months have you ever felt stress from work has affected your personal life? (no, yes)* | 168 | 0 | 1 | 0.58 | 1 | 1 |

*Note: for all variables a higher score is positive, with the exception of those marked * where a higher score is negative, e.g., yes to work related stress item.*

***Happiness***

Most care home staff (22%) felt some level of happiness within the last week before the survey and 9% were very happy. However, 2% and 3% of care home staff were not happy at all/not happy, respectively, in the last week. Responses from another item on happiness which measured how happy care home staff were in the past six months showed similar results to responses recorded for happiness felt in the past week. On a scale of one (not at all happy) to ten (very happy), a total of 63% of care home staff expressed different extents of happiness within the last six months with scores from six to ten. Lastly, happiness in roles

was evaluated. Almost half of care home staff felt mostly happy in their respective roles and 18% reported being very happy. However, 27% were neutral about they felt about their roles, leaving 7% who reported being very unhappy or mostly unhappy.

***Work-life balance***

Care home staff rated work-life balance on a scale of one (poor) to five (brilliant). Thirty-two percent of care home staff reported an average work-life balance by choosing response option "three". The majority (49%) rated work life balance above average and "brilliant". The remaining responses showed below average (15%) and poor (4%) work-life balance. Also, 57% of care home staff reported their work-life balance has stayed the same for the past year and proportion for worse (21%) or better (22%) work-life balance was similar.

***Motivation to work***

Most staff (70%) looked forward to going to work but the rest (30%) did not in response to "do you look forward to coming to work most days?"

***Productivity***

The greatest proportion (58%) of care home staff felt productive at work whereas the smallest proportion at 4% never felt productive at work. However, 31% felt productive once or twice a week leaving the remaining 7% who reported feeling productive once or twice a month.

***Overworking***

Feeling overworked every day (30%) or once or twice a week (29%) was reported by most care home staff. On the other hand, a total of 41% of care home staff reported feeling overworked less often (once or twice a month) or never.

***Work related stress***

It was also reported by 58% of care home staff that over the past 12 months, stress from work has affected their personal lives whereas the remaining 42% responded "no" to the question, "over the last 12 months have you felt stress from work has affected your personal life?"

**Comparisons across different job roles**

Further analysis compared components/items on the care home staff wellbeing scale across the different care home roles. Below are sub-sections based on the quantitative items in the survey.

***Happiness***

When data were split by roles, significant differences were recorded for components of happiness on the wellbeing scale. There was a significant difference in happiness of participants from different roles in the past week [F (3,191) = 6.85, p < .001]. Post-hoc tests showed significant differences among the administration/management, general/other (p = 0.007) and the clinical/care team (p <.001). As shown in Figure 10, staff in the administration/management were the happiest in the last week. However, staff in the wellbeing team, clinical/care team and general/other were not significantly different from one another in terms of happiness in the past week. Staff in the clinical/care role were the least happy.

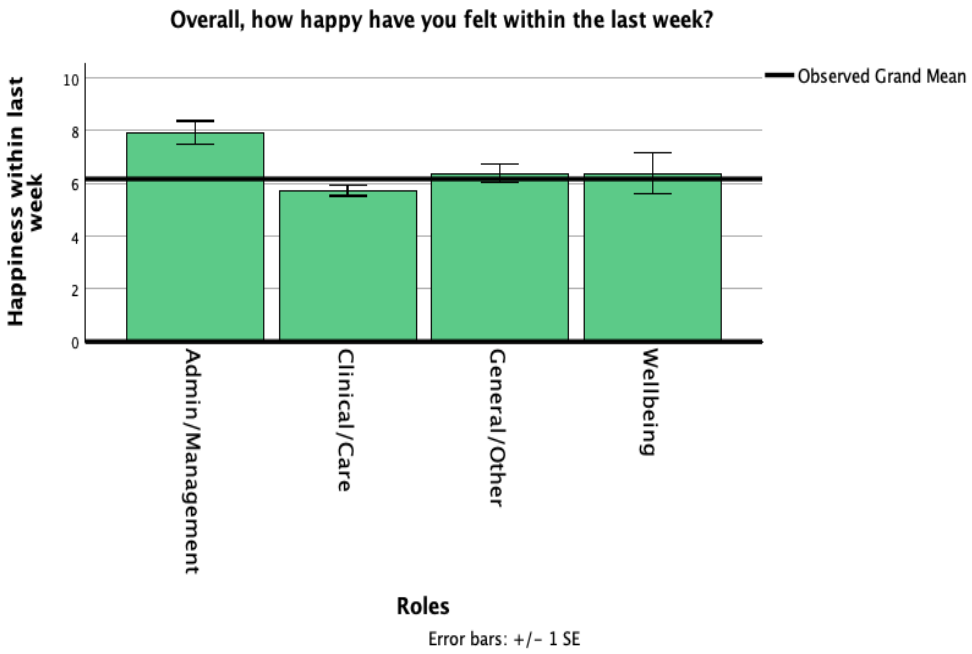


Figure 10: Bar chart on happiness in the last week across roles

When different roles were compared on happiness within the past six months, there were statistically significant differences among the roles [F(3,190) = 3.64, p=.01]. Post-hoc testing showed that administration/management were significantly happier than staff in the

clinical/care role in the past six months. Refer to Figure 11 for bar chart on happiness within the past six months by roles.

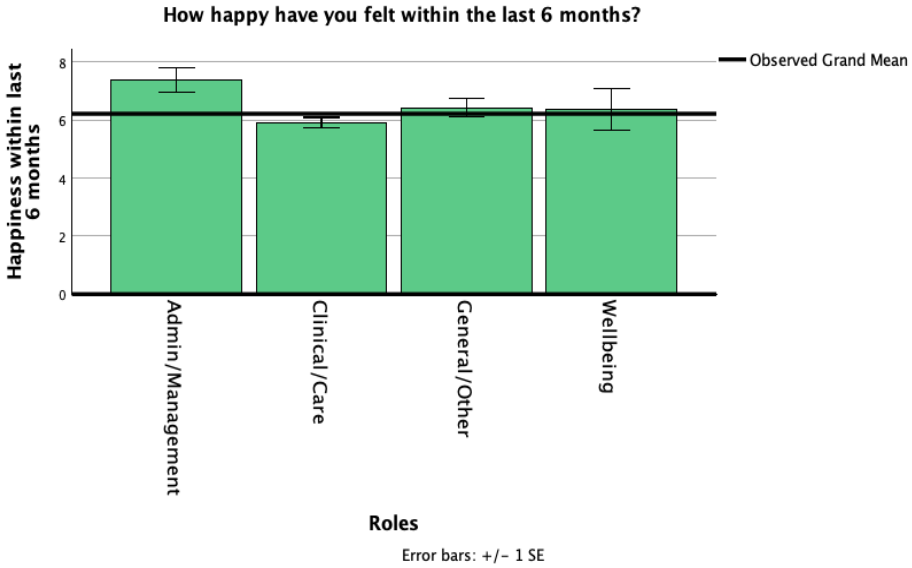


Figure 11: Bar chart on happiness within the past six months across roles

Significant differences were reported among the different roles in how they felt about their roles [F (3,191) = 6.85, p <.00]. The administration/management respondents were the happiest about their respective roles and staff in wellbeing group were least happy. Also, the administration/management group was significantly different from clinical/care and wellbeing groups but not the general/other group. In addition, the wellbeing, clinical/care and general/other groups were not significantly different from one another as shown in Figure 12.

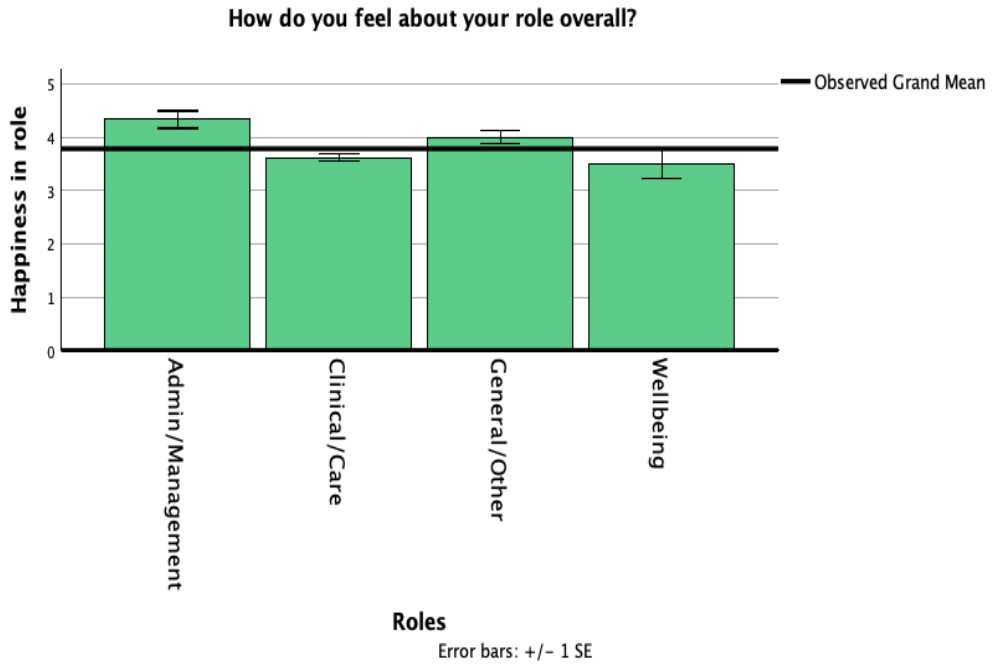


Figure 12: Bar chart on happiness in role across roles

***Work-life balance***

The rating of work-life balance was significantly different across roles [F(3,191) = 3.62, p = .01]. Post-hoc analysis showed that administration/management had the best work-life balance as compared to the other roles and was significantly different from clinical/care staff. The clinical/care staff recorded the lowest rating for work-life balance and was significantly different from general/other as seen in Figure 13.

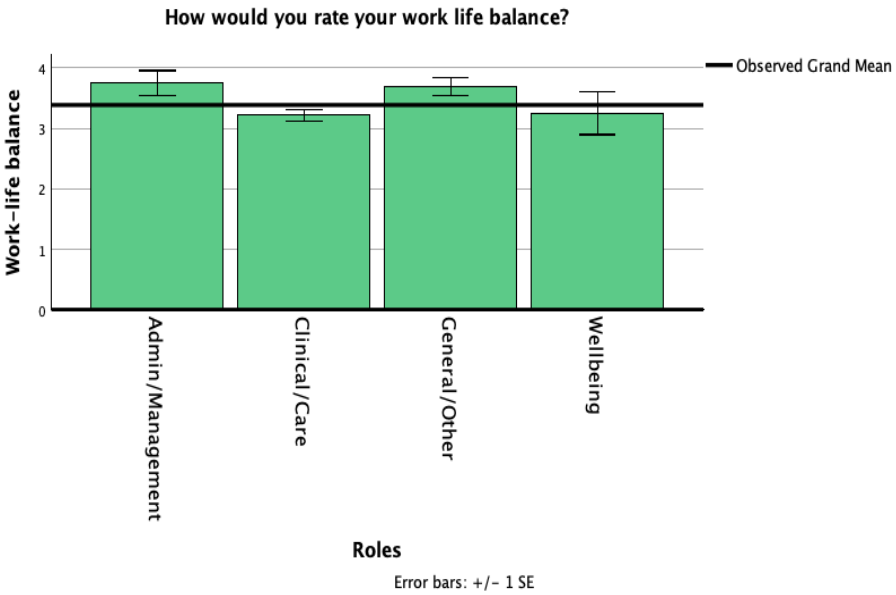


Figure 13: Bar chart on rating of work-life balance across roles.

