# A scoping review of the outcome measures that can be utilised when studying the effects of physical activity for the elderly in care homes

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## List of Abbreviations

| | |
|---|---|
| 6MWD | Six Minute Walking Distance |
| 6MWT | Six Minute Walk Test |
| 30-SST | 30 second-Sit to Stand Test |
| ADLs | Activities of Daily Living |
| APA | American Psychological Association |
| AWS | Algase Wandering Scale |
| BBT | Box and Block Test |
| BI | Barthel Index |
| BMI | Body Mass Index |
| BSMS | Brighton Sussex Medical School |
| BPRS | Brief Psychiatric Rating Scale |
| BS | Back Scratch test |
| CINHAL | Cumulative Index to Nursing and Allied Health Literature |
| CMAI | Cohen-Mansfield Agitation Inventory |
| CMJ | Countermovement jump test |
| COMP | Canadian Occupational Performance Measure |
| CRF | Cardiorespiratory Fitness |
| CSAR | Chair Sit and Reach test |
| DEMQoL | Dementia Quality of Life scale |
| EMS | Elderly Mobility Scale |
| EQ-5D | EuroQoL-Five Dimension |
| EQ-5D-5L | EuroQoL - Five Dimension - Five Levels of Severity |
| EQ-5D-3L | EuroQoL - Five Dimension - Three Levels of Severity |
| EQ-5D-Y | EuroQol - Five Dimensions - Youth |

| | |
|---|---|
| EQ VAS | EuroQoL Visual Analogue Scale |
| GDS | Geriartic Depression Scale OR Goldberg Depression scale |
| GFE | Groningen Fitness test for the Elderly |
| HGS | Hand Grip Strength |
| HRQoL | Health Related Quality of Life |
| IADL | Instrumental Activities of Daily Living |
| ICF | The International Classification of Functioning, Disability and Health |
| IHQoLR | International Hub for Quality of Life Research |
| Katz ADL | Katz Index of Independence in Activities of Daily Living |
| KCL | King's College London |
| LSNS | Lubben Social Network Scale |
| LSNS-6 | Lubben Social Network Scale - 6 item |
| ME | Motion Exercise |
| MMSE | Mini-Mental State Examination |
| MoCA | Montreal Cognitive Assessment |
| NHPPT | Nursing Home Physical Performance Test |
| NHS | National Health Service |
| NIA | National Institute of Ageing |
| NPI | Neuropsychiatric Inventory |
| NPI-Q | Neuropsychiatric Inventory Questionnaire |
| PAcES | Physical Activity Enjoyment Scale |
| PAcES-8 | Physical Activity Enjoyment Scale-8 item |
| PAI | Paratonia Assessment Instrument |
| PAL | Pool Activity Level Checklist |
| P-CAT | Person-Centred Care Assessment Tool |
| POMA-B | Tinetti Performance Oriented Mobility Assessment - Balance |
| PPT | Purdue Pegboard Test |

| | |
|---|---|
| PROM | Patient Reported Outcome Measure |
| PREM | Patient Reported Experience Measure |
| QoL | Quality of Life |
| SCP | Stair-climbing power test |
| SF-8 | Short Form-8 item |
| SF-12 | Short Form-12 item |
| SF-36 | Short Form-36 item |
| SFT | Senior Fitness Test |
| SMAF | Functional Autonomy Measurement System |
| SMBT | Seated Medicine Ball Throw test |
| SPPB | Short Physical Performance Battery |
| SLS | Single Leg Stance Test |
| TILS | Three Item Loneliness Scale |
| TLC | Total Lung Capacity |
| TMT-A | Trail Making Test - Part A |
| TSP | Timed Static Peddling |
| TUG | Timed Up and Go test |
| UCLA | University of California |
| UCLA-LS | University of California Los Angeles-Loneliness Scale |
| ULS-8 | UCLA Loneliness Scale - 8 item |
| WHO | World Health Organisation |
| WHOQoL | World Health Organisation Quality of Life scale |
| WHOQOL-100 | World Health Organisation Quality of Life scale - 100 item |
| WHOQoL-BREF | World Health Organisation Quality of Life scale-abbreviated version |
| WHOQOL-OLD | World Health Organisation Quality of Life Scale - Old module |

# Introduction

*'Motion Exercise'* offers a care home programme that utilises chair-based exercises that are tailored to individual needs and delivered by trained members of the team. The sessions include a warm up, a strength based exercise, a group activity (such as balloon or parachute games), a mobility focussed exercise and stretches. The sessions are delivered virtually using facebook portal devices, and use a 'buddy system' in which a staff member is allocated to a care home, ensuring consistency and familiarity across the sessions within each care home.
The link to Motion Execise's website is: https://motionexercise.co.uk

Whilst on our placement, our role was to conduct a scoping literature review that explored the priorities of the care homes and determined what assessments may be suitable as outcome measures to assess residents in different domains. This research is intended to support a future feasibility study, the results from which Motion Exercise intend to use in order to put together a request for future funding.

The population of this research project is older adults residing in care homes in the UK. Many participants will have cognitive impairments such as a diagnosis of Dementia that may impact their ability to complete outcome measures.

# Method of Literature Review

Search Strategy:
A scoping review was completed. We utilised the EBSCO host interface to search the Medline and Cumulative Index to Nursing and Allied Health Literature (CINAHL), using the search terms
'care home or residential care or nursing home or residential home or long-term care'
AND
'physical activity or exercise or fitness or physical exercise'
AND
'outcomes or benefits or effects or impact or effectiveness or consequences'
with the results restricted to those of the English language, were reviews, and had a publication date 2017-2022. This search generated 185 papers. All articles identified by the search strategy were screened for eligibility through reading of the abstracts. The potentially eligible papers were assessed more thoroughly by reading the full article. With 125 discarded, leaving 60 papers to be further explored. All the eligible papers were downloaded, if freely available, and stored in a folder, with the first author surname author and date (e.g. Kelly, 2021) as the document titles. A further 20 papers from the electronic search were excluded due to not being relevant to care home residents, or did not mention a physical activity or exercise intervention. This meant that 40 papers from the electronic search with full access and 1 out of 10 of the papers from Shona, therefore 9 papers were excluded due to time limitations. In total 41 papers were analysed in depth and included in this scoping review. Figure 1 shows the search strategy process.
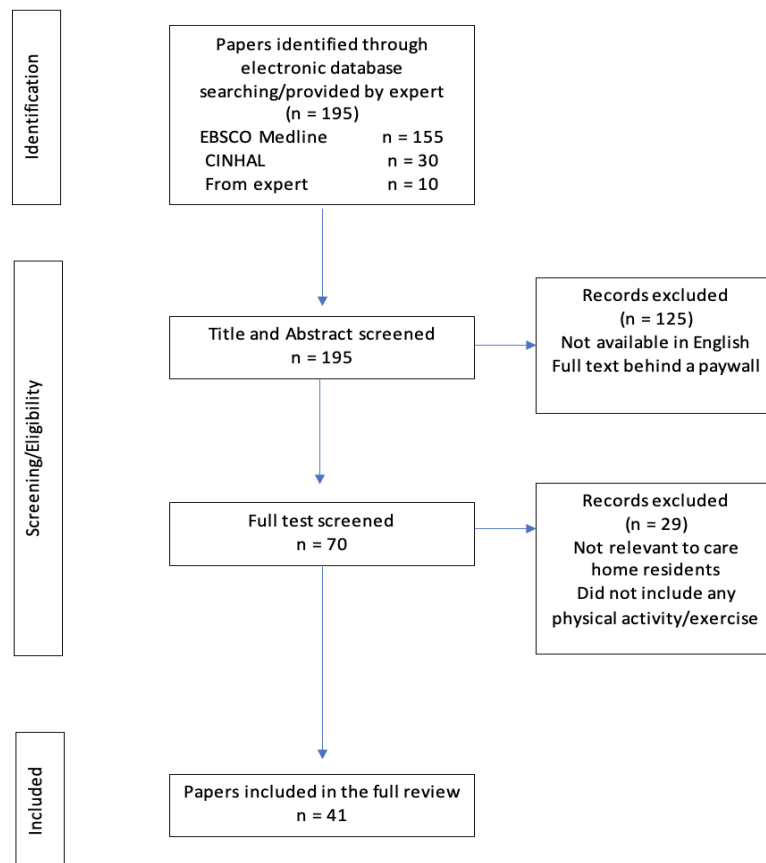
*papers were not eligible if:
- the participants were not care home residents

- the participants all had excellent cognitive functioning
- Did not have any physical activity or exercise

However, the papers on the observational method of behavioural mapping did not meet the previous criteria.

Figure 1 - flow chart to show the search strategy



Data Extraction:

From the 41 papers that were relevant enough to use, we used a qualitative approach to identify the domains covered by the factors measured in the papers. The term domain refers to a body of knowledge, skills or abilities being measured or examined. Each domain is conceptually different, measuring different aspects of life.

We used a mind-mapping tool to visualise the 8 domains focused on the individual, and six domains related to the environment. When relevant, sub-domains were identified within each domain and defined by one of the researchers. During the process, subdomains that were the same as others but described using other terms were merged together. The number of subdomains for each varied, changed and added as the research progressed (details of domains and subdomains can be viewed in figures 2 and 3).

Once the domains and respective sub-domains were established and approved by our educator and supervisor, they were numbered for ease.

The literature review identified only one environmental domain care home factors, however from discussion with experts we identified (how many) other environmental factors that may affect the participation in the exercise interventions and the feasibility of the intervention. The environmental domains are explained under the Environmental Domains heading (page 48).

