The Development and Feasibility of an Ethnically Tailored Intervention to Prevent Physical Risk Factors for Falls in Older Adults: a Mixed Methods Exploratory Design

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Abstract

Falls are a common problem for Older Adults (OAs) throughout the world, often with very serious consequences. While risk factors such as increasing age, female gender, and low socioeconomic status are well documented in the literature, less is known about the effects of ethnicity on fall prevalence. Substantial health inequalities are known to exist between different ethnic groups, particularly among OAs, but how cultural attitudes and preferences may influence interventions designed to reduce falls is currently not well understood. This thesis follows the first two steps of the Medical Research Council (MRC) guidance for the development of complex health interventions, and using the Behaviour Change Wheel, designs an appropriate intervention to reduce fall risk in OA from a particular ethnic group.

The first objective systematically reviewed the existing literature on reported fall prevalence in different ethnic groups. Twenty-three articles were included in the systematic review, and 16 in the meta-analysis of the 16 retrospective studies that reported falls in the previous 12 months. Differences were found in fall prevalence between ethnic groups, with the Asian group showing the lowest rates at 13.9% (10.9, 16.9). The Hispanic and Black groups were similar with levels of 18.5% (13.0, 24.1), and 18.6% (13.3, 23.9) respectively. The highest rates were seen in the White group at 23.8% (18.7, 28.9). In studies that provided adjusted estimates of effect sizes for the odds/risk of falls, differences still existed between some ethnic groups, even after adjusting for other risk factors. However, heterogeneity was high, and although differences in reported falls rates were found, the reasons for these differences require further research and are likely to be complex and multi-dimensional.

The second objective analysed data from Electronic Health Records (EHR) and the Census to decide which ethnic group to choose for this study. When compared to the White group, the highest fall prevalence was seen in Bangladeshi and Caribbean OAs at 1.26 (1.05, 1.51) and 1.21 (1.04, 1.41) respectively. Census data showed that the population of over 65s in the East London boroughs of Newham, Hackney, Barking & Dagenham, and Tower Hamlets, was greater for Caribbeans than Bangladeshis, and thus Caribbean OAs were selected as the target for this thesis.

The third objective was to perform a qualitative analysis of Caribbean attitudes to ageing, falling, and fall prevention interventions. While PA has been shown to be the most effective intervention for reducing fall risk, the specific attitudes of the Caribbean community to physical activity was not well understood. Therefore, 19 semi-structured interviews were carried out with participants from the Caribbean OA community, as well as with their family members, community leaders, and medical professionals, in order to identify some of the facilitators and barriers this community have towards a fall intervention programme. Seven main themes were identified from analysis of the interviews: attitudes to ageing, the impact of Caribbean life and culture on OAs attitudes, facilitators of PA, barriers of PA, understanding of PA and health, group leader, and preferred activities.

The fourth objective was to use the results from objective three in a behavioural analysis, employing the Behaviour Change Wheel (BCW). Physical activity (PA) is a complex issue, and thus all the components of the COM-B model were found to influence behaviour. The BCW then led to the identification of 39 Behaviour Change Techniques (BCTs), of which 28 were selected as being likely to be effective after application of the APEASE criteria. These BCTs were used as the foundation of the intervention design.

The final objective was to design a protocol for an RCT used to evaluate the feasibility of the multicomponent intervention. The 12-week intervention protocol includes educational and workshop sessions, weekly supervised sessions with an instructor followed by social sessions, and PA "homework" to be carried out throughout the week. Outcomes of this study will include feasibility of recruitment, percentage of participants completing the programme, its acceptability by participants, and its successful delivery. Overall, its success will determine the feasibility of moving forward to a large-scale trial of the intervention, and the sample size necessary for this trial.

Overall, this thesis identifies differences in the fall prevalence of different ethnic groups, and presents a protocol for feasibility testing of a fall prevention intervention designed for a specific ethnic group of Caribbean OAs. The intervention is based on their particular cultural attitudes and preferences regarding ageing, falling, and PA, and by using the BCW, it is

hypothesised that acceptability will be enhanced, therefore increasing adherence and eventual success in reducing falls.