For the different roles, the change in work-life balance in the past year was not significantly different [F(3,191) = .52, p=.67] even though Figure 14 shows the wellbeing staff worsened compared to the rest of the role groups.

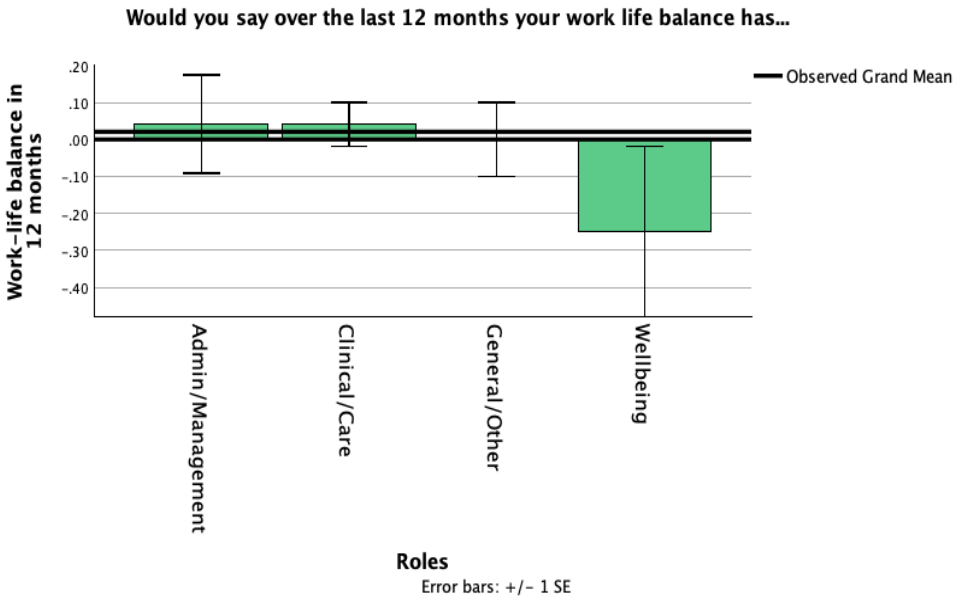


Figure 14: Bar chart on change in work life balance in the past year across roles. A positive increase indicates an improvement in work-life balance

***Motivation to work***

Care home staff across all roles were motivated to go to work and looked forward to work most days. There were no significant differences among the different roles; $\chi^2(3,195) = 7.08$, $p = .07$. The highest percentage of staff who did not look forward to work (35%) were in clinical/care roles as presented in Table 14.

**Table 15: Frequency of Responses on Staff Motivation across Roles**

| **Roles** | **Do you look forward to coming to work most days?** | |
|---|---|---|
| | Yes | No |
| Administration/Management | 92% | 8% |
| Clinical/care | 65% | 35% |
| General/Other | 74% | 26% |
| Wellbeing | 75% | 25% |

***Productivity***

Feelings of productivity were not significantly different based on role [$F(3,189) = .37$, $p = .78$], being lowest in the wellbeing roles as shown in Figure 15.

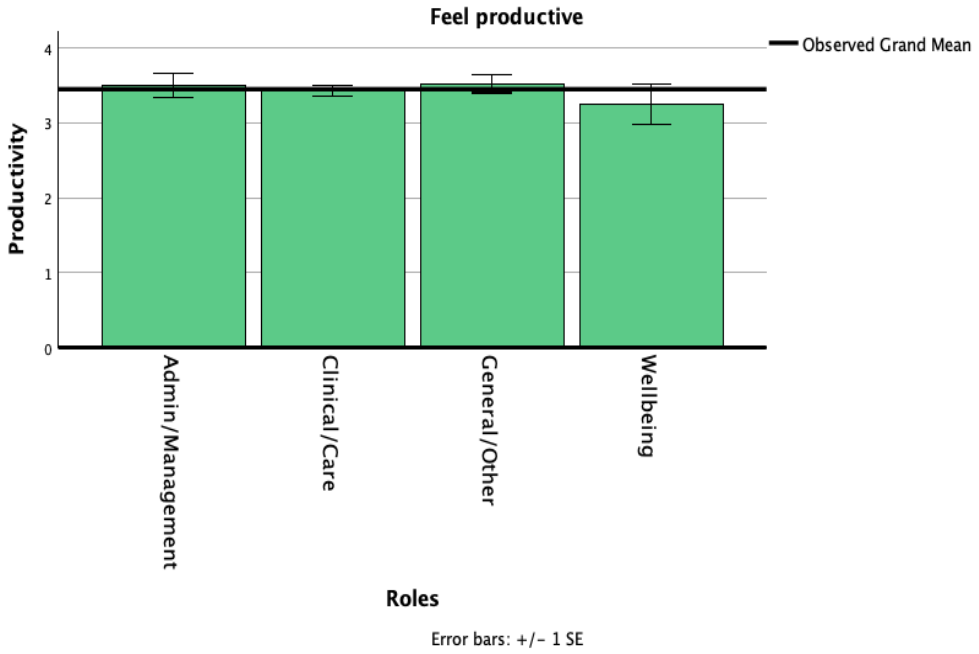


Figure 15: Bar chart on productivity across roles

***Overworking***

Feeling overworked was significantly different by role group, [F(3, 189) = 9.19, p < .001]. Post-hoc comparisons showed staff in clinical/care roles (highest feeling of overwork) were significantly different from staff in administration/management and general/other but not the wellbeing roles as presented in Figure 16.

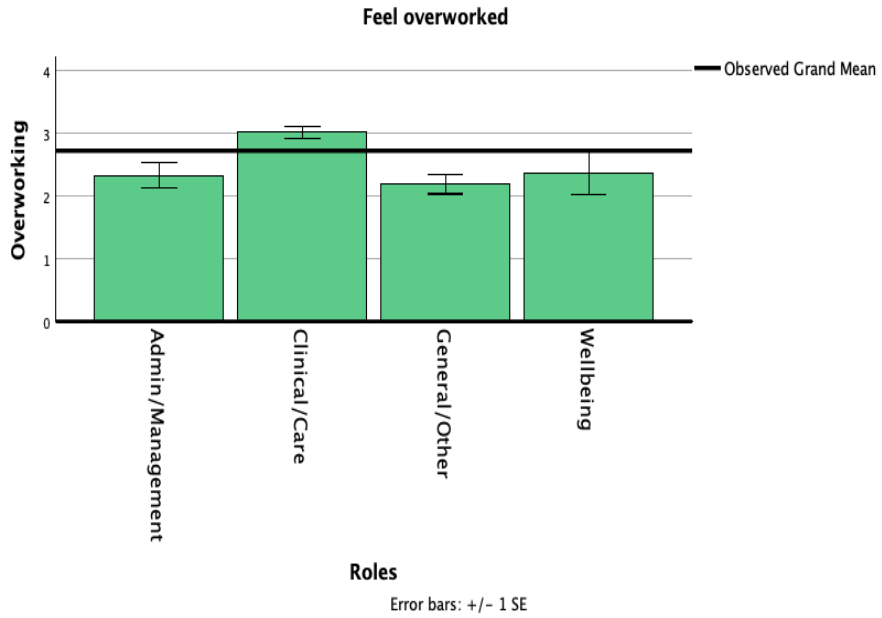


Figure 16: Bar chart on overworking across roles

***Work related stress***

There were no significant differences in the impact of work stress on personal life across the different roles [ $\chi^2(3,165) = 5.76$, p = .12]. Notwithstanding, over 60% of staff in clinical/care roles reported stress from work has affected their personal lives but the majority of staff from administration/management (59%) and those in general/other roles (54%) were of a different opinion that, in the past year there had not been an impact of work stress on their personal lives (refer to Table 15)

**Table 16: Frequency of Responses on the Impact of Work Stress across Roles**

| **Roles** | **Over the last 12 months have you ever felt stress from work has affected your personal life?** | |
|---|---|---|
| | Yes | No |
| Administration/Management | 41% | 59% |

| | | |
|---|---|---|
| Clinical/care | 64% | 36% |
| General/Other | 46% | 54% |
| Wellbeing | 57% | 43% |

### 6.4.2 Qualitative Findings

Thematic analysis of open-ended questions from this study revealed themes in line with a range of components of wellbeing. Not surprisingly, given the focus of the questions, the major themes included work-life balance, impact of work, job satisfaction and future directions. The themes have been explained in the subsections below and are displayed in Figures 17, 18, 19 and 20.

***Work-life balance***

In reference to work-life balance, care home staff attributed poor work-life balance to work schedules and shortage of staff (see Figure 17 for a summary of this theme and sub-themes). Responses showed that care home staff who have multiple jobs and work extra hours finish late from work resulting in devoting less time to other areas of their lives. In some cases, working extra hours was to cover for the shortage of staff at work and the type of shifts worked affected work-life balance, for example:

> *"I get home late because I stay to help out and just go to bed, basic things at home don't get done. Last week I had no clean clothes to wear because I don't have time to get the washing done it is not every week, but it happened last week"*,

and

> *"Changed jobs and now finishing at 6. My last job finished at 4 and I had more family time. Now, I don't get home till 6:45, and very tired"*,

and

> *"I have my own business and it can be hard to work it around my work…"*,

and

> *"Working more hours to cover others as we have been short-staffed (no one newly hired) and there have been holidays to cover"*.