Two of the researchers then entered the domains/subdomains into a spreadsheet, and the papers thoroughly read to draw out the measures used across the board for each subdomain. Further research was required to identify who first established the measurement tools, and when they did so. This information was added to the spreadsheet, as was the reference to any of the papers mentioning the respective measurement tool.
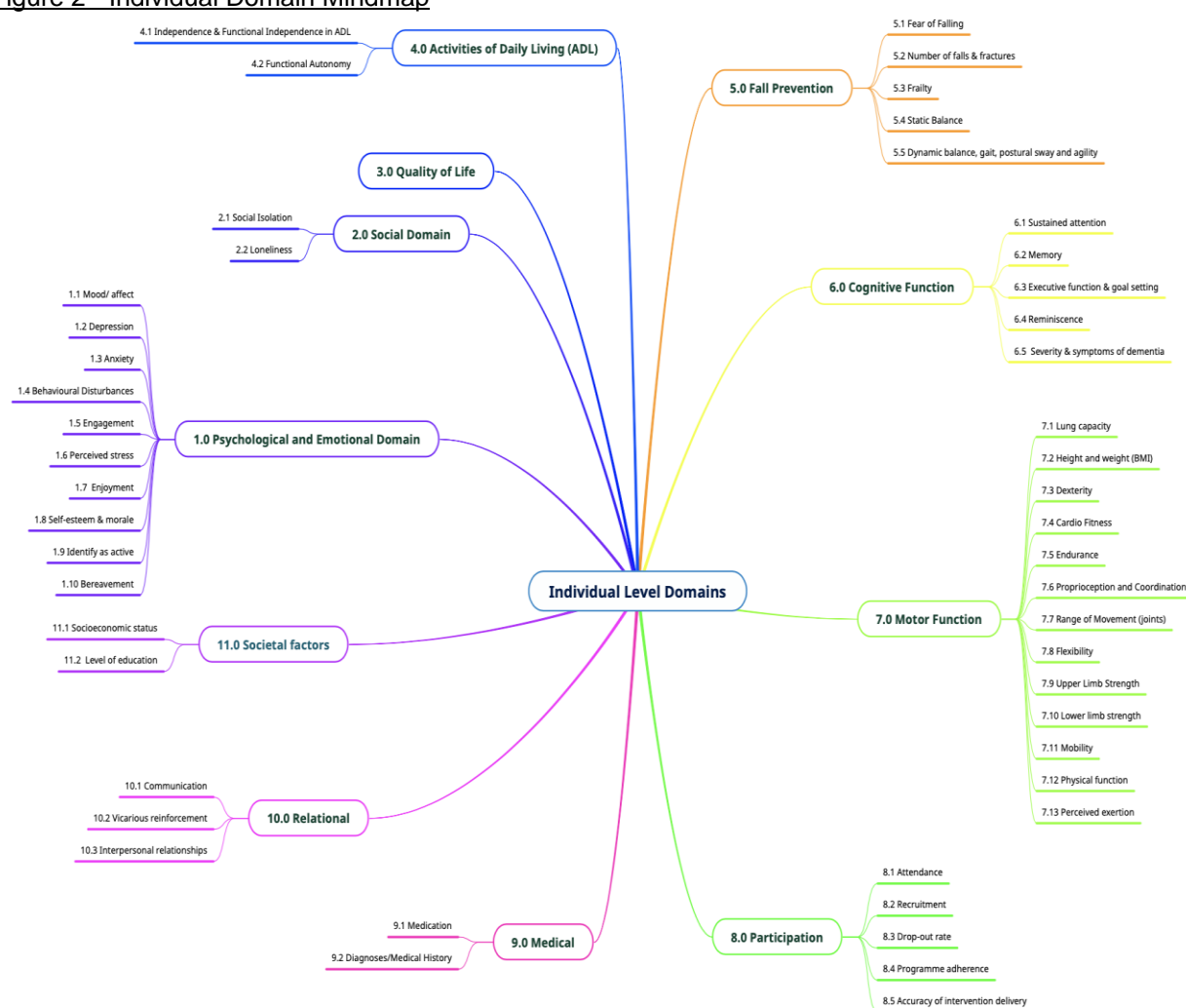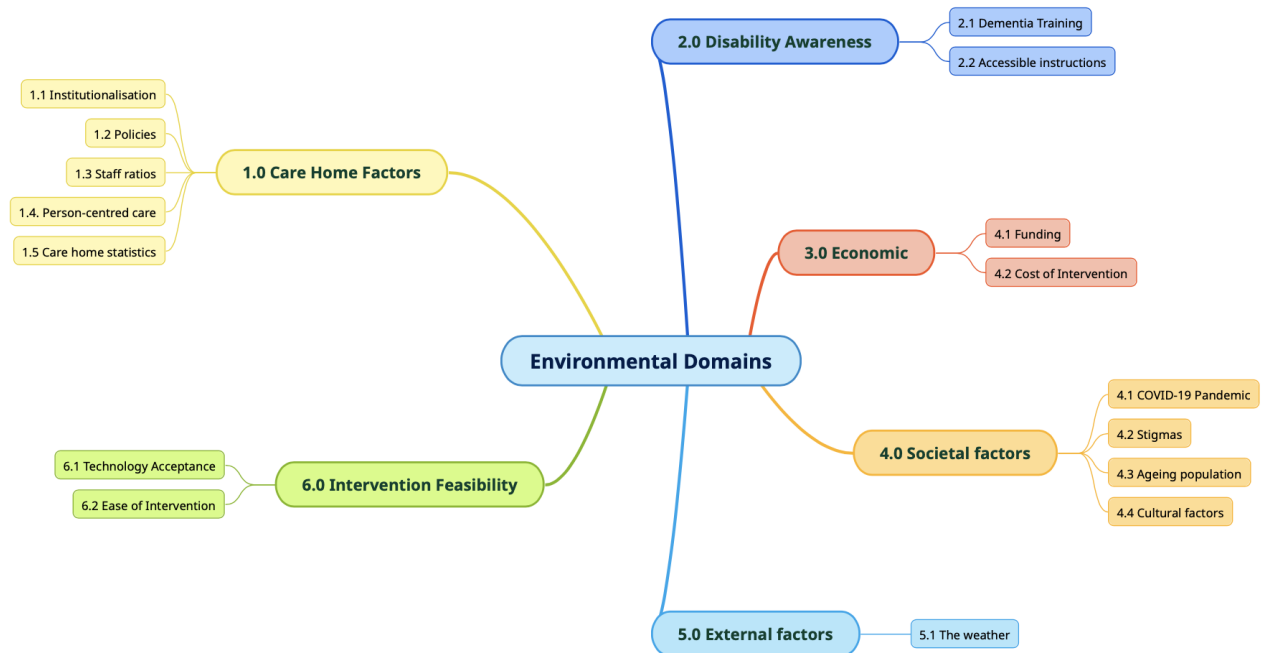
Figure 2 - Individual Domain Mindmap

Figure 3 - Environmental Domain Mindmap



Once all the available information had been collated into the spreadsheet, another spreadsheet was created, listing the domains across the top, and the measure name/acronym down the side, and we indicated which tools had been used in each domain. It was done in this format for us to be able to see more clearly which tools were being utilised and for how many domains they could be used across. The pdf files for the outcome measure assessment tools were downloaded if freely available, and stored in a folder, using the appropriate acronym as the title for the document.

Potential limitations when conducting this literature search:
Due to some of the papers analysed not referencing the measures that the papers they reviewed utilised, it meant that we had to try and trace these back through the papers referenced. Sometimes the full versions of these papers were not accessible, thus meaning that we could not be certain which outcome measures were used, and therefore couldn't document these. Some of the papers also only used the acronyms for the outcome measure tools, which proved to lead to some confusions when they also weren't clear with the referencing. For example, both the Geriartic Depression Scale (Yesavage, et al., 1983; Sheikh, & Yesavage, 1986) and the Goldberg Depression scale (Goldberg, 1993) are commonly referred to using the acronym 'GDS', and therefore when the full name or reference wasn't given, we could not assume which was actually used, and therefore had to disregard that information.
Furthermore, as the research process progressed expert advice was sought and the priority changed to focus on engagement for this population. We began to include research papers provided by an expert that concentrated on observational methods for a different population, however, due to time limitations we could not research further.

Table 1: A table to show the individual domains summaries.

| Number | Domain | Summary |
|---|---|---|
| 1.0 | Psychological and Emotional | The Psychological and Emotional domain relates to the mental and emotional state of a person. |
| 2.0 | Social | The social domain refers to social interactions and experiences of the care home residents. |
| 3.0 | Quality of Life | The quality of life (QoL) domain refers to the standard of health, comfort and happiness of the care home resident's experience. |
| 4.0 | Activities of Daily Living | Activities of daily living (ADL) refers to the tasks that individual's perform within the areas of self-care, productivity and leisure. |
| 5.0 | Fall Prevention | Fall prevention relates to any action taken to reduce the number of accidental falls in older populations and the factors that contribute to this. |
| 6.0 | Cognitive Function | The cognitive domain relates to brain based skills and mental processes that are required for knowing, learning and understanding. |
| 7.0 | Motor function | Motor functions relate to how the body functions and the decline in these functions as people age. |
| 8.0 | Participation | Participation relates to the action of taking part in something. |
| 9.0 | Medical | The medical domain relates to the individual's health status and any factors that may impact this. |
| 10.0 | Relational | The relational domain relates to individuals' relationships with other care home residents, the Motivators, care home staff and their interpersonal skills |
| 11.0 | Societal Factors | These relate to factors in society that affect someone's lifestyle. |

Table 2: A table showing the environmental domain summaries.

| Number | Domain | Summary |
|---|---|---|
| 1.0 | Care Home | The care home factors domain relates to anything to do with the care home setting and environment that may impact on the engagement and participation of the care home residents. |
| 2.0 | Disability Awareness | Disability awareness relates to the understanding the motivators have of care home residents' disability and diagnoses and how this might impact their engagement in physical activity sessions. |
| 3.0 | Economic | This relates to anything to do with funding, budget and the sector of the care home. |
| 4.0 | Societal Factors | Anything related to the structure of the population, politics, culture, ageing (both healthy and unhealthy), and wider determinants, such as the temperature |
| 5.0 | External Factors | External factors relate to factors outside the care home or Motion Exercises control that may impact on engagement. |
| 6.0 | Intervention Feasibility | Intervention feasibility relates to how feasible it is for the care home to facilitate the Motion exercise sessions for their residents. |

## Individual Domain Summaries

### 1.0 Psychological & Emotional

The Psychological and Emotional domain relates to the mental and emotional state of a person. Many older adults in care home settings experience negative impacts on their psychological and emotional wellbeing due to their sedentary lifestyle, the prevalence of chronic illness and changes in financial status, relationships with family and friends, social roles and the ability to engage in meaningful activities, therefore impacting on overall quality of life (Forster et al, 2017; Steptoe et al., 2015). This psychological and emotional domain includes the following sub-domains; (1.1) mood & affect, (1.2) depression, (1.3) anxiety, (1.4) behavioural disturbances, (1.5) engagement, (1.6) perceived stress and (1.7) Enjoyment, (1.8) self-esteem and morale (1.9) identify as active and (1.10) bereavement.

Following review of the literature and discussions with experts we chose to focus on the following subdomains 1.4 behavioural disturbances, 1.5 engagement and 1.7 enjoyment of interventions. These will be discussed in further detail below, and the other subdomains will be summarised.

<u>1.1 Mood and affect</u>
Mood and affect relates to the expression of individuals' emotions. Following an investigation into the outcome measures used in previous literature to measure mood and affect in older adults in care home settings and discussion with experts, we decided not to focus on this subdomain at the moment.

<u>1.2 Depression</u>
Depression is a common mood disorder and relates to persistent feelings of sadness and low mood. Following an investigation into the outcome measures used in previous literature to measure depression in older adults in care home settings and discussion with experts, we decided not to focus on this subdomain at the moment.

<u>1.4 Behavioural disturbances</u>
Behavioural disturbances are often associated with a diagnosis of dementia and include agitation, wandering, depression, anxiety, verbal and physical aggression and sleep disturbances (Abraha et al, 2017). Four measures of behavioural disturbances have been identified and are described below:

a. The Neuropsychiatric Inventory (NPI; Cummings et al., 1994) is a common and useful multi-domain tool used to measure behavioural disturbances and changes in older people with Dementia and other neurodegenerative disorders (Cummings, 2020) within care home settings (Abraha et al, 2017; McArthur et al, 2017). The NPI is a questionnaire given to caregivers looking at the following 12 subdomains of behavioural disturbances; delusions, hallucinations, agitation/aggression, dysphoria, anxiety, euphoria, apathy, disinhibition, irritability/lability, aberrant motor activity, night-time behavioural disturbances and appetite and eating abnormalities (American Psychological Association [APA], 2011). A screening question is administered to caregivers about each subdomain, if these indicate problems in a certain subdomain the caregiver is then asked all the questions about the particular domain, rating the frequency of the symptoms on a 4-point scale, their severity on a 3-point scale, and the distress the symptom causes them on a 5-point scale (APA, 2011). It has shown to have high inter-rater reliability, test retest reliability and validity (Cummings, 2020; APA, 2011).  The use of the screening questions helps streamline the NPI and should mean it takes no longer than 15 minutes to complete, for individuals demonstrating average level of behavioural disturbances, however it will take longer for individuals demonstrating more severe disturbances (Cummings, 2020).
The (NPI-Q) is a validated brief version of the NPI used to measure behavioural disturbances through caregiver responses. It is designed to be self-administered by care home staff and should be able to be completed in 5 minutes or less (Cummings, 1994). Similarly with the NPI, the NPI-Q asks caregivers to rate the severity of the behavioural disturbance on a 3-point Likert scale and the distress this causes them on a 5-point Likert scale.

b. The Brief Psychiatric Rating Scale (BPRS; Overall and Gorham, 1962; Overall et al., 1967) is a multi-domain scale that has been used to measure agitation in older adults with

dementia within care home settings (Abraha et al, 2017). However, the BPRS was originally developed to assess young adults with schizophrenia and it is preferable to use standardised measures that are developed for the specific population as the BPRS may not translate well to older populations as this is not what it is designed for (Burns et al, 2002).

c. The Cohen-Mansfield Agitation Inventory (CMAI; Cohen-Mansfield & Billig,1986; Cohen-Mansfield et al, 1989) is a common valid and reliable tool used to measure agitation in older adults within care home settings (Brett et al, 2017; Ballard et al, 2020).

The term agitation relates to an increase in socially inappropriate behaviours such as aggression, restlessness, emotional distress and exaggerated motor activity, impacting on social relationships and the ability to carry out Activities of Daily Living ([ADLs], Carrarini et al, 2021; Cohen-Mansfield, 1991). It is a common behavioural disturbance amongst the elderly (Carrarini et al, 2021; Kyomen & Whitfield, 2008).

The original version of the CMAI is 29-items long with a 7 point likert scale used to measure the frequency of agitation. There is a shorter version available that is 14 items long with the frequency of agitated behaviours rated on a 5 point likert scale (Werner et al., 1994). The CMAI was originally designed to be conducted as a one-to-one interview, however has previously been adapted to meet participants' needs in particular studies into a tally chart version (Brett et al, 2017). The CMAI requires completing every day for two weeks by care home staff and requires training to administer (Brett et al, 2017; Abraha et al, 2017).