Declaration

I declare that this work has been composed solely by myself, and that it has not been submitted, in whole or in part, in any previous application for a degree. Except where explicitly stated otherwise by reference or acknowledgment, the work presented is entirely my own.

Natasha Wehner-Hewson

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Wehner-Hewson, N., Watts, P., Buscombe, R., Bourne, N. and Hewson, D. (2022) 'Racial and Ethnic Differences in Falls Among Older Adults: a Systematic Review and Meta-analysis', *J Racial Ethn Health Disparities,* 9(6), pp. 2427-2440.

Abbreviations

2MWT	The 2-minute walking test
6MWT	The 6-minute walking test
ABC	The Activities-specific Balance Confidence scale
ADLs	Activities of Daily Living
ANCOVA	Analysis of Covariance
APEASE	Acceptability Practicability, Effectiveness/cost-effectiveness, Affordability, Safety/side-effects, and Equity criteria
BAME	Black, Asian, and Minority Ethnic
BBS	The Berg Balance Scale
BCTs	Behaviour Change Techniques
BCW	The Behaviour Change Wheel
BMI	Body Mass Index
CAQDAS	Computer-Assisted Qualitative Data Analysis Software
CDC	Centers for Disease Control and Prevention
CINAHL	Cumulative Index to Nursing and Allied Health Literature
CL	Community Leader
EHR	Electronic health records
ELSA	The English Longitudinal Study of Ageing
EMR	Electronic Medical Records
FA	Framework analysis
FES	Falls Efficacy Scale
FES-I	Falls Efficacy Scale- International
FM	Family Members
FoF	Fear of Falling
HBM	The Health Belief Model
HEI	The Healthy Immigrant Effect
HP	Health Professionals
HRA	Health Research Authority
IDAOPI	Income Deprivation Affecting Older People Index
IMD	Index of Multiple Deprivation
LiFE	Lifestyle integrated Functional Exercise programme
MCID	Minimally Important Clinical Difference
MDC	Minimal detectable change
MM	Mixed methods
MRC	Medical research council
NHS	National Health Service
NICE	National Institute for Health Care Excellence
NIH	National Institutes of Health
NIHR	National Institute for Health and Care Research
OAs	Older adults

PA	Physical activity
PBC	Perceived behavioural control
PICO	Population, Intervention, Comparison, Outcome methodology
PRISMA	Preferred Reporting Items for Systematic reviews and Meta-Analyses
ProFaNE	Prevention of Falls Network Europe
PURE study	The Prospective Urban Rural Epidemiology Study
QOL	Quality of Life
RL	Religious Leader
RaR	Rate Ratio
RR	Risk Ratio
SAYGO	Steady As You Go
SCT	Social Cognitive Theory
SEM	The Social Ecological Model
SFT	The Senior Fitness Test
SPPB	The Short Physical Performance Battery
TA	Thematic analysis
TDF	Theoretical Domains Framework
TPB	The Theory of Planned Behaviour
TTM	The Transtheoretical Model
TUG	The Timed Up & Go
UEL	University of East London
UN	United Nations
WHO	World Health Organisation

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Lastly, but certainly not least, David. I'd like to make this fancy, but it's simple really. Without you I simply would not have been able to do this. Ever. I dedicate my thesis to you with all my love.

1. Introduction

1.1. Rationale

1.1.1 Ageing and age-related conditions

The emergence of an ageing population is now apparent worldwide. The United Nations have declared that the percentage of the world population over the age of 65 rose from 5.9% in 1980 to 9.4% in 2020. Furthermore, it is predicted to increase further to 18.7% by 2060 (United Nations, 2024). This growth in the ageing population is mirrored in the UK. In the 2011 census, 16.4% of the population were aged 65 years or older, which grew to 18.6% in the 2021 census. This percentage is predicted to grow still further to 27% of the population by 2072 (Barton, Sturge and Harker, 2024).