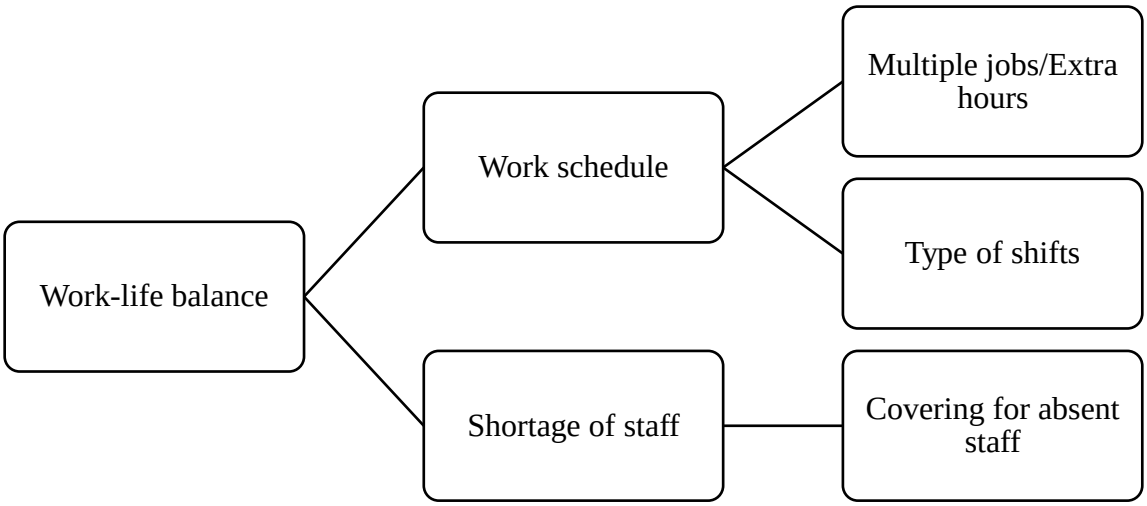


Figure 17: Summary chart for theme: Work-life balance

***Impact of work***

Another theme was “Impact of work”. This theme was generated from responses to questions that explored the impact of work on the health of care home staff. Responses showed there was a multidimensional impact of work on individual health, and these ranged from psychosocial to physical components (sub-themes are shown in Figure 18).
Care home staff reported that due to their busy work schedules, there was no time for social activities such as spending time with family and friends. A typical example was when one participant said:

*“I feel work takes over my life and then I am too tired for my family at weekends”.*

Psychological problems, physical pain and aches from work have been associated with poor working conditions such as short staff, high workload, and ineffective training. Care home staff said:

*"I also experience back pain and believe that manual handling training is not being respected by management or given the time it needs to properly implement it into the care setting. Staff are expected to do as much as possible as 1 carer",*

and

*"Physically the job is more demanding than it should be, but we don't have enough staff to share out the workload. Mentally the work environment can be quite toxic",*

and

*"Heavier workload physically more demanding and causing painful issues, mentally exhausting as the same peoples are coming up time after time, emotionally draining as there is no light at the end, the treadmill is getting heavier with no hope for improvement",*

and

*"The nature of the work is very mentally draining and affects my mood when I am home - very lethargic"*

Also, stress, tiredness and lack of quality sleep were common concerns about wellbeing. Shift patterns and the demanding nature of the job resulted in high stress levels in care home staff and in most cases disrupted sleeping patterns thus negatively affecting sleep satisfaction. Examples of quotes depicting these are:

*"I am not able to maintain a regular working pattern which affects my sleep schedule, eating schedule and ability to take care of my family. I have to put others first before must. This is causing me immense stress",*

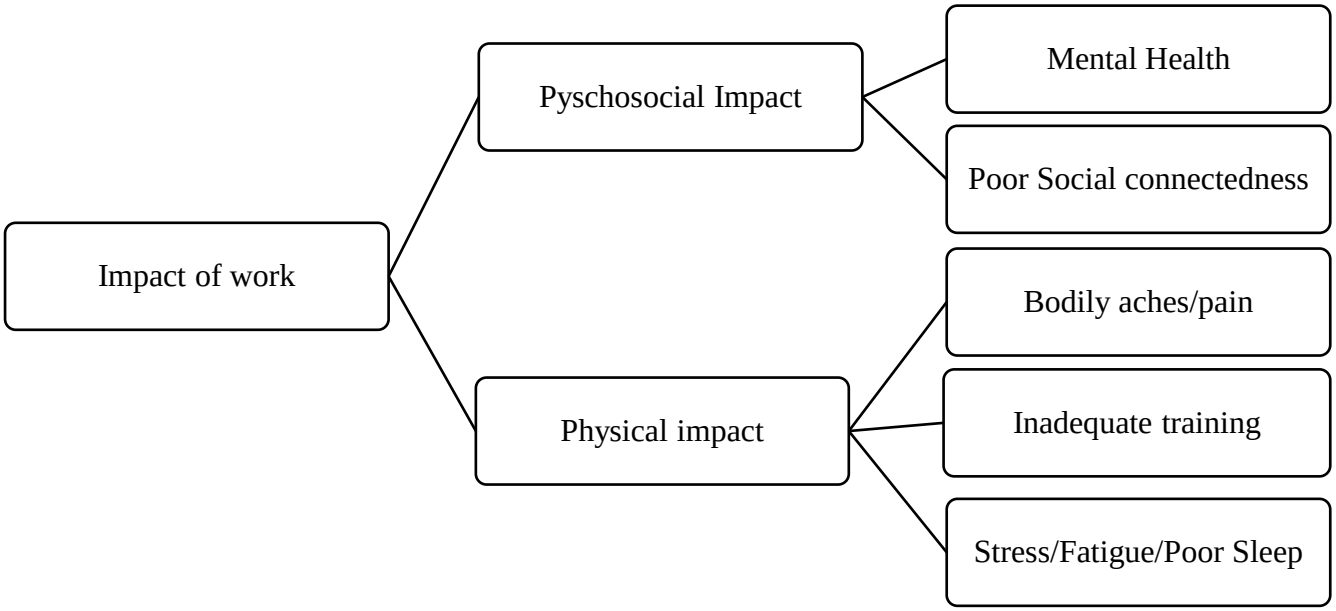


Figure 18: Summary of "impact of work" theme

***Job satisfaction***

Job satisfaction was one of the major themes that emerged from the qualitative data. According to care home staff, job satisfaction was crucial and affected wellbeing and attitudes towards work. The sub-themes were low motivation going to work, unhappiness in current roles and improved job satisfaction (See Figure 19 for theme summary).

Care home staff expressed hesitation going to work and less enthusiasm towards work. For some care home staff challenges at work discouraged them. Like other concerns raised, short staffing and its consequences were predominant when explaining this theme. In addition, personal problems, the amount of work to do, absence of support from management and not promoting a sense of belongingness and appreciation of staff were other causes of low morale at work. For example, care home staff said:

> *"Staff shortages due to poor wages, we are overworked, team morale is low, we feel underappreciated, good staff that train/teach leaving we then have lots of new staff filling in for short periods of time, standards of care fall as we are constantly training up new staff",*

and

*"It's not so much the work itself I love my job but it's my personal life at the moment outside of work",*

and

*"The lack of proper management from the head of the department means that the care standard is poor, we work with a lot of agencies which is terribly stressful and there are poor practices by team members which go unnoticed and those who work hard and dutifully are unappreciated",*

and

*"Not enough staff on shift to carry the workload. We end up burnt out and exhausted",*

and

*"Feel like most days being segregated due to there being a clique".*

Responses showed that some staff were not happy in their various working environment and roles. This displeasure was due to low wages, unfavourable working conditions such as staff shortage, and little to no support and appreciation from senior staff and management. Moreover, staff expressed unhappiness about increased responsibilities in the role due to changes in the needs of residents. These concerns were conveyed in statements such as:

*"The job no longer pays enough to support the cost of living",*

and

*"The expectations are too high. I feel I don't have time to meet the needs of residents due to a lack of staff. Some members of management can be very rude and demanding. I work extremely hard when I'm at work, and it still doesn't feel like I'm doing enough",*

and

*"Uncertainty in the role, not feeling valued, lack of teamwork and support"*

and

*"…….because of being short staffed and how the needs of the residents have changed from residential to more like nursing".*

However, on the positive side, some staff mentioned being recognised, appreciated and listened to by the management which served as an incentive that boosted morale and

increased happiness at work. In response to why staff enjoyed working at Christadelphian care homes, care home staff members said:

> *"I feel valued by the organisation"*,

and

> *"Keep doing what you're doing. I've found management to be extremely compassionate and easy to talk with for which I am grateful. It has helped me feel safe, understood and supported during a very difficult time in my life"*.

Care home staff also reported feeling like a part of a community with residents and other staff members and being self-fulfilled contributed to enjoying work. Care home staff expressed self-fulfilment as making a difference by taking care of residents. They went on to say:

> *"Residents are like family, colleagues are my friends- working with other great people",*