However, due to the number of items within, and thus the time required to complete, this may not be the most appropriate measure to assess behavioural disturbances in an older population with potential cognitive deficits.

d. The Algase Wandering Scale (AWS) has been used to assess wandering behaviours in care home residents based on caregiver responses (Traynor et al, 2018). Wandering relates to an individual being confused about their location, or becoming lost, and is extremely common and potentially dangerous in older adults with dementia (Taylor et al., 2018).

The AWS is a 28-item questionnaire, based on five dimensions of wandering (Algase et al, 2001) looking at persistent walking, absconding behaviour and spatial disorientation (Lai & Arthur, 2003). The AWS has been proven to be a reliable and valid tool to measure wandering behaviours in care home settings (Martin et al., 2015; Algase et al., 2001).

However, due to the number of items within, and thus the time required to complete, this may not be the most appropriate measure to assess wandering in an older population with potential cognitive deficits.

## 1.5 Engagement

Engagement is different from merely participating in something and relates to the intrinsic investment and motivations individuals place on the activities they choose to engage in (Madden & Bailey, 2017).

After seeking expert advice, it was more a priority to focus on engagement in this population. The appropriate measures that could possibly do this could be behavioural mapping. The clinical setting was in a stroke rehabilitation unit, with service users at different ages and cognitive abilities, but they did observe physical activity and exercise.

Two outcome measure was identified and is described below:

a. The Pool Activity Level Checklist (PAL; Pool, 2012) is a common, reliable and valid tool used to assess level of activity and engagement with activities in older adults with cognitive impairments, such as dementia (Hurley et al, 2020; Dudzinski, 2016). The PAL is used to rate participants' ability to plan and perform in 9 common daily activities such as self-care and leisure activities. It has been used as an outcome measure in previous research to investigate if physical activity has an impact on older adults ability to plan and perform in these activities following engagement in physical activity sessions (Hurley et al, 2020).

b. Behaviour Mapping (Willems & Vineberg, 1969) is an outcome measure that has been used in observational studies to measure the time spent by service users in different clinical settings (De Weerdt et al., 2001). It establishes a link between the effect of the environment and behaviour interactions and is rooted in environmental psychology (Miller & Keith, 1973).

   It essentially involves observing: what service users are doing, the location, how many service users are there, what time of day. This observation is done at different times of the day and is recorded on a specifically designed tally sheet which lists every room and area service users have access to (De Weerdt et al., 2001).

   We were unable to find research papers to show how valid and reliable this outcome measure is for this population. However, this method has been used in several other papers which due to time constraints we were unable to look into further at this time.

Given the time constraints surrounding this literature review, and establishing engagement as a priority for the care homes at the later stages of this, we have limited information about the appropriateness for either engagement outcome measures for this specific population. However, due to it being of importance for care homes, this is something to be explored further in the future.

1.7 Enjoyment

Enjoyment is a positive emotion linked to intrinsic motivation and is an important factor for understanding participation in physical activity (Murrock et al, 2016). Participation in physical activities can in turn improve care home residents psychological outcomes (Forster et al 2017). An individual's enjoyment of physical activity relates to their perceived self-efficacy in the task and their personal preference which is dependent on the type of the activity, the intensity of the activity, the environment and whether the activity is at an individual or group level (Murrock et al, 2016). Enjoyment has been positively associated with social support, as social aspects of physical activity can enhance the experience (Mullen et al, 2011).

Enjoyment is also an important predictor and outcome of physical activity in older adults (Chu et al, 2021).

From the literature available, only one measure was identified as appropriate for this population, and is discussed below:

a. The Physical Activity Enjoyment Scale (PAcES) has been used to measure enjoyment of physical activity interventions in care home settings (Hanratty et al, 2019) and has proven to be valid and reliable in assessing enjoyment of physical activity in older adults with functional limitations (Murrock et al, 2016; Mullen et al, 2011). The PAcES is an 18-item measure assessing enjoyment of physical activity through questions to the participant to rate themselves on a 7-point Likert scale (Murrock et al, 2016). There is also an 8-item version, Physical Activity Enjoyment Scale-8 item (PACES-8), that has been used to

assess enjoyment of physical activity in older adults in care homes with varying cognitive abilities (Chu et al, 2021) and has proven to be valid and reliable (Mullen et al, 2011).

## 1.8 Self-esteem and Morale

Self esteem and morale are similar constructs and relate to an individual's confidence in their own abilities. These both seem to be measured by the same outcome measures and grouped together in previous literature investigating the benefits of physical activity in older adults in care homes (Lewis et al., 2021; Wootten et al., 2021; Hanratty et al., 2019).

Following an investigation into the outcome measures used in previous literature to measure self esteem and morale in older adults in care home settings and discussion with experts in the field, we decided not to focus on this subdomain at the moment.

## 1.9 Identify as Active

This domain relates to the potential effect the level of activity previously done by an individual may have on their participation within the intervention. Individuals who have previous enjoyable experience of physical activity/exercise may be more inclined to participate in interventions such as Motion Exercise.

Due to this domain being developed at a later stage within the research, this is an area that may need further research.

## 1.10 Bereavement

Bereavement is the experience of losing someone/something important to us, characterised by grief. This can lead to a range of secondary symptoms such as tiredness/exhaustion due to sleep problems, changes in appetite, physical health problems, and social withdrawal, all of which in turn can have an effect on an individual's motivation and ability to participate in exercise/social interventions.

Due to this domain being developed at a later stage within the research, this is an area that may need further research.

## **2.0 Social Domain**

The social domain refers to social interactions and experiences of the care home residents and includes the following subdomains; (2.1) social isolation and (2.2) perceived loneliness. Although social isolation and perceived loneliness are closely linked and can have an impact on one another, they are separate constructs. For example individuals may experience feelings of loneliness due to social isolation but the two are not mutually exclusive and living alone may not always result in loneliness or social isolation and being around people may not mean a person does not feel lonely or socially isolated (National Institute on Ageing [NIA], 2021).

Loneliness and social isolation are prevalent amongst older adults, particularly in care homes settings and can have a negative impact on quality of life and physical and mental health outcomes (Gardiner et al, 2020; NIA, 2021). Social networks can play a vital role in improving quality of life in care home residents (Custers et al., 2012).

## 2.1 Social Isolation

Social Isolation relates to a lack of social contacts an individual has to interact with on a regular basis and is often associated with feelings of loneliness (NIA, 2021). It is an objective measure of the number of contacts an individual has (Age UK, 2018).

People tend to experience greater social isolation as they age due to deteriorating health, leaving the workplace, death of family members and friends, and disability or illness (Age UK, 2018; National Health Service [NHS], 2018). Social isolation may include isolation from family, which has been defined in some studies as 'having less than weekly direct contact with family' (Victor et al., 2003; Tilvis et al., 2012), isolation from the community was defined as 'having less than weekly direct contact with friends and neighbours' (De Koning et al., 2016).

Two measures of social isolation have been identified and are described below:

a. The UCLA Loneliness Scale (UCLA-LS; Russell, 1996) is a 20-item questionnaire that has been used to assess loneliness and social isolation in care home residents (Hanratty et al, 2019) and has proven to have high internal consistency and test retest reliability (Jung et al, 2009). It contains statements that are self-rated on a 4-point Likert scale (Jung et al, 2009). Since the development of the UCLA-LS shorter versions have been developed where 20-items is too much, such as the ULS-8 (Hays & DiMatteo, 1987) which has been shown to be reliable and valid amongst elderly populations in care home settings (Hays & DiMatteo, 1987; Hosseinzadeh et al 2022). The ULS-8 is an 8-item questionnaire that individuals self-rate themselves on a 4-point Likert scale to evaluate the severity of feelings of loneliness and reflects social isolation (Ali Yildiz & Duy, 2014).

b. The Lubben Social Network Scale (LSNS; Lubben, 1988) is a self-report measure of social engagement including family and friends. From the LSNS-6 items that ask about relatives, a family subscale is constructed. Similarly, a LSNS-6 Friends subscale is constructed from the questions that ask about friends.There are different variations of this scale; including the short (LSNS-6; Lubben et al., 2006) which is a 6 item scale, and the longer, which is a 12 item scale. The LSNS-6 has demonstrated high levels of internal consistency among community- dwelling older adult populations in European countries (Lubben et al., 2006). It has been suggested that the LSNS-6, which takes about 5-10 minutes to complete,  is a viable instrument for assessing the social networks of older adults (Myagmarjav et al., 2019).

Prior to using this form, it is requested that researchers fill out a permission form.

2.2 Perceived Loneliness

Loneliness relates to the unwanted, subjective feeling of being alone, lacking companionship or being separated (NIA, 2021; Perlman & Peplau, 1981; Smith, 2017). Loneliness is highly prevalent in care home residents, and these individuals are twice as likely to report feelings of loneliness than those living independently (Victor 2012).

Older adults experiencing feelings of loneliness in care homes are at higher risk of experiencing anxiety, depression, stress, pessimism and low-self esteem as a result, negatively impacting their health outcomes (Rodrigues et al 2021) which can include cognitive decline (Wilson et al., 2007).

Two measures of perceived loneliness have been identified and are described below:

a. The UCLA Loneliness scale (Russell, 1996) is a 20-item questionnaire that has been used to assess loneliness and social isolation in care home residents (Hanratty et al, 2019) and has proven to have high internal consistency and test retest reliability (Jung et al, 2009). It contains statements about feelings of loneliness that are self-rated on a 4-point Likert

scale. The higher the score, the higher the feeling of loneliness (Jung et al, 2009). Since the development of the UCLA-LS shorter versions have been developed where 20-items is too much, such as the ULS-8 (Hays & DiMatteo, 1987) which has been shown to be reliable and valid amongst elderly populations in care home settings (Hays & DiMatteo, 1987; Hosseinzadeh et al 2022). The ULS-8 is an 8-item questionnaire that individuals sel-rate themselves on a 4-point Likert scale to evaluate the severity of feelings of loneliness and reflects social isolation (Ali Yildiz & Duy, 2014).

b. The Three Item Loneliness Scale (TILS; Hughes et al, 2004) was designed to measure the perception of social connectedness using the items of the UCLA-LS that have the highest loadings in the loneliness factor (Trucharte et al., 2021). The questions ask participants to self rate how often they feel they are lacking companionship, feel left out and feel socially isolated on a 3 point Likert scale with higher responses indicating higher levels of loneliness (Trucharte et al., 2021).

### 3.0 Quality of Life

The quality of life (QoL) domain refers to the standard of health, comfort and happiness of the care home resident's experience. The World Health Organisation (WHO, 2012) defines quality of life as "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." Many care home residents experience a decline in their quality of life due to either a diagnosis, comorbidities or as part of the ageing process.

The quality of life of care home residents raises concerns especially those with cognitive and functional impairment. It seems to be a persistent issue due to complex comorbidities and a sedentary lifestyle (Lewis et al, 2021). Other contributing factors include loneliness, the lack of control in one's autonomy and fulfilling preferred daily activities (Andrew & Meeks, 2018).

The quality of life domain previously included '*life satisfaction*' subdomain, however after discussion with an expert we decided to merge the two subdomains into a single domain of quality of life. Researchers used the terms '*life satisfaction'* and '*quality of life'* interchangeably and all the appropriate instruments for this population are measuring quality of life, so therefore it made more sense to assimilate the two terms.

Life satisfaction exists within quality of life but is not exactly the same. Life satisfaction is when the individual finds their life rich, meaningful and fulfilling (APA, 2022). Quality of life measures how health impacts an individual's functional performance and their perceived well-being in physical, mental and social aspects of their life (Stenhagen et al., 2014) which is what we are trying to measure in this population. Some outcome measures were used to measure both quality of life and life satisfaction, further implying that some researchers did not distinguish a difference between the two.

Quality of life is to what degree the individual can obtain life satisfaction in all aspects of their lives, this includes emotional, physical, material well being, social interactions, interpersonal

relations, exercising their rights, self-determining lifestyle choices and self-development (APA, 2022).

We merged sub-domains of health related quality of life (HRQoL) and general QoL together as there were similar usage of outcome measures to assess the same aspects of a care home resident's life experience during their stay.