This ageing of the population is largely caused by longer life expectancy and decreased fertility. Longer life expectancy began with improvements in healthcare from birth, with factors such as improved sanitation, nutrition, and vaccination increasing survival from what used to be a precarious time of life (Chan and Hubbard, 2014), which increases the chances of living into old age. In addition, later life issues such as cardiovascular diseases or cancer, can now be treated with improved medical interventions that have higher success rates, allowing further increases in the chances of living even longer (Vaupel, Villavicencio and Bergeron-Boucher, 2021).

Age brings with it increased chances of developing chronic diseases. Common health conditions found in OAs are sensory issues (including hearing loss, and visual conditions such as refractive errors and cataracts), osteoarthritis and joint pain, chronic obstructive pulmonary disease, diabetes, depression, and dementia. Age-related diseases rarely occur independently, and age brings increased chances of multimorbidity where several conditions occur simultaneously (World Health Organization, 2015). When certain groups of health conditions occur together, they may form what are known as “geriatric syndromes” (World Health Organization, 2015). Multimorbidity affects more than half the OA population, increases with age, decreases quality of life, increases the disability and care costs, and these effects are often greater than the summed effects of each separate condition (World Health Organization, 2015; Marengoni *et al.*, 2011).

The aforementioned increasing longevity is not all good news however and creates challenges. If the population of OAs increases as predicted, then when children are included, there is a potential for half the population to potentially not be working. This lower ratio of working adults places a strain on the economy, healthcare, and social services, as well as creating high pension expenditure (Scott, 2021). Within the European Union, this dependency ratio is predicted to rise from 33.4% in 2023, to 59.7% by 2100 (Eurostat, 2024), which is likely to create considerable social problems.

Another important concern is also that although people may be living longer, they are not necessarily living well. The time spent in good health over a lifetime may have increased, but so has the time spent living in poor health (Choi *et al.*, 2024; Scott, 2021). It is not age specifically that is a measure of the degree of healthcare needed or the costs incurred, rather the proximity to end-of-life that determines these needs (Diernberger *et al.*, 2021).

1.1.2 Falls

With respect to the myriad of health conditions faced by OAs, falls are a common, and potentially serious issue that may result in serious injury or even death (Bergen, Stevens and Burns, 2016). These outcomes are not only distressing and painful for the faller, but have considerable costs to the NHS and care services (Masud and Morris, 2001), amounting to approximately £4.4 billion every year (Gov.UK Office for Health Improvement and Disparities, 2022). Due to the potentially disabling consequences, falls have good predictive value for institutionalisation (Scuffham, Chaplin and Legood, 2003), and death, as one in three OAs die within a year of suffering a hip fracture (Guzon-Illescas *et al.*, 2019).

Falls are seldom the result of a single element, but instead occur due to the interaction of multiple, interacting risk factors (Gillespie *et al.*, 2012). The greater the number of risk factors, the greater the risk of falling (Tinetti, Speechley and Ginter, 1988). In order to describe the risk factors for falls, Lord et al. (2001) have classified them into seven categories: balance and mobility, or the ability to maintain body position in space; environmental or extrinsic risk factors; psychological factors that affect performance and learning; medical factors or comorbidities; medications with potentially adverse effects or polypharmacy; sensory and

neuromuscular issues with physiological systems that affect motor function; and sociodemographic (Jehu *et al.*, 2021).

Falls are often preventable, and in order to reduce fall risk, risk factors must be identified, and removed or modified through fall prevention interventions where possible. A Cochrane review looking at the effect of interventions on falls (Hopewell *et al.*, 2018) showed that interventions may reduce the rate of falls. The number of potential fall prevention interventions reflects the wide variety of risk factors. Interventions may tackle individual risk factors, or multiple risk factors. Interventions that target multiple risk factors can be further divided into multiple component interventions where the same intervention components are delivered to all, or multifactorial interventions where the intervention components are targeted to each recipient depending on their individual needs. However, the latter option, although being the recommended approach in the UK, is both time consuming and expensive (National Institute for Health Care Excellence, 2013; Hopewell *et al.*, 2018).