and

> *"Feeling like I am making a difference by getting to care for others",*

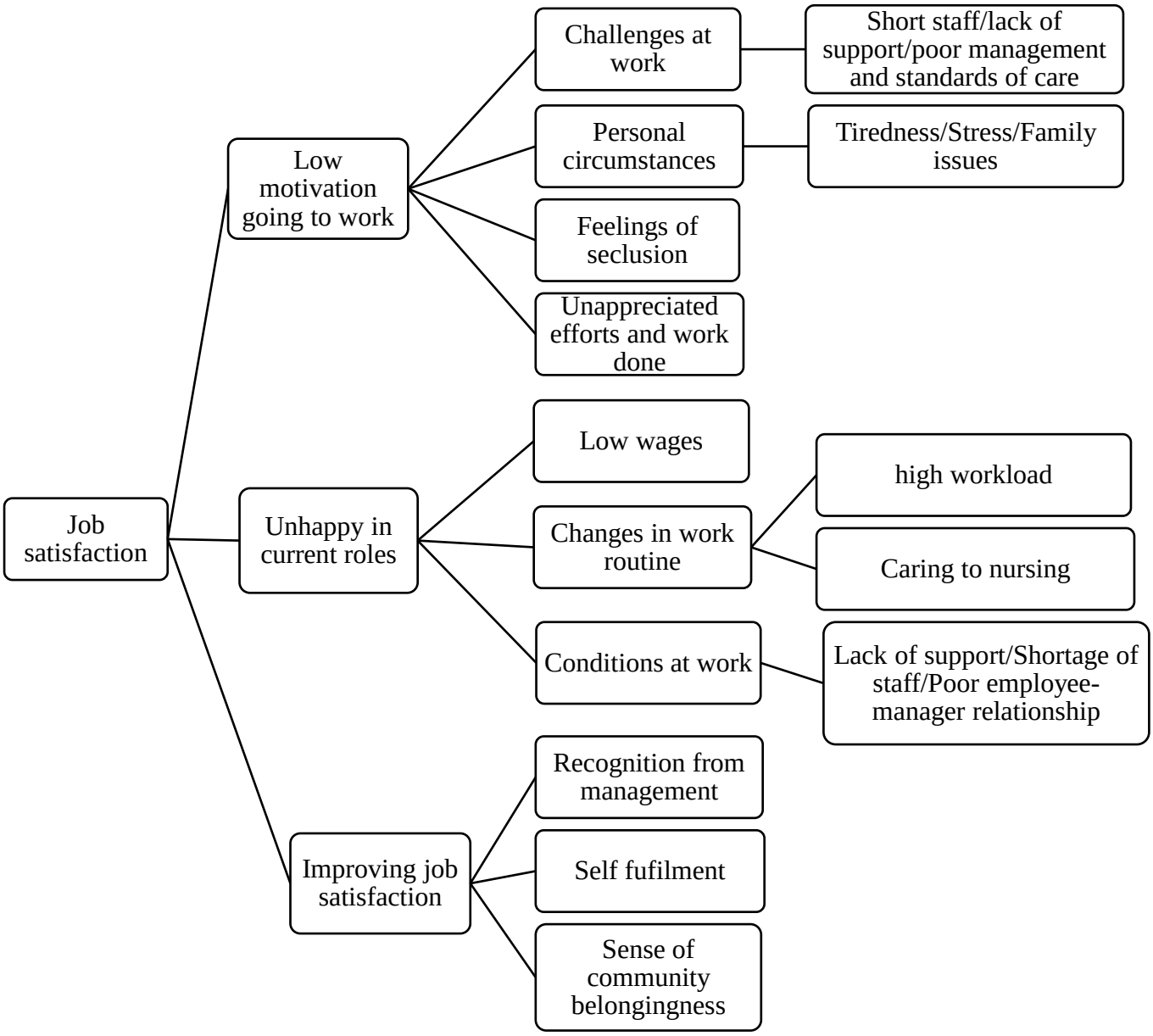


Figure 19: “Job satisfaction” theme summary

***Future Directions***

Responses from staff have emphasised that lack of support and resources at the workplace negatively affects staff wellbeing. Staff expressed ways in which support available to care home staff could be improved and thus reflect in the wellbeing of staff. These responses were themed as “future directions” (see Figure 20 for a summary of the theme). One major challenge that affected staff wellbeing was the shortage of staff and so, recruiting and adequately training new staff was one way to reduce the workload on staff and also provide the needed care to residents. In light of this, care home staff said:

*"Increase staffing levels with knowledgeable reliable staff who genuinely want to give quality care which in turn would lighten the load on colleagues and help to improve low morale",*

and

*"Make sure we are well staffed and have the right equipment to do our jobs".*

Another form of staff support was to increase wages to make up for the high cost of living, present staff with incentives to appreciate and motivate them, provide essential and updated training, and present staff with continuous development opportunities. Examples of statements that supported meeting the needs of staff were:

*"I think Christadelphian ..[care homes].. should increase the pay rate and compared to the other care homes pay rate around because, at the moment, other companies pay 2 pounds more. Also, I think Christadelphian […] should [do] 3 in 3 months give an incentive to the staff as other companies do",*

and

*"Raise wages, this would attract new more permanent staff, that could be fully trained and give lasting strength to our workforce. Improving the care to residents, team morale, standards overall",*

and

*"I think more gratitude and incentives would give staff a bit of a boost to feel better about going to work. Praise the positives that the carers do. Show more appreciation so we feel valued",*

and

*"Respect that proper manual handling technique takes time, and often 2 carers; incorporate that into staffing. Promote staff looking after their backs when manual handling, rather than turning a blind eye",*

and,

*".....more staff and more opportunities for staff training."*

Also, some care home staff acknowledged the existence of some level of wellbeing support services from the organisation by saying:

*"Keep doing what you're doing. I've found management to be extremely compassionate and easy to talk with for which I am grateful. It has helped me feel safe, understood, and supported during a very difficult time in my life",*

and

*"I feel safe and supported by the manager and can always go to her. I feel we are supported and looked after",*

and

*"Personally, I believe support is there, it has to be asked for".*

In contrast, other staff disagreed and wished for more support to be provided. Therefore, improving the wellbeing of staff meant making wellbeing support services and resources more accessible and enhanced to include aspects of psychosocial and physical wellbeing. These requests were seen in responses like:

*"Encourage talk sessions, especially after residents' deaths. Also, wellbeing chats /check-ins with a trusted senior supervisor, not just work-related issues but mental health issues should be treated as a priority",*

and

*"To have a designated relaxing space to take our breaks, a relaxing room with facilities such as a kettle, microwave, and fridge. Perhaps since Covid-19, this has not been possible due to restrictions and having to cohort in our areas",*

and

*"……. Offer support for mental and physical health".*

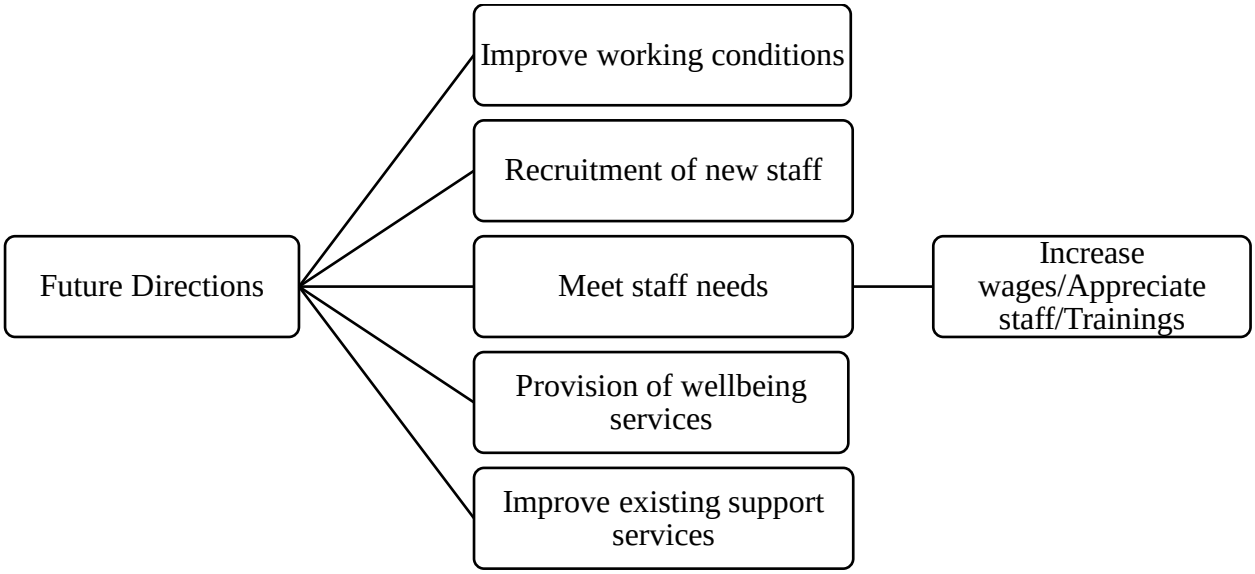


Figure 20: Summary of theme: "Future Directions"

## 6.5 Discussion

### 6.5.1 Summary of Overall Key Findings

The objective of this study was to investigate the multifaceted dimensions of wellbeing within the care home staff context, encompassing a range of psychosocial and physical aspects relating to happiness, motivation, productivity, work-life balance, job satisfaction, overworking and work-related stress/ impact of work. The varied roles and experiences of care home staff were reflected in the results. Through an exploration of the experiences and perceptions of care home staff in different roles, the following summarises the overall key findings of this study.

To explore psychosocial wellbeing, the study focused on happiness, productivity, motivation to work, work life balance and job satisfaction. Across these aspects of psychosocial wellbeing, diverse levels of happiness in the job role, over the past week and in the last six months were recorded. Notwithstanding some variability, most care home staff were happy. Also, a notable percentage of care home staff reported feeling productive and had a positive anticipation to work while the rate of work life balance, varied substantially. In further exploration of work-life balance, results showed that, poor work-life balance was predominately affected by staff work schedules and shortage of staff. Job satisfaction was identified as one of the central facets of psychosocial wellbeing from the qualitative data as this has direct connections with the other aspects of psychosocial wellbeing mentioned above.

Factors that influenced poor job satisfaction included challenges at work, personal problems, low wages, lack of management support, and a sense of not belonging, which then led to reduced enthusiasm for work and unhappiness in current roles. On the positive side, recognition, appreciation, and a sense of community with both residents and staff contributed positively to job satisfaction. Further, staff reported poor mental health and social connectedness associated with their working in care homes. These findings emphasise the demanding and complex nature of roles in care homes, necessitating a comprehensive approach to address psychosocial concerns and promote overall job satisfaction within care home environments.

The physical wellbeing of care home staff was evaluated from items on overworking, work-related stress and from follow up questions on impact of work. The frequency of overworking varied among care home staff. However, a high prevalence of work-related stress was highlighted throughout this study. From the qualitative results, poor physical wellbeing was a result of stress, fatigue, poor sleep, body aches, and inadequate training. The multiple causes contributing to poor physical health underscore the relevance of improving working conditions for care home staff.

### 6.5.2 Summary of Key Differences Across Roles

Notably, significant differences were reported in the wellbeing of staff in the care home setting across various roles. Staff in the clinical/care and wellbeing roles consistently reported the lowest levels of overall happiness and happiness in their roles while staff in administration/management roles reported the highest in all aspects of happiness. Rating of work life balance was generally low for staff in clinical/care and wellbeing roles with the wellbeing staff worsening over the past year. Overall, there were no significant differences in staff's motivation to work but descriptives showed that the greatest percentage of staff who did not look forward to coming to work were from the clinical/care roles. Similarly, staff in the categorised roles were not significant different from one another in terms of how productive they felt.

Feelings of overworking followed a similar pattern to the other components of wellbeing, with clinical/care staff reporting elevated levels, followed by wellbeing staff while the other roles reported lower scores. Also, even though significant differences were not reported for work-related stress across roles, more than half of clinical/care and wellbeing staff reported stress over the past year and agreed to its impact on personal life. The above

shows the specific needs and aspects of wellbeing across different roles that should be prioritised to improve wellbeing.

### 6.5.3 Comparison of Findings to Existing Literature

The variation in the psychosocial wellbeing of care home staff over time recognises the dynamic and subjective nature of wellbeing especially in a challenging setting. This study acknowledged that psychosocial wellbeing among care home staff could be influenced by various factors such as lack of social connectedness, poor work-life balance and working conditions. These factors then go on to affect the care home staff's happiness, motivation to work, job satisfaction, work-life balance, work-related stress and productivity. The considerable percentage of care home staff reporting enduring contentment offers valuable insights into the possible intrinsic motivation and self-fulfilment that comes with the working in a care home (Mittal et al., 2009; Ofosu et al., 2023). This sense of self-fulfilment may be rooted in the job satisfaction and joy derived from meaningful interactions and positive impact on residents' lives (Hebson et al., 2015). In my recent study, care home staff reported expressed job satisfaction due to being recognised and acknowledged by residents following facilitation and delivery of digital music and movement intervention in the care home (Ofosu et al., 2023). Additionally, the alignment of personal values with caregiving values that is ought for in care home staff during recruitment likely contributes to sustained contentment, thus maintained psychosocial wellbeing (Rakovski & Price-Glynn, 2010).