The main aim of QoL outcome measures is to look at the subjective reporting of the physical, mental, social and functional aspects of a resident and the impact it has on their quality of life. QoL instruments have a multidimensional approach as quality of life is difficult to define due to its subjective and ever changing nature (Dempster & Donnelly, 2000).

Six outcome measures were identified and are described below. Inclusion criteria: used by at least two papers we have researched, and recent research evidence to show its reliability and validity with the elderly living in the UK. A weblink is provided for the ones that are available for free public use.

  a.  Dementia Quality of Life Scale (DEMQOL; Smith et al., 2005)
      https://www.bsms.ac.uk/research/neuroscience/cds/research/demqol.asp
      DEMQOL is a patient reported outcome measure (PROM) consisting of two questionnaires, the DEMQOL and the DEMQOL-Proxy. It was developed by a multidisciplinary team including Brighton Sussex Medical School (BSMS), King's College London (KCL), the London School of Hygiene and Tropical Medicine, the London School of Economics and Nottingham and Sheffield Universities. DEMQOL is designed to work across dementia subtypes and care arrangements and can be used at all stages of dementia. It is used to assess health related quality of life of people with dementia. It has been adapted to be used across different cultural settings and languages.
      It is a frequently used outcome measure proving reliability and validity in people with mild and moderate dementia but may also be effective with severe dementia.  (Hendricks et al, 2017).

      The two instruments are widely used in research and are currently being considered to be used routinely in the Department of Health (UK) (Department of Health, 2014).
      The DEMQOL is a 28 item questionnaire answered by the person with dementia. The DEMQOL-Proxy is a 31 item interviewer-administered questionnaire answered by a caregiver.
      Both questionnaires consist of three sections: feelings, memory, everyday life and a final question of quality of life. Each question is assessed using a four point scale:  a lot, quite a bit, a little and not at all.
      In the majority of studies, DEMQOL and DEMQOL-Proxy are used together and need to be administered by an interviewer which may be limiting on a practical level.

  b.  EuroQol Five Dimensions (EQ-5D; Rabin & de Charro, 2001) is a two part questionnaire that asks participants to rate their current health in five aspects of their lives: mobility, self-care, usual activities, pain/discomfort and anxiety/depression. There are different versions of EQ-5D the most recent is EQ-5D-5L (Devlin & Brooks, 2017) which has five levels of severity to choose from to account for more sensitivity in changes and the ceiling effect in the EQ-5D-3L version. There is also a visual analogue scale (EQ VAS)  in the second part of the questionnaire.

Mode of administration is self-directed via online or hard copy but can also be administered by an interviewer, or care-giver. The questionnaire is also available in formats that are compatible with different server platforms specifically for academic research. The different modes of administration come in different versions of the questionnaire so it's important to use the correct one.

It is cognitively undemanding and takes a few minutes to complete, which is appropriate for this population (EuroQol Research Foundation, 2021).

In order to obtain EQ-5D you need to register and pay a licensing fee according to the type of study and funding source. However, this is the most frequently used instrument in measuring quality of life in this population in the UK due to its validity, reliability (Feng et al., 2015) and economic evaluation of interventions for the elderly (Marten et al., 2021).

The EuroQol Five Dimensions Youth (EQ-5D-Y; Devlin & Brooks, 2017; https://euroqol.org/eq-5d-instruments/eq-5d-y-about/) is a child friendly version of the EQ-5D-3L and consists of two pages: the questionnaire and the visual analogue scale (EQ VAS). The 3L refers to the questionnaire having three levels: no problems, some problems and a lot of problems. The questionnaire comprises five dimensions: mobility, self-care, usual activities, pain/discomfort and feeling worried, sad or unhappy.

The EQ-VAS is a vertical visual analogue scale with the end points labelled as "The best health you can imagine" to "The worst health you can imagine".

There are different versions: paper, online, server platforms, interviewer and proxy. It is cognitively undemanding and takes a few minutes to complete, which is appropriate for this population (EuroQol Research Foundation, 2021).

c.  Short Form-12 item (SF-12; Ware et al., 1996) and Short Form-36 item (SF-36; Ware, 1979) have a paywall and require a licence to use them. The SF-36 would be the next frequently used outcome measure for this population.

d.  The Short Form-8 item Health Survey (SF-8; Ware et al., 2000) is a generic eight-item assessment, generates a health profile consisting of eight scales and two summary measures describing HRQoL. The SF-8 is an alternate form to the SF-36 Health Survey (SF-36), the most widely-used patient-based health status survey, translated into more than 40 languages and administered to millions of people worldwide. The SF-8 uses one question to measure each of the eight SF-36 domains (Turner-Bowker et al, 2003).

The mode of administration would be either, self, interviewer or online which takes two minutes to complete. It has good evidence to show it is reliable, has content validity and been used in a range of clinical practice and research (Adams et al, 2012; Wirtz et al, 2021). The advantages of using SF-8 for the elderly is that it does not take long to complete whereas any lengthy questionnaire could tire out the service user.

The 8 items consist of the following areas: general health, physical health, pain, emotional health, daily activities and social activities. Each question is assessed using a 5 or 6 point scale.

Although the other SF health surveys are trademarked under Quality Metrics, the SF-8 doesn't seem to be available on their website. However, on the International Quality of Life Assessment website they state that it is under licence and registration with Quality Metrics Incorporated.

e.  World Health Organization Quality of Life Scale (WHOQOL-100; WHO, 1998)
    https://www.who.int/tools/whoqol
    The WHOQOL-100 has a free English Australian version and is a questionnaire of 100 items, this is considered to be too long to complete for care home residents and is not appropriate for this population. However, there is a shorter version which was used to measure quality of life in the next section, please see below for the shorter abbreviated version (WHOQOL-BREF).

    There are other English versions of WHOQOL-100 available: UK English and US English but for these you need to register and sign a user agreement form to use and if you have funding from a pharmaceutical or commercial organisation you will be charged a fee to use it, otherwise it is free to use.

f.  World Health Organization Quality of Life Scale - Abbreviated version (WHOQOL-BREF; WHO, 1998; Harper et al., 1998)
    https://www.who.int/tools/whoqol
    Developed by the World Health Organisation (WHO) the WHOQOL-BREF is a short version of the WHOQOL-100 which is better suited to this population. There are free English versions in Australian English and New Zealand English from the WHO website. It contains 26 specific items that cover each of the 24 facets of the WHOQOL-100. Each item is measured using a 5 point Likert scale. The WHOQOL-BREF items are typically combined to form the four domain scores: Physical Health (7 items), Psychological (6 items), Social relationships (3 items), and Environment (8 items) (Skevington & McCrate, 2012; Goes et al., 2021).

    To use the UK English version you need to register as a user and receive permission from the International Hub for Quality of Life Research (IHQoLR). This was founded by Professor Suzanne Skevington who has worked with the World Health Organization Quality of Life Group, based at The University of Manchester, UK within the Manchester Centre for Health Psychology. Payment is required where users have received funding from commercial or pharmaceutical organisations. Please find the link below:
    http://research.bmh.manchester.ac.uk/ihqolr/questionnaires/research/Userinformation.pdf

    The tool if self-administered usually takes less than 11 minutes but if interviewed then approximately 15 minutes to complete (Hwang et al, 2003) which is appropriate for this population. It is also considered an economical measuring standard in QoL (von Steinbüchel et al, 2006), a validated and established PROM tool (Skevington & McCrate, 2012; Goes et al, 2021).

    World Health Organization Quality of Life Scale - Old module (WHOQOL-OLD; Power et al., 2005)
    The questionnaire contains 24 items and 6 domain modules: sensory abilities (4 items), autonomy (4 items), past, present and future activities (4 items), social participation (4 items), death and dying (4 items), and intimacy (4 items). It uses a 5 point Likert scale: score 1 = not at all, 2 = a little, 3 = a moderate amount, 4 = very much, 5 = an extreme amount (Fang et al., 2012).

It is designed to be an add-on module to be used in conjunction with WHOQOL-BREF or WHOQOL-100 (Peel et al., 2007), this would be too lengthy for this population and would not be suitable.

## **4.0 Activities of daily living (ADLs)**

Activities of daily living (ADL) refers to the tasks that individual's perform within the areas of self-care, productivity and leisure. This domain was split into two sub domains; 'independence in ADL/functional independence/instrumental ADLs' and 'functional autonomy'.

In an elderly population residing in care homes, it may not prove beneficial to consider the domain of ADLs - it may be that residents are receiving a lot of support from care home staff due to functional and/or cognitive abilities. However, if the exercise intervention was to be carried out in the future in a more community based setting, this is a domain that may want to be considered more.

This domain was split into two subdomains; the first subdomain (4.1) considers the ability an individual has to perform activities of daily living independently, whilst the second (4.2) considers functional autonomy,  a theory of motivation proposed by Allport (1937).

### 4.1 Independence in ADL/Functional Independence

Functional Independence is defined as an individual's ability to perform ADLs. The achievement of functional independence ensures that individuals can participate fully in ADLs that are meaningful and purposeful, thus in turn having a positive effect on health and wellbeing, such as through quality of life and self-efficacy.

Below are the details of six outcome measures that have been used to assess individuals' independence in ADLs/their functional independence.

   a. Katz Index of Independence in Activities of Daily Living (Katz ADL; Katz et al., 1963, 1970) is a tool that has been exenxiely used to assess  functional capabilities of older adults in clinical and home environments. The Index ranks adequacy of performance in the six functions of *bathing, dressing, toileting, transferring, continence, and feeding*. Clients are scored either *independent (score 1)* or *dependent (score 0)* for each of the six functions. A score of 6 indicates full function, 4 indicates moderate impairment, and 2 or less indicates severe functional impairment. Some research has suggested that whilst Katz ADL is sensitive to changes in declining health status, it is limited in its ability to measure small increments of change seen in the rehabilitation of older adults (Wallace & Shelkey, 2007). Katz (2003) suggested that this measure takes 5 minutes to complete, however, it does require training. Scores on the Katz ADL have been found to be correlated with scores on the Barthel Index (BI; McCabe, 2019).
   In relation to caring for the older adults, administering Katz ADL may require special training or clinical experience in certain cases. In particular, cognitively impaired individuals require more extensive evaluation, and therefore, functional assessment can sometimes be very challenging in geriatric population (Arik et al., 2015).
   The KATZ ADL has been found to have a significant floor effect, meaning that it is unable to detect change at low levels of disability. This occurs as the measure does not assess the more advanced activities of daily living, as well as being limited in its ability to measure

small increments of change seen in the rehabilitation of older adults (McDowell & Newell,1996).

b.  The Barthel Index (BI; Mahoney & Barthel, 1965; Collin, et al., 1988)  is an ordinal scale which is used to measure performance in ADLs. The Barthel Index measures the degree of assistance required by an individual on 10 items of mobility and self care ADLs. Higher scores suggest a greater ability to function independently following hospital discharge. Time taken and physical assistance required to perform each item are used in determining the assigned value of each item. This can be completed through patient self-report, by an individual who is familiar with the patient's abilities (such as a carer), or through observation, however in all cases, the patient's actual abilities as opposed to potential abilities, should be recorded. The time taken to complete this is likely to depend on who is completing it, however it is estimated to take approximately 5-15 minutes to complete.

c.  The Canadian Occupational Performance Measure (COMP; Law, et al., 1990) is a commonly used measure of a client's self-perception of occupational performance in the areas of self-care, productivity, and leisure. The COMP utilises a 10-point scale in order to rate the subject's level of performance and satisfaction with performance for five subject-identified problems. The average COMP performance score and satisfaction score can then be calculated.  These typically range between 1 and 10, where 1 indicates poor performance and low satisfaction, respectively, while 10 indicates very good performance and high satisfaction. It is suggested that COMP is a reliable measure, with the intraclass correlation coefficients for test-retest reliability of performance and satisfaction scales range from 0.75 to 0.89 in a mixed group of patients (Law, et al., 2014). Whilst there is no formal training needed to utilise COMP, there is a one-off fee for purchasing the manual and measure.

d.  The Elderly Mobility Scale (EMS; Smith, 1994) is a 20 point validated assessment tool for the assessment of frail elderly subjects, usually used in a hospital setting. The EMS is measured on an ordinal scale. The EMS takes approximately 15 minutes to complete, and there are only a few items of equipment needed; metre rule, stop watch, access to a bed and chair, and the patient's usual walking aid.
Research so far suggests that the EMS has only been used in acute care, with research appearing to have only validated it in an acute hospital setting. It has been suggested that this is an outcome measure that is difficult to use in community environments. Research has also suggested that there is a ceiling effect for more able patients, and that it is not sensitive enough for patients with issues of poor confidence. However, Splig et al. (2001) suggested that the EMS is significantly more likely to detect improvement in mobility than the BI.

e.  The Short Physical Performance Battery (SPPB) developed by the NIA and is available for use without permission or royalty fees. It utilises a group of measures that combines the results of the gait speed, chair stand and balance tests (Guralnik et al., 2000). Research has shown that the SPPB has predictive validity showing a gradient of risk for mortality, nursing home admission, and disability.

f.  The Nursing Home Physical Performance Test (NHPPT; Binder et al., 2001) designed to measure physical function in very frail older adults in the presence or absence of cognitive

impairment, in nursing home settings. There doesn't appear to be much research yet to demonstrate the validity or reliability of NHPPT as an outcome measure.