The most commonly used intervention is exercise or PA, which helps to maintain strength, balance, flexibility, and reflexes, all of which are essential for maintaining posture and reducing falls (Gillespie *et al.*, 2012; Myers, Young and Langlois, 1996). The most successful PA for fall prevention uses multiple categories targeting balance, strength, and general PA (Gillespie *et al.*, 2012). Interventions may also be delivered to groups outside the home, or for individuals to perform privately within their own homes. One reason why PA interventions are so common is that many OAs do not achieve recommended levels of PA (Arnautovska *et al.*, 2019; Maula *et al.*, 2019; Sport England, 2023). The reasons for this lack of PA are likely to be as varied as the OAs themselves. Acceptability is an essential factor in any PA-based fall prevention intervention, as if a programme is deemed unacceptable by an individual, no matter the specific reason, it will not be adhered to, and therefore the programme is unable to be effective in reducing falls (Mahmood *et al.*, 2023).

1.1.3 Ethnicity

The UK is a multicultural population, with 18.3% of the population identifying as a minority ethnic group within the UK, according to the 2021 UK Census (Office of National Statistics, 2022). Within the UK population however, these minority ethnic groups have been shown to

have poorer health outcomes compared to the White British population (Nazroo, 2015). Rates of heart disease, hypertension, stroke, and type II diabetes in particular are higher than in White groups (Office of National Statistics, 2021; Williams *et al.*, 2010; Bidulescu *et al.*, 2015). Health inequalities such as these are unjust and modifiable differences in health between different groups within a society (McCartney *et al.*, 2019). The causes of these differences are complex and may include factors such as genetics, socioeconomic differences, health literacy, and discrimination (Nielsen and Krasnik, 2010). The culture of the different minority ethnic groups may also play a role, as lifestyle also has an effect on health which may be a factor in daily habits such as diet, smoking, PA… (Patel *et al.*, 2017).

The differences in health are even more stark in older age, with the health of White English OAs aged 61-70 shown to be considerably better than that of Caribbean, Indian, Pakistani, and Bangladeshi people (Nazroo, 2015). The data on ethnic minorities is limited however, and more research is required to investigate the complex underlying factors of health inequalities in older age, and improve the health outcomes for these populations.

The commonly cited statistic for falls is that one in three adults over 65 years of age fall every year (Gale, Cooper and Sayer, 2015), rising to 40% for adults over the age of 80 years (Tinetti, Speechley and Ginter, 1988). However, most of the studies used to calculate this figure were carried out in Western countries, and other countries report different levels, such as a systematic review by Kwan et al. (2011), finding a median fall prevalence of 18% in Chinese people. The reasons for this difference are unknown, but appear to persist in the event of migration, with a study comparing fall rates between Chinese people living in Taiwan and Hong Kong, Chinese people living in Australia, and White Australians (Kwan *et al.*, 2013). Fall rates were found to be lowest in the Taiwanese and Hong Kong cohorts, and highest in the White Australian cohort. However, the Chinese people who had emigrated to Australia had fall rates in between the two other cohorts, suggesting an adaptation to their fall risk factors. Similar differences were also found in the US, with different fall rates reported between Asian, Black, Hispanic, and White groups (Kwon *et al.*, 2018).

Curiously, there does not appear to be any studies of fall prevalence between different ethnic groups within the UK. Although large cohort studies within the UK such as the English

Longitudinal Study of Ageing (ELSA) do measure fall prevalence, the populations of these studies are predominantly White British, with the latest wave only including just over 500 ethnic minority OAs, only 160 of whom were over the age of 65 (Kapadia, 2021). These potential differences need to be investigated, as identification of the most at-risk groups will allow responses to move away from a 'one size fits all' approach, to better target resources to groups with the greatest need.

Although physically active OAs have been shown to have a reduced risk of falling (Chang and Do, 2015), ethnic minorities have lower levels of PA than the White population (Saffer *et al.*, 2013; Williams *et al.*, 2010). The reasons for this difference may include factors such as language difficulties (Patel *et al.*, 2017), comorbidities which may hinder their participation (Teagle *et al.*, 2022), or socioeconomic inequalities including living in areas with less opportunities for PA, poorly maintained footpaths, or dangerous neighbourhoods (Mathews *et al.*, 2010). For some ethnic groups, PA is not traditionally a part of their cultural experience (Patel *et al.*, 2017; Wilcox *et al.*, 2009), and aesthetic preferences may differ (Patel *et al.*, 2001). Different cultural and religious values may also make it more difficult for women to participate in PA due to the need for gender segregation, culturally appropriate clothing, or movements that may be considered inappropriate (Patel *et al.*, 2017; Williams *et al.*, 2010).