On the other hand, the presence of a proportion of respondents expressing neutral or negative sentiments about their overall role signals a noteworthy variability in the demands of care home staff across respective roles. Individual differences, organisational factors, workload, and the inherent challenges associated with providing services for residents in a care home significantly shape how staff feel about their jobs and roles occupied (Mittal et al., 2009; Rakovski & Price-Glynn, 2010; Chamberlain et al., 2016; Costello et al., 2019; Hebson et al., 2015). Diverse motivations and expectations upon entering the profession influence overall job satisfaction, and misalignment with caregiving demands can lead to unhappiness in the role (Mittal et al., 2009; Rakovski & Price-Glynn, 2010). Staff in the clinical/care and wellbeing role were the least happy in their roles and this may have been a result of the direct exposure to the emotionally and physically demanding nature of caregiving to residents (Hebson et al., 2015) as compared to staff in the administrative/ management role who reported feeling happiest in their role. This finding is consistent with other studies that have shown carers and nursing staff in care homes experience greater psychological demands than

their managers (Gray et al., 2022b; Islam et al., 2017). Also, the past and lingering challenges presented by the Covid-19 pandemic, such as navigating evolving health protocols, concerns about personal safety, and the burden of managing the pandemic's impact on residents, could have collectively contributed to stress within this context, perhaps particularly for staff in hands-on roles such as caring and wellbeing. Consequently, these factors possibly contributed to the poor psychosocial wellbeing of staff and are corroborated by similar studies carried out to evaluate the effects of Covid-19 on care home staff (Gray et al., 2022b; Hanna et al., 2022; Martín et al., 2021; Riello et al., 2020).

The number of staff reporting a positive work-life balance, despite fluctuations over the past year, signifies a noteworthy aspect of resilience and adaptability within the caregiving profession (Chang & Kim, 2022; Marshall et al., 2021). This resilience and adaptability are essential for navigating the dynamic nature of caregiving and may have been influenced predominately by staff skills, values and support systems. Care home staff with high rating of work-life balance may have mastered effective time management with a more organised lifestyle, routines and activities to be prioritised. This skill is essential to help staff separate work-related issues from personal life and discourage working excessive hours. Effective time management is known to be useful in promoting good work life balance in the health care sector and beyond (Albertsen et al., 2014; Anwar et al., 2013). However, poor work life balance in this study may have been because of poor working conditions (changes in schedules), meeting financial needs and shortage in staff, thus encouraging working excessive hours leaving no time for family and social commitments as reported in similar studies (Islam et al., 2017; van Diepen et al., 2023). In addition, the working conditions (staff motivation, working environment, facilities/resources available) could have impacted staff productivity. Studies have shown that improved working conditions can influence and encourage staff to work efficiently and effectively (Ajala, 2012; Rechel et al., 2009; Sabir, 2017). To promote psychosocial wellbeing, staff suggested interventions to promote equality and belongingness, improve working conditions and provide comprehensive mental and social support services. These recommendations have been reported to be effective in a systematic review of studies aimed at promoting psychosocial wellbeing among care home staff (Otto et al., 2021).

The high rate of staff shortages and turnover increases workload thus encouraging overworking among care home staff. From the qualitative data, staff reported the effects of high workload on physical wellbeing included bodily aches, pain, fatigue, poor sleep and ultimately stress and burnout. Also, staff highlighted lack of up-to-date training in their

respective roles increased the physical demands of the job. Considering this, staff suggested ways to improve physical wellbeing which included, creating an organised care home environment, providing relevant and up-to-date physical and manual handling training and recruiting new staff. These suggestions are promising as studies have found a relationship between adequate staffing and fewer physical health problems (Schwendimann et al., 2016), positive effects of manual handling training (Asuquo et al., 2021) and the impact of working conditions (Grasmo et al., 2021) on physical health.

The wellbeing of care home staff is crucial when considering the delivery and implementation of digital music and movement intervention in care homes. For digital interventions to be successfully implemented in care homes, care home staff must be motivated, engaged and have a positive attitude towards the technology. However, the wellbeing of care home staff may impact their enthusiasm and willingness to embrace and make commitment to facilitating new programs in the care home. This assumption is supported by studies that suggest staff who feel supported and healthy are more likely to promote an active and engaging environment (Bright et al., 2021; Wieneke et al., 2019). These show that when staff are physically and emotionally well, they are better equipped, can inspire, motivate and are more likely to help residents engage with wellbeing activities in the care home. Facilitating digital music and movement intervention in care homes comes with additional responsibilities (attendance monitoring, setting up room and device for the digital intervention, coordinating residents to meet at the intervention room) on care home staff (De Nys et al., 2024; Ofosu et al., 2023). In cases where staff are already experiencing high levels of stress and burnout, it becomes more tasking and unfeasible for staff to adopt and facilitate additional wellbeing programs efficiently. Ensuring a good workload balance for care home staff does not only improve their wellbeing but also reduces the stress that may come with facilitating a digital intervention without feeling overwhelmed. Moreover, staff wellbeing is paramount in creating a supportive atmosphere for residents (Ajala, 2012; Sabir, 2017). A supportive atmosphere may include quality interactions with residents, being more patient, attentive and supportive which are all essential for fostering a positive environment for the delivery of digital interventions (Mares et al., 2002; Potter et al., 2018). In addition, the success of a digital music and movement intervention relies on how well staff are trained on the use and facilitation of the digital intervention (De Nys et al., 2024; Ofosu et al., 2023). It is possible that care home staff' capacity to learn can be influenced by their wellbeing (Anselmann, 2022; Crouse et al., 2011). Stress, fatigue and low morale may affect the ability

to learn and adopt new technologies. A positive wellbeing culture encourages innovation, openness to new methods, critical thinking and overall readiness to learn (Crouse et al., 2011). This may increase the likelihood of successful implementation and sustained use of the intervention. For example, in a study exploring the feasibility of digital music and movement intervention in care homes, some care home staff were proactive, learnt the dynamics of the intervention and adopted using music as a cue to summon residents for the intervention sessions (Ofosu et al., 2023). One major challenge to implementing digital music and movement intervention in care homes is high staff turnover (Ofosu et al., 2023). High staff turnover often due to poor wellbeing can disrupt the continuity of the digital interventions in care homes (Islam et al., 2017; Ofosu et al., 2023). Focusing on staff wellbeing will help to retain staff and impact the long-term sustainability of intervention in care homes.

### 6.5.4 Strengths and Limitations

This study is the first to access the wellbeing of care home staff using a holistic framework with focus on concerns relevant to the provision of physical activity to residents i.e., psychosocial and physical wellbeing) in the care sector as perceived by human resources staff at the care organisation in the wake of Covid-19. The survey approach with open ended questions also gave room for staff to highlight their concerns into details with suggestions on how to improve wellbeing. Also, this study compared wellbeing across different roles giving a more specific account of the relative state of wellbeing of care home staff in the administration/ management, clinical/care, general/other and wellbeing roles across eight locations. This aimed to help identify priorities for intervention and support for staff in terms of staff roles. Despite the practical implications of this study for the care sector, some limitations were present. First, data were collected using an unstandardised survey which means its psychometric validity and reliability were not established. However, although not ideal, designing the questionnaire was informed by standard widely used workplace wellbeing items. Second, items and responses on the survey varied greatly in terms of the response options (variability in a number of points on Likert scales and double negatives on some items) and scoring, thus making it impossible to analyse data using a composite score for wellbeing components even with z-scores due to the differences in the Likert scale anchors used. Notwithstanding this, the individual item analysis of data has possibly improved the interpretation and applicability of the results. Third, staff (36%) that participated in the survey was a less-than-ideal representation of the total number of staff and

may have been those with high wellbeing dissatisfaction, thus more motivated to respond and generating more negative responses. Also, this response rate may have been because of the use of surveys where response rates are typically low. Other staff may have experienced survey fatigue leading to the recorded response rate. However, 36% is not a poor response rate for online surveys (Poynton et al., 2019). Even though the use of an anonymised online survey may have been suitable for a large cohort at multiple sites in this instance, it may have also resulted in social desirability bias as staff may have provided answers they deemed acceptable rather than being fully honest, as they may have been concerned that site and job role might have led to the identification of them as individuals.

### 6.5.5 Recommendations

Care home staff suggested possible ways to improve psychosocial and physical wellbeing which focused mostly on improvements in working conditions. Similarly, the researcher made suggestions towards care home staff wellbeing and for future surveys. Details of these recommendations can be seen in the table below.

**Table 17: Recommendations from Care Home Evaluation of Workplace Wellbeing Study**

| Recommendations from staff | Recommendations from researcher |
|---|---|
| 1. Improvements in working conditions;<br>• increased pay, incentives, staff appreciation<br>• recruitment of new staff<br>• positive work environment (equality, belongingness and effective communication)<br>• relevant training (continuous professional development)<br>• organized work schedules and appropriate allocation of tasks | 1. Promote a tailored, all-inclusive wellbeing support system and improve existing ones.<br>2. Adopt the use of validated questionnaires or an improved version of the existing survey<br>• changes with scoring and rephrasing items.<br>3. Explore changes in wellbeing over time<br>4. Assess associations between the multi-component care home staff wellbeing measures and quality of care delivered/ care home ratings. |

### 6.5.6 Conclusion

In conclusion, the wellbeing of care home staff is important as it impacts the quality of care delivered in care homes to their residents. The quality of care provided to residents

includes facilitating wellbeing interventions (such as physical activity) which requires the optimal levels of wellbeing components explored in this study as well as motivation and good time management. The pattern of low wellbeing among clinical/care and wellbeing roles points to the toll that providing direct care to residents in a care home has on staff. Low wellbeing across the clinical/care and wellbeing roles has been majorly attributed to poor working conditions, therefore improving working conditions may improve care home staff wellbeing and consequently ensure smooth facilitation of interventions in care homes. Exploring multiple components of wellbeing gives a well-rounded perspective of care home staff wellbeing concerns. The heterogeneity in care home staff wellbeing based on different roles suggests the need for a prioritised and tailored support system targeted at staff in clinical/care and wellbeing roles.

**Afterword**

It is worth noting, that based on the survey findings, the care home organisation CCH has implemented several activities and taken initiatives in line with the recommendations here. These included 1) introducing incentives like staff vouchers, 2) increasing pay in line with high cost of living, 3) re-evaluated pensions and benefits across the organisation, 4) providing a more accessible staff support programme online/via app and 5) redesigning staff wellbeing survey with more standardised scoring.

## 6.6 References


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# Chapter 7: Overall Thesis Discussion

## 7.1 Summary of Thesis Findings

This thesis set out to explore the psychosocial impact of PA on older adults and the influence of care home staff on promoting healthy ageing. Firstly, the systematic review and meta-analysis assessing the effects of PA and its dimensions (frequency, session time, period and type) on anxiety in older adults revealed that PA has a significant small to moderate positive impact on anxiety. Analysis of PA dimensions showed that all PA types, session times, frequency, and intervention periods were effective when compared with the control groups but with moderate differences in the magnitude of effects. This suggests designing a PA intervention with the aim of promoting healthy ageing especially by reducing anxiety should take into consideration 1) how long and frequent the exercise would be and 2) the type of PA to deliver. These considerations are important, as effects may be stronger for just one type of PA, shorter duration interventions and PA sessions lasting 60 minutes, three times a week.