4.2 Functional Autonomy

Functional autonomy refers to *"any acquired system of motivation in which the tensions involved are not of the same kind as the antecedent tensions from which the acquired system developed"* (Allport 1961, p. 229).

One outcome measure that could be utilised to assess functional autonomy is described below:
a.  The Functional Autonomy Measurement System (SMAF; Herbert et al, 1988) is a 29-item instrument, utilising an autonomy rating scale. SMAF was originally developed to measure the functional ability and needs of the elderly and handicapped. SMAF measures functional ability in 5 areas: ADL [7 Items], mobility [6 Items], communication [3 items], mental functions [5 items] and instrumental activities of daily living (IADL) [8 items] (Hébert, et al, 2001). These items are standardised using a four-level measurement scale; level 0: autonomous, level 1: needs supervision or stimulation, level 2: needs help, and level 3: dependent. Subscores for each of the 5 areas can be calculated from the individual item scores, as well as an overall score. Internal consistency reliability has been tested (Lannin, et al., 2015). It has been stated that the scale can be used in epidemiological studies of older adults being cared for at home or in institutions (Rai et al., 1996).
Due to the number of items within, and thus the time required to complete, this may not be the most appropriate measure to assess behavioural disturbances in an older population with potential cognitive deficits.

**5.0 Fall prevention**

Fall prevention relates to any action taken to reduce the number of accidental falls in older populations and the factors that contribute to this.
Falls can add burden to health and social systems, whilst also having the potential to have a personal cost to the individual and their family (Logan et al., 2021).
Public England found that falls in care home residents are three times more common in care home residents than those of a similar age who live in the community.
Fall prevention was separated into 5 separate subdomains; (5.1) fear of falling, (5.2) number of falls/fractures, (5.3) faility, (5.4) static balance and (5.5) dynamic balance/gait/postural sway/agility.

5.1 Fear of Falling

Older adults who have had a history of falls often experience a loss of confidence as a result and can result in a decrease in self esteem and fear of falling again (National Institute for Health and Care Excellence [NICE], 2013; Logan et al., 2021). It has been investigated in the previous literature whether physical activity interventions have had an impact on older adults in care homes fear of falls (Valenzuela et al., 2018; Wootten et al., 2021). Following an investigation into the outcome measures used to assess fear of falling in previous literature and discussions with experts we have decided not to focus on this subdomain at the moment.

## 5.2 Number of Falls and Fall Related Fractures
This subdomain relates to the prevalence of falls in older adults in care home settings and whether these falls result in fractures or not. It has been investigated in previous literature whether physical activity interventions had an impact on the number of falls and fractures in older adults in care homes (Cameron et al., 2018; Brett et al., 2017; Nyman, 2021; Wang, 2021; McArthur et al., 2017). Following an investigation into the outcome measures used to assess the number of falls and fractures in previous literature and discussions with experts we have decided not to focus on this subdomain at present.

## 5.3 Frailty
Frailty relates to age-associated vulnerability that increases older adults' risk of adverse health-related events such as falls, disability, hospitalisation, institutionalisation and death. Frailty has been used in previous research as a predictor of falls (Arrieta et al., 2019) and investigated whether physical activity can improve frailty in older adults in care home settings (Arrietta et al., 2019; Cordes et al., 2019; Daryanti Saragih et al., 2021). Following an investigation into the outcome measures used to assess frailty in previous literature and discussions with experts we have decided not to focus on this subdomain at present.

## 5.4 Static Balance
Static balance relates to the ability to maintain an upright posture within the limits of the base of support and plays a role in falls in older adults. Having good static balance may help prevent falls in older adults (Galhardas et al., 2022) and it has been investigated in previous literature whether physical activity interventions had an impact on static balance in older adults in care homes (Galhardas et al., 2022; Valenzuela et al., 2018; Marmeleira et al., 2017). Following an investigation into the outcome measures used to assess static balance in previous literature and discussions with experts we have decided not to focus on this subdomain at present.

## 5.5 Dynamic Balance, Gait, Postural Sway and Agility
Similarly to static balance (5.4) dynamic balance, gait, postural sway and agility are all factors that can influence the likelihood of falls in older adults (NICE, 2013). Dynamic balance refers to the ability to maintain an upright posture when moving. Gait refers to the individual's pattern of steps when walking. Postural sway refers to the small movements that happen around the body's centre of gravity in order to maintain balance. Agility refers to an individual's ability to make small changes to the body's position in order to maintain balance.

These have all been measured in previous literature to investigate the impact physical activity has on these and therefore falls (Barrett et al., 2018; Galhardas et al., 2022; Brett et al., 2017; Valenzuela et al., 2018; Pereira et al., 2018; Furtado et al., 2015; Giné-Garriga et al., 2020). Following an investigation into the outcome measures used to assess dynamic balance, gait, postural sway and agility in previous literature and discussions with experts we have decided not to focus on this subdomain at present.

After considering all of the domains and subdomains, it was decided that at this point, fall prevention may not be the most important domain to focus on.
If patients fall and have to be admitted to hospital, then this puts a burden, including financial, on both the NHS and the care home. Therefore, for potential funding, it may be beneficial to collect data on the number of falls, to demonstrate whether the intervention has a positive effect on reducing the number of falls, however due to the residents likely receiving a lot of help with transfers, which in turn may affect the falls rate. Similarly to ADLs, this may be a domain that

requires more consideration if the intervention was to be carried out in a more community based setting.


## 6.0 Cognitive function

The cognitive domain relates to brain based skills and mental processes that are required for knowing, learning and understanding. Cognitive impairment relates to when an individual has difficulty learning new things, remembering, concentrating and making decisions, negatively impacting their ability to carry out everyday tasks (Centres for Disease Control and Prevention, 2011). Cognitive impairment is common in elderly people and can be due to medications, depression, delirium due to illness and dementia (NIA, 2021). Cognitive function can play an important role in quality of life and independence of an individual (Klojčnik et al., 2017).

We explored the cognitive domain identifying the following subdomains from the previous literature; (6.1) Sustained attention, (6.2) memory, (6.3) executive function and goal setting, (6.4) Reminiscence and (6.5) Severity and symptoms of Dementia. We investigated the outcome measures used in previous literature to measure cognitive functioning in older adults in care home settings.

### 6.1 Sustained Attention
Sustained attention is the ability to focus on an activity or stimulus for a longer period of time, even if there are other stimuli acting as a distraction. This ability has been found to decrease throughout the lifespan (Staub et al., 2013), and in individuals with conditions such as dementia (Huntley et al., 2016). There is some research to suggest that declining sustained attention has a strong association with both prefrailty and frailty (O'Halloran et al., 2014), as well as falls rate (Nagamatsu et l., 2013).

### 6.2 Memory
Episodic memory, which refers to the memory an individual has of personal experiences, and working memory, which refers to the short-term active storage mechanism that is used to achieve a variety of cognitive activities including decision making, has been found to decline as individuals age (Nyberg, et al., 2012). There is some research to suggest that gender may also have an effect on the rate of decline of cognitive function, and in particular, working memory (Pliatsikas et al., 2018).

### 6.3 Executive Function and Goal Setting
Executive function refers to a set of neurocognitive skills, including working memory (refer back to 6.2), inhibitory control, and set shifting/flexibility,  which are involved in processes such as goal-directed problem solving (Carlson et al., 2013).
Klojčnik et al (2017) consider the impairment of executive functioning to be one of the classic signs of cognitive impairment in late-life depression.

### 6.4 Reminiscence
Reminiscence is a term that refers to  the recollection and sharing of life experiences, memories and stories from the past. Individuals with cognitive impairment such as dementia may have the ability to still recall events that happened in their earlier stages of life (however may get the time frame for these confused), however struggle to recall events that occurred during that same day

(Woods et al., 2018). This therefore may affect their ability to participate in activities such as Motion Exercise in the most effective way if they cannot remember what has been done in the previous session, or to apply the skills developed into other aspects of life.

6.5 Severity and Symptoms of Dementia

Symptoms of dementia vary amongst individuals depending on the type and stage of their dementia, impacting individuals in different ways (WHO, 2021). Severity and symptoms of dementia will have an impact on the other cognitive subdomains discussed above (6.1, 6.2, 6.3, 6.4). Please refer to these for further information.

Whilst there are assessments that could be used as outcome measures to assess the effect of physical activity on cognitive function in this population, due to the priorities established by the experts, within this review we have not focused on cognitive function outcomes. Future research might consider the effectiveness of the Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005) and the mini-mental state exam (MMSE; Haubois et al., 1975).

If this domain was to be looked at in the future, following investigation of other outcome measures previously used within this domain, at this time we do not recommend them due to many of them having a floor effect and having insufficient sensitivity to demonstrate change. A floor effect occurs when a large proportion of participants score at the lower end of the scale or perform poorly, skewing the data and not demonstrating a change in function after an intervention. In this case, the outcome measures available may be limited in the ability to demonstrate a change in cognition following the physical activity intervention due to the care home residents potentially already having low cognitive function. However, as we haven't looked at the statistics for the number of care home residents with cognitive impairments, we cannot comment on this much at this stage.

**7.0 Motor Function**

Primarily, the motor function domain, and its subdomains, concentrate on measuring how the body functions. According to gerontological research, otherwise known as research that revolves around the ageing process, there is a decline in motor function as people grow older. For instance, people tend to become more frail. Frailty often acts as a precursor to physiological and psychological problems, as people are afraid to walk in case they fracture a bone, so they, in turn, become increasingly sedentary. However, naturally, people are only likely to fall if they themselves are mobile or if they are being moved and handled. Improvements in motor functions will improve quality of life, amongst other domains and subdomains. The motor subdomains include generic physical function, lung capacity, height and weight, cardio fitness, endurance, proprioception and coordination, mobility, perceived exertion, flexibility, and the subdomains which are more likely to be researched: dexterity, upper limb (and grip) strength, lower limb strength and range of movement. (All the subdomains will appear below as they appeared on the mind map in the introduction of this document). We chose to focus on these subdomains because we received advice from experts in the field, and they argue that the intervention is likely to be a catalyst for significant change in these subdomains. This is due to the fact that they are the motor skills which are used most frequently during the intervention, as many of the participants will be sat in chairs. Furthermore, according to the International Classification of Functioning, Disability and Health (ICF; World Health Organisation, 2001), researching motor function, as opposed to diagnosis, '*places all health conditions on an equal footing*', allowing them to be compared using

the same outcome measures. The ICF also clarifies that we cannot infer participation in activities of daily living, including exercise, from an individual's diagnosis alone.

### 7.1 Lung Capacity

The first motor subdomain is lung capacity (Total Lung Capacity; TLC), which has been defined as the volume of air in the lungs when the effort of inspiration, or the process of bringing air from outside the body into the lungs, is at its maximum. Among healthy adults, the average lung capacity is about 6 litres. The range of lung capacity can be affected by variables such as age, gender, ethnicity, body composition, atmosphere, medical history, and how active an individual has been and currently is. There are several natural body changes that happen as you get older that may cause a decline in lung capacity. For instance, muscles like the diaphragm can get weaker and lung tissue that helps keep your airways open can lose elasticity, which means your airways can get a little smaller. The total lung capacity decreases by 40% between the ages of 25 and 80, and this is if an individual is ageing healthily. If an individual is not ageing healthily, total lung capacity could decrease to an even greater extent. The outcome measures for lung capacity include the TruZone Peak Flow Meter, the 6 Minute Walking Test, the 2 Minute Step Test, the Walking Endurance Test, the 10 Minute Walk (Wheelchair) Distance Test, and the Cooper Test. Lung capacity was not a subdomain we chose to focus on when typing up this brief, as we sought advice from the care home managers, who said that this was not a research priority for them.