By appreciating differing preferences for PA, ethnically tailored responses can be created that may better address the low adherence of certain groups to fall prevention interventions involving PA. Increasing the acceptability of an intervention is likely to increase the adherence to the programme, thus making it more effective in reducing fall risk factors and ultimately reducing falls.

1.1.4 Summary

This introduction has presented the issues of population ageing, described how it has come about, and looked at the social issues these changes in the balance of the population will potentially bring over the next 50 years. The health conditions that are associated with older age have also been discussed, and the costs to both the individual and also to the wider society have been explored. One of the many health concerns facing OAs are falls, which have been shown to put the individual at risk of injury, institutionalisation and even death, while

also coming at great financial cost to society. The literature suggests that there may be differences in fall prevalence between ethnic groups, but this has not been systematically explored, with a single fall prevalence usually applied to all. There is also no apparent data on ethnic differences of fall rates in the UK population, even though it is increasing considerably in ethnic diversity. The risk of falls has been shown to be lower in physically active individuals, and interventions based on increased PA shown to be successful in reducing falls in OAs. However, these interventions have been designed with the White cultural majority in mind, and may be less acceptable to UK ethnic minority populations, who already have lower levels of PA in their daily lives. It is hypothesised that by tailoring an intervention to the specific needs and preferences of a given ethnic minority group, the resulting intervention will be more acceptable to them, therefore more likely to be adhered to, and finally more likely to be effective in reducing fall risk.

This rationale has led to the development of the following objectives, which are described below.

1.2. Aims and objectives Overview

The primary aim of this thesis was to design an appropriate intervention to reduce fall risk in OAs from a particular ethnic group.

In order to achieve this aim, five main objectives were chosen and carried out:

Objective One: While the commonly cited prevalence of falls is one-third of OAs falling every year, there appear to be differences in fall prevalence cited in individual studies around the world. Therefore, the first objective is to carry out a systematic review and meta-analysis, to determine whether differences in reported fall rates exist between different ethnic groups worldwide.

Objective Two: As there is currently little to no UK data on fall rates in different ethnic groups, a study needs to be carried out to determine firstly, whether differences in fall prevalence occur between different ethnic groups in the UK; and secondly, to determine a group with a

high fall prevalence, and a population large enough to ensure that recruitment is feasible. Electronic health records are used to determine reported fall prevalence, and Census records to determine population sizes.

Objective Three: In order to ascertain the specific attitudes of the selected ethnic group, a qualitative study was carried out to identify the cultural influences, preferences, attitudes, facilitators, and barriers with respect to fall risk factors, and PA in adults aged 65 years or older.

Objective Four: As most fall prevention interventions have been designed for a Western White population, the results of the previous qualitative study were used to design a culturally tailored fall prevention intervention programme using the Behaviour Change Wheel model. This intervention would therefore be created to respond to the specific needs and preferences of the ethnic group selected.

Objective Five: A protocol for a feasibility and acceptability study of the novel fall prevention intervention was then presented. The aims of the feasibility study were to determine if it is feasible to advance this intervention to large-scale testing, and to identify the sample size required for a full-scale trial.

1.3. Organisation of this thesis

This thesis uses a mixed methods exploratory design, and is organised into nine chapters, including this chapter. Details of the following chapters are described below:

Chapter Two reviews the literature currently known on the core topics of this thesis: ageing, falling, ethnicity, PA, and fall prevention interventions. This review led to the identification of a gap in the literature, thus creating the aim and objectives. This chapter reviews the associations between ageing and falling, and how this may be affected by ethnicity. The strategies used to prevent falls are evaluated, and PA is considered and its current guidelines for OAs identified.