Second, the mixed methods study exploring the feasibility of implementing a digital music and movement intervention in care homes and its effects on wellbeing showed that implementing the intervention was feasible but was associated with delivery challenges such as limited resources and staffing, motivation, engagement, disabilities and cognitive status of participants. Additionally, significant changes were recorded for measures of anxiety, depression and loneliness in residents. Even though no significant changes were shown in fear of falling, appetite, and general health, the qualitative results revealed improved mood, physical health, social support in residents and job satisfaction in ACs. These findings suggest that a digital music and movement intervention could be successfully implemented in care homes when the delivery challenges are resolved. Moreover, the preliminary significant change in some psychosocial measures supports the capabilities of digital music and movement in promoting healthy ageing.

Subsequently, the pilot mixed methods study aimed to investigate the impact of a digital music and movement intervention, considering the results of the feasibility study, on multidimensional wellbeing and progression to a full-scale trial. Results from the psychosocial measures showed significant changes in anxiety, loneliness and fear of falling. Also, the qualitative findings supported the potential progression of the intervention to a full-scale RCT and emphasised the benefits of the intervention for the psychosocial wellbeing of residents including; enjoyment, encouraging sense of community, stimulating positive

emotions and memories. Notwithstanding the positive outcomes of the intervention, and despite changes and improvements based on the first study, the delivery of the intervention was still challenging due to understaffing, care home routines and technical problems.

Lastly, based on the important role care home staff play in the delivery of physical activity interventions in this setting, the psychosocial and physical wellbeing of care home staff across roles were assessed with the aim of exploring wider staff-related factors that could influence delivery of care and specifically a physical activity and music intervention. Findings from the secondary data analysis highlighted that staff in clinical/care and wellbeing roles reported the lowest wellbeing scores for happiness, motivation, productivity, work-life balance, overworking and work-related stress, whereas staff in the administration/ management role had the highest wellbeing scores. This implied that staff that provide direct care to residents in care homes have poorer wellbeing when compared to staff that do not provide direct care to residents and this may be attributed to their working conditions and aspects of the role which previous studies indicate can impact delivery of physical activity interventions. Also, the qualitative results for all role groupings highlighted work-life balance, job satisfaction, impact of work as areas of wellbeing and made suggestions towards improving wellbeing.

### 7.2 Physical Activity Interventions and Psychosocial Wellbeing in Healthy Ageing

The positive impact of PA on anxiety reported throughout the studies in this thesis suggests the potential of PA in improving psychosocial wellbeing in older adults (Ofosu et al., 2023a, 2023b). Other than the anxiety exposure and sensitivity mechanism (Smits et al., 2008) described in Chapter 2 (Ofosu et al., 2023b), other psychological mechanisms like self-efficacy and distraction might be a possible explanation for the anxiolytic effects of PA. Self-efficacy (belief in one's ability to have control over and master tasks and situations to achieve a desired outcome) has been associated with reaction to anxiety symptoms where individuals with high self-efficacy are believed to have the ability to manage potential threats, less prone to worrying thoughts and have low anxiety arousal (Anderson & Shivakumar, 2013). It is argued that with frequent exercising, higher self-efficacy is achieved when one effectively manages exercise stress and increases exercise duration and endurance (Olsen et al., 2015; Toros et al., 2023). Based on the self-efficacy theory, a study aimed at establishing the impact of varied exercise intensities and self-efficacy on anxiety reduction in older adults found that, at moderate intensity exercise, increase in self-efficacy was associated with a decrease in state anxiety (Katula et al., 1999). Notwithstanding the findings from Katula et al., (1999),

other intensities of exercise (low and high) have been associated with higher self-efficacy and a positive impact on anxiety (Blacklock & Rhodes, 2007; Bodin & Martinsen, 2004; Marquez et al., 2002). This theory suggests that exercise with subjective optimal level of challenge requires self-efficacy to carry out and that the self-efficacy derived from exercise can possibly impact anxiety arousal and reaction. The concept of self-efficacy fosters a sense of empowerment and autonomy in older adults and these qualities are essential for maintaining a positive and active lifestyle in old age (Rawlett, 2014). Potentially this theory of self-efficacy impacting anxiety and PA effectiveness could have been explored as a mechanism in the empirical chapters of this thesis, but this did not align with the main aims of the feasibility and pilot mixed methods studies and would have increased the burden of measures to participants. Aside from potential mechanisms of effect via self-efficacy, PA has also been considered as a form of distraction away from the threat or anxiety arousal state, thus reducing anxiety arousal and its symptoms. Even though this mechanism has been reported to be effective in some studies (Petruzzello et al., 1991; Raglin & Morgan, 1985), there is limited extensive up to date evidence to support it, thus PA working as a distraction is debatable. In addition, the supervised and group delivery of the digital PA interventions in many studies including those in this thesis may have contributed to the significant changes in anxiety. As reported in the systematic review in this thesis, the majority of the included studies adopted a group-based and/or supervised delivery of PA and saw significant changes in anxiety symptoms. Being informed by this possibility, the present intervention studies were designed and delivered in a group. This assumption has been supported by several studies explaining that the presence of peers, colleagues or even a supervisor motivates and boosts the confidence of participants, improves engagement and adherence and possibly results in positive impact on anxiety (Burke et al., 2006; Fennell, 2016; Komatsu et al., 2017; Ntoumanis et al., 2017; Ofosu et al., 2023b; Smith et al., 2018).

Similar to anxiety symptoms, there was a significant change in loneliness in the feasibility and pilot mixed methods studies (De Nys et al., 2024; Ofosu et al., 2023a). Also, changes in loneliness in this study were supported by the qualitative findings where residents reported building friendships and establishing positive meaningful relationships throughout the PA intervention. Having this in mind, loneliness and social support showed similar outcomes and implied a major contribution of PA and music on psychosocial wellbeing for healthy ageing. Reduced loneliness and improved social support in both studies may be attributed to the group-based nature of the music and movement intervention delivered. Primarily, the music and movement intervention was delivered to residents in a large

common area (lounge) and required all participants to leave their rooms to converge as a group. In doing so, this may have created an atmosphere to support social interactions out with existing activities, strengthen resident-to-resident and resident-to-care home staff relationships thus decreasing the feelings of loneliness and increasing social support and a sense of belongingness. This assumption aligns with findings from a study that reported established connections with residents in a care home following music and dance movement therapy (Melhuish et al., 2017). The intervention was an activity to look forward to as a group other than the typical care home activities that some residents had less interest in. Loneliness can be subjective and occurs when an individual is not satisfied with their existing interpersonal relationships and several studies have supported the positive influence of group-based PA on loneliness (Brady et al., 2020; Komatsu et al., 2017; Pels & Kleinert, 2016; Sebastião & Mirda, 2021). Moreover, this typical duration of the interventions (12 weeks) is considered as enough time for friendships and social connections to be formed. For example, some studies have shown that social connections can be established between three to nine weeks of interactions and closer friendships may take up to three to four months (Hall, 2019; Saramäki et al., 2014). PA as a form of social engagement is a crucial aspect of maintaining psychosocial wellbeing during the ageing process, thus this thesis supports group-based PA and encourages future PA interventions to adopt this approach especially in the care home setting. Also, a review aimed at investigating the effectiveness of interventions targeted to reduce loneliness and social isolation in older adults reported the success of the interventions relied on factors including adaptability, community development approach and productive engagement (Gardiner et al., 2018). The music and movement intervention described in this thesis was designed in consultation with health and social care experts, researchers and the targeted consumers (older adults) which meant the intervention was based on the needs of the older adults and well suited for the varied levels of capabilities in older adults. For example, the movement sessions were categorised into low, moderate and high intensity exercises with different durations and a large collection of music for ACs to select from based on the group's abilities and preferences. This shows that the design and delivery of the intervention made use of the community development approach and adaptability. One finding that was consistent in both the feasibility and pilot mixed methods study was enjoyment/improved mood associated with participation in the intervention. Both residents and ACs enjoyed engaging in the PA intervention and looked forward to the activities indicating productive engagement with the intervention. Considering that the intervention in this thesis included the approaches thought to make an intervention successful, this might explain the success of the

digital music and movement intervention in reducing loneliness and promoting social support among residents in care homes.

Loneliness in older adults has been found to predict mood (Kahlbaugh et al., 2011) such that reduced feelings of loneliness are associated with improved mood. Even though significant changes in depression were only found in the feasibility study, the qualitative findings from both studies (De Nys et al., 2023; Ofosu et al., 2023a) emphasised increased positive mood following the movement and music intervention. Improvement in mood may be related to the music component of the intervention. For example, despite the positive impact of PA on mood (Boolani et al., 2021; Gruenenfelder-Steiger et al., 2017; Ofosu et al., 2023a; Peluso & Guerra de Andrade, 2005), residents also reported that both the music sessions only and the movement accompanied by music resonated with memories, improved mood, and made the movement sessions more enjoyable. This finding can be explained by the Music, Mood and Movement theory which was initially developed in line with physical activity guidelines and music theory (Murrock & Higgins, 2009). This theory suggests that music produces the psychological response of mood modification, makes PA more enjoyable, and encourages engagement in PA leading to positive health outcomes and healthy ageing (Murrock & Higgins, 2009). Also, the emotions attached to memories resurrected by music can be experienced when the right music is being played and this emotion-altering effect can also result in improved mood (Chan et al., 2012). The collection of music adopted for the interventions in this thesis was generally calm, relaxing or upbeat thus may have elicited improved mood. Several studies have supported the positive effects of music on depression (Chan et al., 2012; Petrovsky et al., 2015; Wang et al., 2023). As well as the factors that make an intervention successful for psychosocial outcomes, the dose-response relationship should also be considered (Chan et al., 2012; Wang et al., 2023). For example, one study reported significant changes in depression from music therapy, but the intervention duration had to be six weeks or more (Chan et al., 2012). The music and movement interventions in this thesis lasted for 12 weeks thus the longer duration may have contributed to the improved mood noted and significant changes in depression.

Another component of psychosocial wellbeing that yielded significant changes only in the pilot mixed methods study and not the feasibility study was fear of falling. Differences in the fear of falling outcomes for the two intervention studies may have been influenced by the delivery challenges reported in the feasibility study. On the other hand, the pilot mixed methods study addressed some of the challenges from the feasibility study thus improving the delivery, implementation and effectiveness of the intervention. A reduction in fear of falling

is believed to have broader implications for psychosocial wellbeing, frailty, independence and overall wellbeing. Fear of falling often initiates a cycle of reduced physical activity and mobility, contributing to deconditioning and an increased susceptibility to falls (Kendrick et al., 2014; Scheffer et al., 2008). Participation in the digital music and movement intervention may have enhanced coordination, balance, and confidence to break the cycle of fear of falling and possibly contribute to maintaining or improving physical function which is key to healthy ageing (Gillespie et al., 2012). Fear of falling has been highly associated with anxiety and so it is possible that changes in anxiety indirectly influenced changes in fear of falling, although this mediation was not formally assessed given the small sample size. This association has been found in in several other studies (Lach & Parsons, 2013; MacKay et al., 2021; Payette et al., 2017; Van Haastregt et al., 2008). For this reason, the exercise self-efficacy mechanism is a probable explanation for the significant change in fear of falling (Soh et al., 2021). To support this possible claim, future studies would need to measure and test mediation pathways of fear of falling and exercise self-efficacy. The impact of the digital movement and music intervention on fear of falling in older adults is in line with the societal goal of preventative healthcare in ageing populations, aiming to reduce the burden of fall-related issues and promote healthy ageing (Hartholt et al., 2011).