### 7.2 Height and Weight (BMI)

The second motor subdomain comprises both height, or the measurement of someone from the top of their head, to the bottom of their feet, and weight, or an individual's 'heaviness'. Both height and weight are calculated as part of the historical Body Mass Index (BMI; Eknoyan, 2008). The BMI is one of the earliest outcome measures for this subdomain and it produces a value that is derived from the mass and height of a person, as aforementioned. Furthermore, the BMI is frequently defined as the body mass divided by the square of the body height, and is expressed in units of kg/m², resulting from mass in kilograms and height in metres. Despite the BMI having its merits, such as identifying and prioritising nutritional needs amongst an elderly population, as it is based upon a sample of athletes. This means that it may underestimate body fat in older persons and people who do not have a lot of muscle tissue. This is a problem because what is normal for an older person is likely to be atypical for an athlete, so the results will be skewed. It is also much more time and cost-effective than other methods for calculating height and weight such as bone density, or Dual-Energy X-ray Absorptiometry scans. Other outcome measures for height and weight, excluding the BMI, encompass the Omron KARADA Scan Body Composition Scale (HBF-214-PK, Japan), the Bioimpedance Analysis, the Bioimpedance Meter Model HBF-510W, the Whole-Body Potassium Test, and the Mid-Thigh Scan. The subdomain of height and weight was not chosen as our educator did not believe it would be relevant to the study that is to be conducted. This could be due to the fact that residents in a care home are unlikely to be able to make such a significant improvement, due to their age and their ailments, that quality of life and encouraging them to eat food they enjoy is more important than regulating their diet, and therefore their growth.

### 7.3 Dexterity

The third motor subdomain is dexterity, which can be defined as a fine motor skill that specifically involves the use of one or both hands. An example of dexterity, in the context of this exercise intervention, would be when the intervention leader asked the participants to touch their thumb

with their fingertips. This is essential because it would enable the participants to maintain their activities of daily living, such as eating, drinking and dressing, and this, in turn, would increase their independence which would improve their wellbeing.

Three outcome measures have been identified, from our literature search, and they are discussed below:

a. The Groningen Fitness Test for the Elderly (GFE; Lemmink, Kemper, de Greef & Stevens, 2001) is a generalist inventory of outcome measures. The outcome measures in the GFE inventory are as follows: leg extension test, sit and reach flexibility, circumduction, balance board test, block transfer, reaction time test, walking endurance test, and grip strength test. The grip strength test has been recognised as an outcome measure for dexterity. The test procedure involves the subject hanging their hand by their side, holding the dynamometer, and the best result from several trials for each hand is recorded, with at least 15 seconds recovery between each effort. If a researcher was to specifically use the grip strength test, they would collect the scores fortnightly, to detect any changes longitudinally, and the average sample size should be 450 participants, more or less. This sample size is necessary in order to produce accurate statistical analysis. The GFE is also a field-based motor assessment which can be conducted with minimal space, equipment, and technical requirements, making it easy to administer in most clinical and community settings, including gymnasiums and retirement communities, or in the home environment. The GFE has been modified for the elderly, as it was originally designed for optimally functioning adults (age 55 and above) and has, therefore, been assessed with a control population. Furthermore, another facilitating factor is the fact that the GFE grip strength test takes under approximately five minutes to complete, which contrasts with psychological assessments, which can take up to an hour. Whilst the test is preferably administered by human movement scientists and physiotherapists, there is no requirement that the researcher is from this professional background. Barriers, such as sensitivity, are not an issue with the GFE as the fact that the scores can now be entered into computer software means that floor and ceiling effects are minimised because the software can properly adjust to the level of cognitive ability.

b. The Box and Block Test (BBT; Desrosiers, Hebert, Dutil & Mercier, 1994) is a quick, simple and inexpensive test, scored by counting the number of 150 2.5cm coloured wooden blocks transferred or carried over the partition from one compartment of a wooden box to the other during the one-minute (60 seconds) trial period. It can be used with a wide range of populations, including clients with stroke and fibromyalgia. However, crucially, the BBT cannot be used for residents with a severe cognitive impairment, only those with mild to moderate cognitive impairment. For this reason, the test is not recommended as an outcome measure for those with dementia. Yet, if the participants do not have a diagnosis of dementia, the test is typically administered, in research, by occupational therapists to a sample of 30, in order to produce the most reliable scores.

c. The Purdue Pegboard Test (PPT; Tiffin & Asher, 1948) is typically administered by occupational therapists and physiotherapists in clinical settings, and it can be used to study the level of impairment in the upper extremities that results from neurological and musculoskeletal conditions, such as hemiplegia, or paralysis in one half of the body, and Parkinson's disease. The equipment for this assessment of dexterity includes an instruction manual, score sheets, a stopwatch, a table that is roughly 30 inches tall, a test

board and 50 pins, 20 collars, and 40 washers. The PPT is conducted and scored within five to ten minutes and takes place when small metal pegs are placed in a cup on the side of the participant's body that is being tested. The participants are then asked to remove the pegs and place them vertically in the holes as rapidly as possible. The number of pegs placed in 30 seconds is scored. Critically, when the PPT was first created, it was applied to a control population of industrial workers, but it has since been used for more minute and nuanced changes in motor functioning.

These outcome measures are suitable for studying this population because they are highly valid and reliable when used in geriatric medicine but there are extraneous variables, like dementia and other illnesses, that must be considered beforehand as they could confound the results.

### 7.4 Cardio Fitness

Cardiorespiratory fitness (CRF) refers to the ability of the circulatory and respiratory systems to supply oxygen to skeletal muscles during sustained physical activity. The primary measure of CRF is $VO_2$ max, which is the maximum rate of oxygen consumption measured during incremental exercise; that is, exercise of increasing intensity (Wikipedia, 2014). We are not exploring this sub-domain further as it is not appropriate for this population.

### 7.5 Endurance

Endurance, synonymously stamina, is the ability to go through a potentially unpleasant or difficult process or situation without giving way. Tests of endurance include: Digital Handgrip Dynamometer Model TKK-5401 GRIP-D, Arm (and Bicep) Curl Test, Chair Stand Test, 6 Minute Walking Test, Senior Fitness Test Battery, Berg Balance Scale and 2 Minute Step in Place Test.

### 7.6 Proprioception and Coordination

In the context of this particular project, proprioception and coordination are two interrelated constructs. Proprioception can be defined as the perception or awareness of the position and movement of the body, whilst coordination refers to the ability to use different parts of the body together smoothly and efficiently. They are similar in the sense that they are both involved in movement. Tests for proprioception and coordination include: Arm Ruler Positioning Test, Lower Limb Matching Tasks, Knee Joint Position Sense Test, Weight Detection Test, Trail Making Test (TMT-A), Goniometry, Functional Reach Test, Repetition Maximum, Progressive Balance Tests, Manual Muscle Testing, Back Scratch Test, Short Physical Performance Battery, Elderly Mobility Scale, 2 Minute Step Test, Arm Curl Test, Senior Fitness Test, Physical Performance Test, Four Square Step Test, Lateral Reach Test and Quantitative Gait Analysis.

### 7.7 Range of Movement

The fourth motor subdomain is range of movement, which can be defined as the extent to which an individual can move a part of their body. An example of range of movement, in the context of this exercise intervention, would be when the intervention leader asked the group to participate in a balloon tennis activity. Range of motion, or flexibility, as it is otherwise known, is important to test because it plays a vital role in determining the cause and severity of issues an individual may be having with joint movement. Improper flexibility can cause pain, limitations in activities of daily living, especially those related to self-care and leisure, and it can even cause compensation patterns that may lead to more dysfunction, as people try to find ways to cope with their dysfunction, rather than seek help to improve their symptoms.

Four outcome measures have been identified and discussed below:

a. A goniometer (Chapleau, Canet, Petit, Laflamme & Rouleau, 2011) is a clinical instrument, utilised by various healthcare professionals, to assess a patient's flexibility. This specialised assessment is performed by measuring the available range of motion at a joint. The action of measuring the joint ranges in each plane of the joint is called goniometry, and goniometry can be employed by the researchers for this project if they wish to study dexterity and upper limb strength. In addition, goniometers have been evaluated in the context of range of movement in the hands, and an advantage of goniometers is that they have been tested with a control population of physiotherapy students but two limitation are that the length of the assessment is dependent upon the mathematical skills of the clinician, and the measurement is subjective. Although, inter-rater reliability has been discovered to be quite high through evidence, and digital goniometers are becoming increasingly available. Approximately 30 participants would be necessary for this outcome measure to be studied effectively, based upon the literature that has been reviewed. Lastly, a goniometer is a sensitive outcome measure as it can detect the most minute change in millimetres (mm).

b. The Timed Get Up and Go Test (TUG; Podsiadlo & Richardson, 1991) is an observational outcome measure primarily used as a fall prevention method by occupational therapy and physiotherapy clinicians, when they are required to ensure safe discharge from hospital, but, as no specialist training is need, any researcher could employ this test, if they read the instructions. The TUG test also demonstrates a patient's range of movement in the lower half of their body. The TUG test is executed when patients are asked to stand up from a standard armchair and identify a line 3 metres, or 10 feet away, on the floor, which they will then walk. The TUG test is useful for an elderly population as participants could wear their regular footwear and could use a walking aid, if they so wished. The TUG test requires basic equipment, namely a stopwatch, that is activated as soon as the task begins and deactivated as soon as the task ends. The TUG test is scored by recording the time it takes for an individual to complete the task. On average, an older adult who takes ≥ (greater than or equal to)12 seconds to complete the TUG is at risk for falling, as they lack the range of movement in their spine, hips and legs, and the upper and lower limb strength that would make standing up from a chair easier.

c. The Senior Fitness Test (SFT; Rikli & Jones, 1999) is a 6 item battery of functional tests used to measure strength, endurance, balance, agility and flexibility in older adults and can be applied to care home settings (Galhardas et al., 2022; Arrieta et al., 2018; Marmeleira et al., 2018). Each test is scored separately on different scales and can be used individually to measure a specific domain rather than having to carry out the complete battery. The SFT is a valid, reliable, simple and easy tool to use with older populations in care home settings. There is no need for additional equipment to complete the tests and they come with thorough instruction manuals and videos that demonstrate how to administer these tests (Langhammer & Stanghelle, 2015). It can take 30 to 40 minutes to complete the whole test however individual tests within the battery can be used separately and are much quicker to administer. The SFT is recommended for use in older adults with and without cognitive impairments (Langhammer & Stanghelle, 2015). The following components of the SFT have been used to measure range of movement in older adults in care home settings (Cichocki, 2015):

- The Chair Sit and Reach Test (CSAR) requires participants to place one hand on top of the other and reach forward toward their toes by bending at the hip ensuring their back is straight and head is up. A  measurement of the distance is taken in cm.
- The Back Scratch Test requires participants to place one hand behind their head and back over the shoulder, and reach as far as possible down the middle of their back. The other arm should be placed behind their back and reach up as far as possible attempting to touch or overlap the middle fingers of both hands. The distance between both hands is measured in cm. If the participants fingers do not touch they receive a negative score and if they overlap this measurement is measured in cm as a positive score.

The reasons why these outcome measures are suitable for studying this population, other than the reasons that have previously been mentioned in this section, are because they are frequently used. This means that they can explore problems before they arise and cause even greater impairment. As this research is taking place in multiple care homes, it is not necessary for the elderly participants to be able to care for themselves independently in every aspect of their lives, but it is crucial that pain is eliminated as much as possible, so that they have greater life satisfaction. Finally, as for the context of this research project, it will be taking place after the start of the Coronavirus pandemic, which will have affected the amount of exercise the care home residents would have been able to do, as they were rarely able to leave the care home and had to rely on opportunities for increasing fitness that were held indoors, such as the service our client, Motion, provides.

<u>7.8 Flexibility</u>
The ability of a muscle or extremity to relax and yield to stretch and stress forces; the range of motion (ROM) of a joint, affected by muscles, tendons, ligaments, bones, and surrounding structures (McGraw-Hill Concise Dictionary of Modern Medicine, 2002). We are not exploring this further as it is not appropriate for this population.