For both intervention studies in this thesis, no significant changes were shown for quality of life, and this may be attributed to the comprehensive nature of quality of life in older adults or the relatively simplistic form of the measure (EQ-5D-3L) used. Quality of life encompasses physical, psychological, and social dimensions, making it susceptible to various influencing factors (Van Leeuwen et al., 2020). While the music and movement intervention may have demonstrated impact in certain dimensions such as anxiety, depression, loneliness and fear of falling, the non-universal changes in quality of life suggest that the intervention may not have addressed the full spectrum of factors contributing to quality of life, particularly the physical variables included in the EQ-5D-3L, such as pain. Also, the present (day of completing measure) perceived health as measured by the EQ-5D-3L may not totally represent changes in quality of life over time as this may vary on different days. Nevertheless, this thesis speculates that there might have been an indirect impact on quality of life regardless the non-significant changes recorded due to the association of quality of life with other components of psychosocial wellbeing that significantly changed and some of the qualitative data supporting improvements in QoL. For example, where participants said they felt they were getting stronger and wanting to try out activities, suggesting increased physical and social participation. Studies have reported anxiety, depression, loneliness and fear of

falling are all associated with quality of life scores (Baldelli et al., 2021; de Oliveira et al., 2019; Korenhof et al., 2023; Li et al., 2024; Sampoon et al., 2019; Sewo Sampaio & Ito, 2013). Also, the positive relationship between adherence levels and quality of life implies the low average attendance and adherence in some care homes may have accounted for the changes being non-significant. It is also relevant to acknowledge that residents in care homes are reported to have poorer quality of life when compared to community-dwelling older adults due to factors like functional dependence, high number of chronic medical conditions and cognitive impairment (León-Salas et al., 2015; Pérez-Ros & Martínez-Arnau, 2020) and so engaging in 12 weeks of music and movement intervention may not be entirely adequate to create substantial changes in this aspect of wellbeing. This underscores the complexity of promoting healthy ageing, requiring interventions that comprehensively target the diverse determinants of quality of life in older adults.

Overall, the psychosocial impact of PA especially digital movement and music interventions on residents in care homes may have been influenced by motivation and retention to the intervention. Due to the enjoyable nature of the interventions (music and movement) facilitated in care homes, many residents were encouraged to participate and reap the benefits, however, this was not the case across the board as some participants were less motivated to start the intervention in the first place and this is evidenced through the moderate adherence. However, participants were motivated to continue and complete intervention sessions once started and were encouraged by care home staff who were also motivated following the intensive training delivered to inform the research procedure and possible benefits to the residents, staff and care homes. This aligns with the hedonic theory of motivation that states individuals are more likely to sustain engagement in activities that bring pleasure and reduce negative experiences (Williams, 2018). From both intervention studies, care home staff interviewed also stated that they adopted specific measures to boost participation and engagement. For example, care home staff created an atmosphere for the interventions by playing music to alert residents of the start of movement sessions which had become part of residents' routine. Researcher (EO) and designers of the digital movement and music intervention also visited care homes to join in sessions and this encouraged and motivated residents and care home staff to continue. Studies have emphasised the role of motivation in the successful facilitation of interventions among older adults (Medalia & Saperstein, 2011; Ofosu et al., 2023a). Consequently, the impact of motivation may have translated into the moderate to high retention to interventions recorded in this thesis. Continued engagement and participation in PA interventions contribute to the extent of their

impact on wellbeing (Jefferis et al., 2014; Salman et al., 2019). The multiple possible explanations for the psychosocial impact of music and movement on older adults highlight the importance of adopting a comprehensive model of music and movement intervention promotion in older adults to enhance healthy ageing.

### 7.3 Digital Interventions and Research Implementation Processes in Care Homes

The approaches (mixed methods, realist evaluation and progression criteria) adopted to evaluating the feasibility and effectiveness of digital music and movement interventions on wellbeing of residents in care homes exposed the intricacies of implementing digital interventions in care homes and the role of care home staff in supporting with facilitation of such interventions. Findings from this thesis showed that, implementing digital interventions was influenced by residents' health status, intervention processes, care home staff, facilities, and conditions in the care home. These factors have been reported in a systematic review as typical of barriers and facilitators to successful intervention implementation in care homes (Peryer et al., 2022).

The health status of residents may affect recruitment, participation and engagement with digital music and movement interventions in care homes (Fudge et al., 2007; Ofosu et al., 2023a). Specifically in this thesis, limited understanding of the study, mostly due to cognitive impairment, negatively impacted recruitment and subsequently resulted in a small sample size for the intervention studies. Residents without capacity to consent due to their level of cognitive impairment were excluded due to the time constraints for ethics approval to be able to recruit this group and the type of measures that were selected for inclusion, despite many of these being claimed to be suitable for cognitively impaired people. However, this group is said to make up 70% of all care home residents (Alzheimer's Society, 2024) so ideally future research would need to seek for the appropriate ethics approval to be able to recruit this group and expand the prospects of generalisation of findings to all residents in care homes. The high prevalence of chronic illnesses among residents in care homes may also have contributed to the occasional low morale and demotivation to participate in the intervention (Boscart et al., 2020; Moore et al., 2014). For example, a resident with arthritis was unable to join some sessions due to feeling unwell at the time and said how they struggled even getting up and about and how sometimes they were just not able or just not well at all. This low motivation and sometimes inability to participate may have affected adherence and retention rates and required care home staff put in more effort to encourage residents. Further, reductions in participation were also influenced by participants'

hospitalisation and, in some cases, death stemming from health conditions. Notwithstanding these difficulties, studies have suggested older adults with or without health conditions should be engaged in research participation to reveal findings worth generalising (Law & Ashworth, 2022; Wortmann, 2012). The multifaceted nature of the obstacles experienced by residents resonates with the complex health profiles of older adults. These challenges may not only impact participant engagement but further support the critical need for digital interventions and research processes that accommodate the diverse and evolving health conditions experienced by older adults in care homes.

Another key factor that can contribute to the implementation of digital music and movement interventions in care homes is the intervention process. In designing the intervention and research process, the complex setting of care homes must be considered. Digital music and movement interventions and research processes could be integrated and made compatible with routines in the care home to avoid the challenge of restructuring daily activities in the care home and help maintain engagement (Peryer et al., 2022; Rycroft-Malone et al., 2018). In this thesis, through the stakeholders' involvement, researchers were informed of the present schedules in the various homes and so the intervention delivery was made flexible to leave room for adaptability and improve attendance. For instance, variations in the number of sessions offered across care homes emphasise the importance of tailoring interventions to the operational aspects of the care home. Also, the recommended number of sessions changed from four sessions a week in the feasibility study to three sessions a week in the pilot mixed methods study based on results from the feasibility study. Incorporating adaptive approaches, evaluations and progression criteria in the design of digital interventions is consistent with implementation science principles and strategies in healthcare which enhance overall quality and effectiveness of interventions (Handley et al., 2016; Pearce et al., 2023; Proctor et al., 2013). This approach is particularly relevant in care homes and in the rapidly evolving field of digital health, where residents' health status varies significantly across individuals and within individuals often daily, thus continuous refinement based on real-time data is essential for success.

Moreover, clearly communicating the procedure for the research especially intervention processes to care home staff and participants is important in implementing digital interventions in care homes (Aasmul et al., 2018; Law & Ashworth, 2022). For this thesis, care home staff were trained and made aware of the impact, procedures, required time and resources needed to facilitate the intervention and residents were well informed of the research using the participant information sheet. This training helped care home staff with

facilitation of the interventions with pointers on troubleshooting the online platform and contributed to the moderate intervention fidelity in the pilot randomised study. Despite this and increasing the training and support between studies, there were still issues with intervention and research delivery, such as the lack of a true control group. In promoting intervention fidelity, regular monitoring of adherence and facilitation would potentially be useful in person if possible, so to identify issues such as not adhering to the intervention design and wait-list control at an early stage by working with care home staff more directly at the start of the intervention.

Care home staff played a crucial role in the facilitation of digital music and movement interventions in care homes. However, the role of care home staff to deliver the intervention and research was mostly impaired by facilities and conditions in the care home. For example, among the challenges in implementing digital music and movement intervention in care homes were limited resources for delivery (space, Wi-Fi and devices- large screens), routines in care homes, high attrition rate in staff leading to regular shortage of staff and high workload. Addressing these challenges is important to the success of digital interventions in care homes and other complex interventions (Devi et al., 2023; Lawrence et al., 2012; Murray et al., 2016; Peryer et al., 2022). The reported challenges in the intervention delivery align closely with the factors that affect care home staff wellbeing as identified in Chapter 6. The secondary data analysis on the wellbeing of care home staff revealed high workload, work schedules and shortage of staff among other factors negatively impacted their psychosocial and physical wellbeing. While the primary focus of digital interventions in care homes is on residents, the potential implications of care home staff wellbeing on intervention delivery challenges identified in this thesis emphasise the importance of considering and supporting care home staff wellbeing for successful programme implementation. Also worth noting is the identification that staff in clinical/care and wellbeing roles reported the lowest levels of wellbeing as compared to the remaining roles and staff in these roles are typically in charge of supporting and facilitation interventions in care homes (Gilster et al., 2018; Ofosu et al., 2023a). This highlights the struggles of staff who are directly involved with the wellbeing of residents as compared to other care home staff involved in administration and management roles. This suggests roles influence staff wellbeing and sets the tone to tailor support when exploring the broader context of care home operations and its impact on the success of interventions targeting residents' wellbeing. On the positive side, care home staff in the empirical studies found facilitating digital music and movement intervention improved job satisfaction, and job satisfaction potentially improves wellbeing as found in the care home

wellbeing study. This positive impact of delivering digital interventions on care home staff could translate into a sense of self fulfilment and reward from delivering care to older adults (Hebson et al., 2015; Ofosu et al., 2023a; Rakovski & Price-Glynn, 2010) and should be explored further in future research. The stark results from the staff wellbeing analysis also suggest that these systemic issues with conditions need to be addressed before any resident wellbeing intervention is likely to be fully successful.

### 7.4 Strengths and Limitations

This thesis is an original piece of work that adds to the scientific evidence on the impact of PA on the psychosocial wellbeing in older adults. For the systematic review, it followed a rigorous methodology and was in line with PRISMA and Cochrane's methods for conducting systematic reviews. This shows that findings from the systematic review and meta-analysis are thorough, valid and reliable (Higgins et al., 2021; Page et al., 2021). This thesis focused on residents in care homes who have been considered as one of the most difficult groups to work with in terms of research and introducing new interventions due to the diverse needs and health conditions of residents (Peryer et al., 2022). The mixed methods approach for both intervention studies captured a comprehensive overview of the feasibility and benefits of the digital music and movement intervention. The interviews and focus groups served as additional sources of information for relevant insights that were not covered in the surveys as well as supplementing the research evidence where the sample size for quantitative analysis was sub-optimal. The realist evaluation and Context, Mechanisms, Outcome (CMO) approach informed researchers of the realities and complex situations ongoing in care homes especially during and post the Covid-19 pandemic and the issues that come into play particularly with implementing digital interventions in care homes (Wong et al., 2016). The methodological strength of employing the realist evaluation is transferable to other digital interventions, allowing for real-time adjustments to enhance the effectiveness and feasibility of the intervention. A part of this approach, the progression criteria, also supported the researchers to further focus on refinements necessary before scaling up to a full-scale RCT. Additionally, the tools used to measure psychosocial wellbeing were selected on the basis of validation with older adults with or without cognitive impairment and brevity to ensure suitability and less research burden on residents in care homes. However, in practice, the effectiveness of some of these measures with individuals with cognitive impairment was debatable. Another positive aspect of this thesis was that stakeholders were involved from the stage of designing to the implementation of the interventions making it

suitable and well-tailored to the needs of the participants. Moreover, the intervention studies are in line with the preliminary steps leading to a RCT according to the Medical Research Framework for developing and evaluating complex interventions, i.e. development, feasibility, evaluation and implementation (Skivington et al., 2021). This thesis also evaluated the wellbeing of care home staff which implies not only did this thesis address wellbeing of older adults but also to better understand the wellbeing of care home staff as this has the potential to seriously affect promoting wellbeing in older adults. Finally, the inclusion of music only sessions resulted in added benefits for the psychosocial wellbeing of residents (Creech et al., 2013).

Notwithstanding the strengths of this thesis, there were several limitations. One profound limitation was the challenges reported in care homes which significantly impacted the intervention implementation and research delivery. These challenges such as short staff, poor Wi-Fi connectivity, limited space and technology e.g., large screens for intervention facilitation, affected the implementation, delivery, and adherence to the intervention. Although, resolving some of these challenges was beyond the capabilities of researchers and efforts from the care home organisation, contingency plans were put in place to manage such situations. For example, care homes with poor internet services were supported with Wi-Fi boosters and music sessions were via danceSing Care radio and not from the online services. This links into one of the strengths which was the rapport and relationship between the research team, intervention deliverer and the care homes who were receptive to suggestions made by the research team. Another limitation was the Covid-19 restrictions affecting in-person recruitment of participants by researchers. This affected recruitment rate to an extent, but the support received from care home staff trained by the team in recruitment to the research partially boosted recruitment rate. The impact of this can be seen in the relatively small sample size of participants in the intervention studies. Covid-19 restrictions in care homes also affected in-person data collection and limited feasibility study to survey measures only, therefore measures were put in place for online data collection via Microsoft Teams or Zoom. This method was not entirely successful for all homes and participants due to poor Wi-Fi connection and hearing difficulties. For this reason, trained care home staff assisted with data collection and completed questionnaires were securely posted to the researchers. Also, participation in the intervention studies was limited to residents with capacity to consent. The timeline and funding for this PhD did not make it possible to seek NHS ethical approval to include participants that required third-party consultation and agreement. Additionally, despite monitoring the intervention process this did not reveal the non-

adherence of participants to a control group condition in the pilot RCT as care home staff only reported adherence of the intervention group weekly and not that they had included the control group in the same intervention sessions. Researchers could have extensively followed the intervention process by probing and constantly reminding care home staff about the importance of control groups. However, the training delivered to care home staff at the start of the research and intervention delivery explained the research protocol and provided the adherence register for one group at a time and reinforced how the study timing would work for each group, but the homes did not enforce this. For some care homes, the non-adherence to a control group was inevitable due to lack of space for the intervention group to engage in the intervention and so the common room for all residents was used. Finally, a direct link between factors affecting care home staff wellbeing and implementation of digital intervention in care homes was not established as this was not assessed concurrently in the same study and same staff however, the similarities in the reported challenges for both issues (poor working conditions and limited resources/staff) across the empirical studies and secondary data analysis chapter highlights a potential indirect association requiring future research on this topic.

### 7.5 Implications and Recommendations

Findings from this thesis support the positive impact of PA (movement and music interventions) on the psychosocial wellbeing of care home residents and emphasises the considerations for feasible facilitation of digital music and movement interventions in care homes. These findings hold substantial implications for future researchers and care home organisations with the aim of promoting healthy ageing through movement and music and delivering quality care to residents. First, it is important to implement adaptable digital music and movement interventions that accommodate the diverse needs of residents. By incorporating PA or music and movement with options for varying durations, frequencies, intensities, and types with a focus on group participation, social support and supervision, these interventions can effectively contribute to the residents' psychosocial wellbeing. The adaptability of digital interventions also makes them effective in addressing unique delivery challenges within specific care homes. Additionally, making interventions adaptable requires continuous evaluation on aspects such as completion rates, adherence metrics, retention, safety, residents’ and facilitators’ feedback to provide valuable insights and inform refinements. This iterative process ensures the sustained effectiveness of interventions,

allowing for adjustments and improvements over time. However, it does require higher intensity of resources.

Also, the integration of digital music and movement interventions serve as a catalyst for fostering a shared sense of community and experiences among residents and care home staff. This implies promoting healthy ageing among residents through digital music and movement should be considered as a lifestyle/cultural change and adopt a holistic approach in its delivery. Considering this, the feasibility of facilitating digital music and movement interventions in care homes is majorly dependent on the wellbeing care home staff and the delivery challenges stated in this thesis. Therefore, improving the wellbeing of care home staff and resolving the delivery challenges may strengthen the delivery of the intervention, then subsequently trigger the positive impact expected in residents and staff. This calls on care home organisations to prioritise the wellbeing of care home staff and especially staff that provide direct care to residents and create an atmosphere fit for wellbeing interventions to be carried out. Measures put in place to enhance care staff wellbeing such as additional staffing, albeit challenging, should reflect on the quality of care delivered and the overall wellbeing of residents.

Findings from this thesis show that progression onto a full-scale RCT is justified, if delivery challenges can be addressed and potentially adopting a cluster randomisation method to avoid the cross contamination between the intervention and control groups or confusion about how to implement this design. This approach will require a much larger network of care homes and sample size as compared to the sample size estimation from the pilot study (132 participants- all in one site) such that a cluster-randomised power calculation will be much more conservative and take into account cluster variance. It is also recommended that future studies should consider initiating longitudinal studies to thoroughly explore the enduring impact of digital music and movement interventions on the multidimensional wellbeing of care home residents. This research avenue can unravel the longer-term benefits of these interventions despite the high mortality rate in this group. Also, a comparative study assessing the social impact of a digital music and movement intervention on residents in care homes versus community-dwelling older adults is suggested. This approach may hold intricate answers to the dynamics of social wellbeing in older adults with different levels of ability and independence. A further complex design could investigate the differences from group based/supervised PA and individual/unsupervised PA in both settings, so not to confound other differences between the settings with the impact of group versus individual delivery. Such a comparative study may help tailor digital PA interventions to address and

improve the social wellbeing of older adults in different contexts. The comparative study may also adopt a more individualised approach in terms of designing the digital music and movement intervention incorporating personalised activities to support the principles of person-centred care among older adults (Ebrahimi et al., 2021; Kogan et al., 2016). It may also help to explore the effect on quality of life further in a group that might not yet have some of the more complex issues more common among frailer care home residents and being in the care home environment. Moreover, it is suggested that future studies should employ more innovative recruitment and monitoring strategies such as (1) introduce incentives, either a fee for staff time and involvement or emphasise the possible benefits for residents and the home itself, (2) organise more in-person engagement events with Q&A sessions before recruitment and during the research process to build rapport, trust, raise awareness and interest among potential participants, and (3) tailor research protocols/strategies based on to the care home context, type and, constraints of each care home and its residents (for example nursing, residential or mixed care homes may need different strategies). These may help to address possible challenges with low recruitment rates and intervention fidelity.

Music as a mostly preferred component of the intervention in this thesis may have contributed considerably to the psychosocial changes recorded in the intervention studies. However, the direct impact of music on psychosocial wellbeing was not established in this thesis. Notwithstanding this, its importance and role in the implementation of digital PA in care homes was evident from the findings. Music as a standalone element is a beneficial therapy tool for cognitive impairment, quality of life and depression (Moreno-Morales et al., 2020). Considering these benefits, it is therefore suggested that PA interventions should be complemented with music for maximum effects especially among residents in care homes.

For healthcare professionals, beyond the impact of music and movement interventions on wellbeing of residents, these interventions have evolved as one of the most cost effective lifestyle strategies that impact multidimensional health in older adults, and so, these interventions should be encouraged among residents not only in care homes but to older adults in different contexts to complement other effective forms of treatment prescribed for better health outcomes.

Encouraging PA and social engagement through interventions like music and movement aligns with public health initiatives aimed at promoting healthy ageing and reducing the burden on healthcare systems. The potential scalability of digital music and movement programmes makes them a feasible and impactful strategy for promoting health and wellbeing among older adults on a larger scale. For these reasons, policy makers should

incorporate these findings into designing health and social care policies especially for older adults and consider funding this beneficial line of future research into the role of digital PA interventions on older adults' wellbeing.

### 7.6 Conclusion

The findings of this thesis align with the overarching goal of promoting healthy ageing through PA, both by considering the dose of PA in maximising the impact on anxiety symptoms and implementing and evaluating digital music and movement interventions in care homes to promote psychosocial wellbeing. Successful implementation of such interventions in care homes depends on a favourable environment, organisational support, the nature of the intervention, complexities of the intervention process, and commitment of residents and care home staff. Music, as a component of the digital intervention played a vital role in the facilitation and may have contributed to the changes in wellbeing recorded. Also, an in-depth analysis of the wellbeing of care home staff and suggestions for improving wellbeing ranging from addressing working conditions to promoting a positive work environment may have direct implications on the success of digital music and movement interventions implementation in this setting. By adopting a holistic approach (all stakeholders involvement and adequate care home facilities) in promoting healthy ageing through digital interventions, the interventions may also create a more supportive and conducive environment in care and positively influence both staff and resident experiences. For long standing benefits of digital music and movement interventions on healthy ageing, regular evaluations should be put in place to meet technology upgrades and the needs of a fast-growing population of older adults.

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