<u>7.9 Upper Limb Strength</u>
Upper limb strength can be defined as strength in the arms, wrists and hands. An example of upper limb strength, in the context of this exercise intervention, would be the parachute game.

Five outcome measures have been identified and are described below:
a. Hand Grip Strength (HGS) is tested and measured using hand dynamometers.
   The most frequently used hand dynamometer for the elderly is the Jamar Hydraulic Hand Dynamometer (Guerra & Amaral, 2009; Mehmet et al., 2020). It is used to measure grip strength which is a strong indicator for disability, increased risk of complications and mortality, health indicator, nutritional assessment and undernutrition screening tool. The hand dynamometer is relatively inexpensive, portable, non-invasive, quick and easy to use, not needing a specialised technician and a high test and retest reliability.
b. Short Physical Performance Battery (SPPB; Daryanti Saragih et al., 2021) After seeking expert advice from the care home this outcome measure is deemed inappropriate. There is evidence to show it is mainly used for lower limb strength (Puthoff, 2008; Fisher et al., 2009). For further information please refer to sub-domain 4.1.e.

c. Arm Curl Test, or Biceps Curl Test is part of the Senior Fitness Test. For further information please refer to sub-domain 7.7c. (Rikli & Jones, 1999). After seeking expert advice from the care home this outcome measure is deemed inappropriate for this population.

d. For the Seated Medicine Ball Throw test (SMBT; Marques et al., 2019), the participant sits on the chair with their back straight and holds a 2kg ball in front of the chest with both hands and then throws the ball as far and as fast as they possibly can. Participants are given three attempts to do this. Different weights can be used (Chad et al, 2011). The distance is then measured, the best result in three attempts is recorded. This outcome measure will not be explored further after receiving expert advice from the care home.

e. 30 Second Sit to Stand Test (30-SST; Rikli & Jones, 1999) is part of the Senior Fitness Test for further information please refer to the sub-domain 7.10.c. This outcome measure will not be explored further after receiving expert advice from the care home.

The reason why outcome measures b - e are suitable for studying this population is because they have high feasibility in care homes and the majority are easily accessible, as they do not require payment and the instructions can be downloaded from the Internet. Expert advice was sought via the care home to find out which were more appropriate to focus on. We concluded that the hand grip strength for this population is more appropriate due to their ability to complete this test quickly and easily.

7.10 Lower Limb Strength

Lower limb strength can be defined as muscle strength in the legs, ankles and feet. An example of lower limb strength, in the context of this exercise intervention, would be when the participants used their resistance bands to complete leg stretches. Lower limb strength is important in older adults to maintain independence and strength to help prevent falls (NICE, 2013).

Twelve outcome measures have been identified and are described below:
a. Test of toe grip strength (Tsuyuguchi et al., 2019) is tested using a toe grip dynamometer (T.K.K. 3361; Takei Scientific Instruments, Niigata, Japan) and reflects lower limb strength and has been used in older adults in care home settings (Galhardas et al., 2022). Participants are required to sit on the edge of a chair maintaining an upright posture with both hands holding onto the chair and place their foot on the dynamometer and grip the bar of the instrument. This requires purchase of a toe grip strength dynamometer to carry out this assessment.

b. The Nursing Home Physical Performance Test (NHPPT; Binder et al., 2001). The NHPPT has been used to assess lower limb strength in elderly populations in care home settings (Galhardas et al., 2022; Brett et al., 2017). Please refer back to 4.1f for further details.

c. Senior Fitness Test (SFT; Rikli & Jones, 1999). Please refer back to 7.7c for further details. The following components of the SFT have been used to measure lower limb strength in older adults in care home settings (Galhardas et al., 2022; Arrieta et al., 2018; Marmeleira et al., 2018):
   ● The Chair Stand Test requires participants to repeatedly stand up and sit down on a chair for 30 seconds. The number of times the participant stands is recorded and reflects lower limb strength.

- The 6 minute walk test requires participants to walk for 6 minutes in a straight line and distance is measured in metres to reflect endurance. If walking for 6 minutes is not feasible, participants can complete a 2-minute Step test instead, where they are required to climb steps for 2 minutes and the number of steps climbed is recorded to reflect endurance and lower limb strength (McArthur et al., 2017). The distance of the walk test can also be adapted to suit participants' needs.

d. Paratonia Assessment Instrument (PAI; Hobbelen et al., 2008). Paratonia is one of the associated movement disorders characteristic of dementia where individuals are unable to relax their muscles impacting their mobility and resulting in contractures (Hobbelen et al., 2008). The PAI is a reliable and valid tool for assessing paratonia in elderly people with dementia that can be applied easily in daily practice. It has been used in previous literature to assess lower limb strength (Galhardas et al, 2022).

e. Timed Static Peddling (TSP; Brett et al., 2017) is a measure of lower limb strength for older adults who are unable to stand or walk. It is completed when participants are seated, in a standard chair or wheelchair, in front of a set of static pedals placed against a wall. The distance between the chair or wheelchair and pedals was customised for each participant to ensure a full revolution could be independently completed. Participants are required to place their feet onto the pedals (with assistance if required) and pedal for 30 seconds. A score of the total number of full revolutions is generated by a counter on the pedal. This was developed as an extra outcome by Brett et al, (2017) and we were unable to find any evidence into the investigation of the validity and reliability of this tool. Equipment would also be required to administer this test.

f. Repetition Maximum Tests (1-RM, 8-RM & 10-RM; Kraemer et al in Maud et al., 2006; American College of Sports Medicine [ACSM], 2006; Jakobsen et al., 2012), require participants to lift a maximal weight once, 8 times or 10 times while maintaining the correct lifting technique (Grgic et al., 2020). It is a valid and reliable measure used in older adults in care home settings (Grgic et al., 2020; Taylor & Fletcher, 2012; Galhardas et al., 2022). It doesn't require expensive equipment and therefore is highly cost effective (Grgic et al., 2020). Resistance is progressively increased until the subject cannot complete the selected repetitions. All repetitions should be performed at the same speed of movement and range of motion to instil consistency. The initial weight selected should be within the participants capacity.

g. Groningen Fitness Test for the Elderly (GFE; Lemmink et al., 2001). Please refer to 7.3a for information about the GFE. The 'Leg Extension Test' of the GFE can be used as an outcome measure for lower limb strength in elder populations in care homes (Galhardas et al., 2022). The leg extension test requires the participant to sit on a table between two arm supports with their legs hanging off the table, bent at the knee. A shin guard with a resistance band attached to it is placed on the participants lower leg and they are asked to extend their leg with maximum strength and hold the position for 3 seconds. A score is given in Kilograms of force. This test was specifically designed for elderly populations, however the equipment related to this test would need to be purchased in order to carry out this outcome measure (Lemmink et al., 2001).

h.  Timed Up and Go (TUG; Podsiadlo & Richardson, 1991). Please refer to 7.7b for further details about this test. The TUG has been used to assess lower limb strength in older populations in care home settings (Brett et al., 2017).

i.  The Countermovement jump test (CMJ, Young, 1995) is a simple, practical, valid, and very reliable measure of lower-body power. It requires participants to jump on a platform and the height of the jump or weight of the power output is measured. Although the CMJ has been used in older adults in care home settings as a measure of lower limb strength (Galhardas et al., 2022), it is primarily a test used in athletes, therefore may not be appropriate for this population. It requires certain equipment to ensure consistency throughout the test such as a reliable and consistent testing facility (such as a gym or laboratory), and a force platform or high-speed video camera and software.

j.  Stair-climbing power test (SCP, Dobson et al., 2012) has been used in previous literature to measure lower limb strength in older adults in care home settings (Wootten et al., 2021; Galhardas et al., 2022). Participants are required to ascend and descend a flight of stairs and the time in seconds is recorded. The number of stairs will depend on individual environmental situations. Where possible, the 9-step stair test with 20cm step height and handrail is recommended. The test will only be an appropriate test of lower limb strength in mobile care home residents. This is an easy and simple test to carry out as it does not require any equipment (Dobson et al., 2012).

k.  Single left stance (SLS) test (Bohannon et al., 1984) has been used in older adults to assess lower limb strength in care home settings (McArthur et al., 2017). Participants are required to stand with their eyes open and hands on their hips, then lift one leg unassisted and the time they can hold this is recorded from the time the foot leaves the ground till when the foot touches the ground again or the arms leave the hips. This is an inexpensive and simple test to administer as it does not require any specialist equipment or training, however it is only suitable for participants who are able to stand and are not a high falls risk.

The reason why these outcome measures are suitable for studying this population is because they will produce quantitative data which is often more useful than qualitative data if one wishes to procure funding from the Government or an NHS Clinical Commissioning Group which is, ultimately, an intended outcome of this study.

7.11 Mobility

Mobility is the ability to move or be moved freely and easily, and this definition is important because, in a care home, if someone is not able to move themselves, they will be assisted by care home staff who have been appropriately trained in moving and handling. Outcome measures for mobility are as follows: Timed Up and Go Test (TUG), Gait Speed (Fast 4-Metre, Maximal Gait Speed, 10-Metre Walk Test), Chair Sit and Reach, Back Scratch Test, Lower Back Scratch and Neck Reach Test, Tinetti Test (POMA-B), Five-Times-Sit-To-Stand Chair Test, 30-Second Chair Test, Locometrix System, 6-Minute Walking Distance (6MWD) Test, 400-M Walk Test, Stabilometric Force Platform (Kistler 9286 AA), and the 12 Walking/ Wheelchair Propulsion Test. After seeking expert advice, we decided to discontinue this subdomain of the motor domain, as the majority of residents are immobile.

7.12 Physical Function

Physical function is the body's overall ability to function healthily (physiology) and to perform motor tasks, and more general activities of daily living. The outcome measures we identified in the meta-analyses were as follows: Accelerometers & Pedometers (ActiGraph wGT3X-BT, Large-Scale Activity Monitors, both ankles 72 Hrs), LASA Physical Activity Questionnaire (LAPAQ), The Rapid Assessment of Physical Activity (RAPA) Questionnaire, Short Physical Performance Battery (SPPB), The Nursing Home Physical Performance Test (NHPPT), Tinetti Performance Oriented Mobility Assessment, Six Minute Walking Speed, One Leg Balance Test, Timed Up and Go Test (TUG), The Extended Timed Get-up- and-Go (ETGUG) Test, Four Square Step Test (FSST), Repeated Chair Stand Test (30-S Chair Stand or 5-Time Sit-To-Stand), Gait Speed (4 to 800 metres, 6MWT, Fast), Berg Balance Scale, Chair Sit and Reach test, Walking/Wheelchair Propulsion, 2 Minute Step Test, Clinical Outcome Variables Scale, Study Osteoporotic Fractures Index (frailty), Frailty and Injuries Cooperative Studies of Intervention Techniques, and the Fried Frailty Phenotype (n = 2). After seeking the advice of experts, including our educator and the care home managers, we decided not to recommend this to our client as a subdomain for their study because it may be too generic, as it was originally created to house outcome measures that did not measure anything specific.

7.13 Perceived Exertion
Perceived exertion is how hard you think your body is working, not how hard it is actually working. This is a purely subjective measure of exertion, straddling multiple subdomains, as it is dependent upon an individual's perceptual capabilities. The main test for perceived exertion that we identified during our literature search was the Rate of Perceived Exertion Timed Walk (RPE Timed Walk) through a 6 Minute Walking Test. However, we will advise our client that they are unlikely to need to test for perceived exertion because, whilst it is arguably a relevant subdomain for an elderly population in general, it is not relevant for the target population of this particular study, as they are unlikely to do enough exercise to exertion; as exertion is effort, it is not similar to fatigue.

**8.0 Participation**

Participation relates to the action of taking part in something. In this case it relates to the care home residents taking part in the physical activities sessions. The participation domain includes the following subdomains which are discussed below; (8.1) Attendance, (8.2) Recruitment, (8.3) Drop-out rate, (8.4) Programme adherence and (8.5) Fidelity.

8.1 Attendance
Attendance relates to the number of care home residents taking part in the physical activity each week. This is already being recorded by Motion Exercise (ME). In the future it may be worth looking at the impact of group size on levels of motivation and adherence.

8.2 Recruitment
The process by which residents are screened and selected against certain criteria to take part in the exercise activity.

8.3 Drop-out rate

Drop out rate relates to the number of care home residents that do not continue to participate in the physical activity sessions. This may be due to a number of factors such as a lack of interest or motivation, ill health, hospital admissions, injury due to fall or death.

8.4 Programme adherence
Programme adherence relates to the care home residents following along with the physical activity session. Their adherence may differ week to week and they may adhere to parts of the physical activity not the whole programme.

8.5 Fidelity
Fidelity relates to the accuracy of the intervention that is being delivered and the consistency of the delivery of the intervention across 'motivators' in different care homes.

## 9.0 Medical

The medical domain relates to the individual's health status and includes subdomains that may impact this. The subdomains are; (9.1) medication and (9.2) diagnosis and medical history. There are no standardised measures for these subdomains, however they may both have an impact on the residents ability to engage in physical activity and may be worth recording if the care homes can provide this information.

9.1 Medication
Many of the care home residents are likely to be taking at least one type of medication due to the prevalence of comorbidities in older adults (NIA, 2017). Many medications have side effects and these may impact engagement and participation in physical activity interventions (NIA, 2019).

9.2 Diagnosis and Medical history
Care home residents will have varying diagnoses and medical history that may impact on their functional ability to engage in physical activity interventions. For example some residents may have reduced cognitive function impacting ability to follow instructions, they may have visual or auditory impairments, they may have reduced motor function and mobility and they may experience fatigue.

## 10.0 Relational Domain

The relational domain relates to individuals' relationships with other care home residents, the Motivators , care home staff and their interpersonal skills. This may have an impact on their likelihood to engage in the physical activity sessions. This domain includes the following subdomains; (10.1) communication, (10.2) vicarious reinforcement and (10.3) Interpersonal relationships. There are no standardised measures for these subdomains, however they may have an impact on residents' engagement of physical activity and be worth being aware of.

10.1 Communication

It is important to know how the care home residents communicate as some may not communicate verbally, which may impact how they interact with one another, staff and motivators (Sanderson & Bailey, 2013).

They may also have difficulty understanding verbal communication which may impact their ability to understand and follow the instructions given by the motivators during the physical activity sessions, resulting in decreased participation.

## 10.2 Vicarious reinforcement

Vicarious reinforcement relates to the fact that an individual is more likely to engage in a behaviour or activity if they observe a peer doing this first (Relojo-Howell, 2014). In this case, as Motion Exercise sessions are carried out in a group setting, some of the residents may end up participating in the session after observing their peers doing this first.

## 10.3 Interpersonal relationships

This relates to the relationships care home residents have with one another, staff and motivators. If the care home residents have a good relationship with the motivators and the staff supporting them during the activity, they may be more likely to engage in the session and find enjoyment in the activity (Weiste, 2018; Molyneux, 2022).

The relationship they have with one another may also increase the likelihood of vicarious reinforcement occurring (10.2).

## **11.0 Societal Factors**

These relate to factors in society that affect someone's lifestyle and include the following subdomains; (11.1) socioeconomic status and (11.2) Level of education. This domain was not included in our original individual domains and literature review as it is likely to require investigation into a different body of evidence. However, it may be worth investigating in the future.

## 11.1 Socioeconomic status

Socioeconomic status refers to objective and subjective factors such as income, class and individual perceptions of their status in society, and has an impact on psychological well being (Navarro-Carrillo et al, 2020).

## 11.2 Level of education

Level of education relates to the education attainment of the care home residents.

## Environmental Domains

Following a review of the literature and discussions with Motion Exercise, we highlighted and explored some environmental domains that may impact the care home residents engagement and outcomes following the physical activity intervention. These domains have not been measured in the previous literature of physical interventions in care home residents that we explored.

Unfortunately, we have not had the capacity to look further into some of these environmental domains due to limited time and the fact that these are likely to require investigation into a different body of literature. We have been able to begin investigating the (1.0) Care home factors domain which is discussed below. The environmental domains we have not been able to look further into are detailed in Table 3.

## 1.0 Care Home Factors

The care home factors domain relates to anything to do with the care home setting and environment as we recognise that these may impact on the engagement and participation of the care home residents. The care home factors domain includes the following subdomains; (1.1) Institutionalisation, (1.2) Policies, (1.3) Staff ratios, (1.4) Person-centred care , (1.5) care home statistics.

### 1.1 Institutionalisation
Institutionalisation relates to the fact that care homes can have strict routines, resulting in reduced autonomy of the care home residents. In addition it relates to deconditioning of care home residents as many live sedentary lifestyles.
Schedules of care homes will impact what time of the day the physical activity session takes place. There may be similar activities taking place in the take home or there may be other activities provided by the care home which may impact participation/attendance of the physical activity session.

### 1.2 Policies
The care home may not be willing or able to provide certain information about care home residents such as their diagnosis, medication or medical history due to confidentiality. It is important to bear this in mind when deciding what data to collect.

### 1.3 Staff ratios
Many care homes in the UK are experiencing staffing shortages due to burn out, being overworked and low pay (Unison, 2021). Therefore, there may not be enough staff to support this intervention. Particularly if residents require physical assistance to engage in the sessions, it would require more staff who are manual handling trained and the care home may not always be able to facilitate this level of support.

### 1.4 Person-centred care

Person-centred care relates to keeping the individual at the centre of their care, allowing them choice and control over their health recognising that a 'one size fits all' approach is not appropriate for healthcare as everyone is different (The Health Foundation, 2016).

One measure has been identified and is described below:
   a. Person-centred Care Assessment Tool (P-CAT; Edvardsson et al, 2010) is an assessment tool used to measure care home staff's experience of person-centred care provided in the care home (Forster et al, 2017). The P-CAT is a 13-item self reporting questionnaire for healthcare professionals working with older adults in long-term care settings. Professionals are asked to rate their setting's level of person-centred care covering individualised care, organisational support and environmental accessibility. It has proven to be a valid and reliable tool to measure person-centred care in older adults in residential settings (The Health Foundation, 2014; Forster et al, 2017).

1.5 Care home statistics
The care home will record mortality rates and hospital admissions of the care home residents which could be useful for this research project as they may affect attendance of physical activity sessions and drop out rates.

Table 3. A table to show the Environmental domains that may require further investigation.
NB. For the overall environmental domain summaries refer back to Table 2.

| Domain | Subdomains & summaries |
|---|---|
| 2.0 Disability Awareness | 2.1 Dementia training<br>Dementia affects 55 million people worldwide, with age being the main risk factor, therefore it is likely some residents in the care homes will have a diagnosis of dementia (WHO, 2021). Dementia impacts cognition, emotions, mood, behaviour and motivations (WHO, 2021; Abraha et al, 2017). It may be beneficial to have an awareness of how dementia impacts engagement and ways to increase this during the physical activity sessions. |
| | 2.2 Accessible instructions<br>The delivery of the physical activity instructions may need to be adapted to meet the individual needs of the care home residents, for example for residents who have visual or auditory impairments. |
| 3.0 Economic Factors | 3.1 Funding<br>This relates to how the care home is funded (NHS, private,charity) and how this will impact on ability to pay for the physical activity sessions provided by Motion Exercise. |
| | 3.2 Cost of intervention<br>This relates to the total cost the care home is required to pay for Motion Exercise sessions. |

| | |
|---|---|
| 4.0 Societal factors | **4.1 Pandemic**<br>This relates to the impact of the COVID-19 pandemic on the participation of the residents. In the future, it may be worth investigating research that supports the effectiveness of remote interventions as opposed to face-to-face and the impact this has on motivation, enjoyment and participation and the benefits or difficulties for the care homes with this being virtual.<br><br>**4.2 Stigmas**<br>This relates to any stigmas residents, staff or the care home may have about who engages in physical activity, and factors that impact this such as gender.<br><br>**4.3 Ageing population**<br>Due to the growth of the ageing population there is likely to be an increased demand on care homes to take on more residents, impacting on staffing levels and financial situations.<br>**4.4 Cultural factors**<br>Some cultures may<br>Equally this can relate to the culture of the care home. Some care homes may have a culture that endorses physical activities more than other care homes and therefore this is likely to impact engagement. |
| **5.0 External factors** | **5.1 The weather**<br>The weather may impact on residents' engagement, for example following discussions with Motion Exercise they highlighted that when it is hot weather, the residents find it more challenging to engage in the sessions. |
| **6.0 Intervention Feasibility** | **6.1 Technology acceptance**<br>This relates to how confident the care homes are in using technology to access the sessions, whether they have access to the appropriate technology and how the residents respond to this. For example, whether they are aware that they can engage with the motivator on the TV screen.<br><br>**6.2 Ease of Intervention**<br>This relates to how easy it is for the care home to support the intervention alongside their day to day responsibilities. |

## Conclusions and Future research

Throughout this scoping review, our thoughts about what would be the main reasons for interventions such as Motion Exercise being implemented within care homes has changed. At the start of this process, we had preconceptions that a main priority for this type of intervention would be to improve balance and motor function, in turn helping to reduce the number of falls, and thus saving both the care homes and the NHS money being spent to admit people to hospital with fractures.

Following discussions with care home managers, it was suggested that care homes prioritise activities which residents will enjoy and engage with, that is suitable for all residents, and that is a continuing activity as opposed to a brief offer. The recommended primary domains/subdomains and outcome measures also fit to suit the priorities of Motion Exercise.

Therefore the following areas have been identified as the primary outcomes:
- Engagement
  Behaviour Mapping (Willems & Vineberg, 1969) may be an appropriate outcome measure to observe engagement in the care home residents. Please refer to 1.5b for further information. However, given the time constraints surrounding this literature review, and establishing engagement as a priority for the care homes at the later stages of this, we have limited information about the appropriateness for either engagement outcome measures for this specific population. However, as this is of importance to care homes, this is something to be explored further in the future. Therefore, it may be beneficial to explore measures for this domain further prior to, or during, the feasibility study.
- Enjoyment
  The PACES-8 may be an appropriate measure to assess enjoyment of the intervention in the care home residents. Please refer to 1.7a for further information.
- Quality of Life
  The EQ-5D-3L-Y would be an appropriate measure to assess the Quality of Life of the care home residents. Please refer to 3.0b for further information.

The following secondary outcomes have been identified:
- Hand Grip Strength (HGS) is tested and measured using hand dynamometers. Please refer to 7.9a for further information.
- Groningen Fitness Test for the Elderly (GFE), the Senior Fitness Test (SFT), or the Short Physical Performance Battery (SPPB) for motor functions including upper limb, strength and dexterity. Please refer to 7.10.g, 7.9.b, and 7.7.c respectively, for further information.

Please see Appendix 1 to see the details in regards to the time to complete, who completes, and whether equipment is required for each recommended outcome measure.

The outcome measures suggested are appropriate to use with an elderly population residing in care homes that may have cognitive impairments such as those linked to dementia.

It is important to the care homes that the types of exercises being completed are appropriate to each resident completing them.

Whilst virtual exercise sessions have advantages opposed to in-person sessions, such as being more cost effective, more research into level engagement may be beneficial. The number of participants, the number of care home staff available to encourage participation, communication

barriers, and the room layout are all examples of factors that may influence the levels of engagement, which may need to be considered within this.

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# Index

Shona said she would complete the index.

## Appendix 1. - Tables to summarise the recommended outcome measures

Primary outcome measures

| Outcome measure | Subdomain | Completed by | Estimated time to complete | Equipment required |
|---|---|---|---|---|
| Behavioural Mapping | Engagement | Care home staff or researchers | Depends on the study, could be done in a period of a day. | No |
| PACES-8 | Enjoyment | Residents | Timing will likely differ depending on residents responsiveness. 8 item scale with 7-point likert scales. | No |
| EQ-5D-3L-Y | Quality of life | Resident, proxy version- carer, interviewer. | Few minutes. | No |

Secondary outcome measures

| Outcome measure | Subdomain | Complete by | Estimated time to complete | Equipment required |
|---|---|---|---|---|
| Dynamometer | Handgrip strength | Resident | Dependant on residents abilities. | Yes |
| Groningen Fitness Test for the Elderly (GFE) | Dexterity (hand grip test) | Scientists, physiotherapists | 5 minutes | Yes |
| Senior Fitness Test (SFT) | Range of movement | Residents with assistance/guidance from researchers | 30 - 40 minutes | No |
| Short Physical Performance Battery (SPPB) | Gait speed & balance | Residents with assistance/guidance from researchers | Dependant on residents abilities. 5 sit to stands are timed in seconds. Balance test requires standing for 10 seconds x | No |

|  |  |  | 3. |  |
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