Chapter Three presents the approach used in this research to create an ethnically tailored intervention to prevent physical risk factors for falls in OAs. The philosophical approach of the researcher, and the chosen research design are discussed. Information is given regarding the development of complex interventions based on guidelines from the Medical Research Council, and health behaviour change theories are evaluated and the choice of the Behaviour Change Wheel defended.

Chapter Four is a systematic review and meta-analysis with the aim of determining whether differences in reported fall rates exist between different ethnic groups worldwide. This component of the thesis was pivotal as while health inequalities clearly exist between different ethnic groups, it was important to determine whether this applied to fall rates also. If so, resources could be better targeted to groups that fall more, to reduce fall risks.

Chapter Five involved selecting the ethnic group to be targeted in this thesis. Analysis of Electronic Health Data allowed fall rates to be evaluated in different ethnic groups across London. Census data from the 2011 census was also obtained to determine which ethnic groups have the largest populations of OAs. The group chosen would be one that had a population group of large enough size, and also showed high fall prevalence.

Chapter Six is a qualitative study that used a systematic approach to identify the cultural influences, preferences, attitudes, facilitators, and barriers with respect to fall risk factors, and PA in Caribbean adults aged 65 years or older.

Chapter Seven used the data obtained from the qualitative study to systematically design a culturally tailored intervention, underpinned by theory. The Behaviour Change Wheel tool was used to identify PA behaviours from the interviews, link these to intervention functions, and then to determine the best behaviour change techniques to design an intervention specifically tailored to the target ethnic group.

Chapter Eight is the protocol study to determine the feasibility and acceptability of conducting a randomised-controlled trial evaluating the ethnically tailored intervention, intended to

reduce falls. This feasibility study follows recommendations from the Medical Research Council for developing complex interventions.

Chapter Nine contains an overview of the thesis with a discussion of the implications of the findings, and recommendations for further research. The strengths and weaknesses of this work are presented, and the effects of the Covid-19 pandemic on this thesis are discussed.

2. Literature review

The literature review will summarise the current knowledge on the four largest sub-topics of this thesis: Ageing, falling, ethnicity and physical activity. The gap in the literature being addressed in this thesis is the area where all these four factors interact as shown in Figure 1 below.

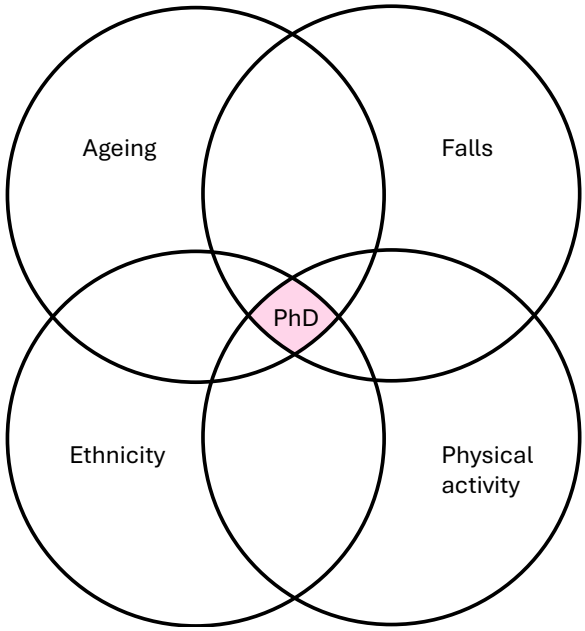


Figure 1: The interrelationship of the domains covered in Chapter 2

2.1. Ageing

2.1.1 Global population ageing

Population ageing is now apparent worldwide, both in developed and developing countries (World Health Organization, 2015). Many factors, such as improved health care and nutrition, mean that people are living longer, and most can now expect to live to old age. According to the United Nations (United Nations, 2024), 5.9% of the world population was aged over 65 in 1980. This had increased to 9.4% by 2020, an increase of 61%. The percentage of OAs is predicted to increase further to 18.7% by 2060.

At a biological level, ageing is related to a lifelong build-up of damage at both a cellular and molecular level. Over time, this damage leads to physical changes, an increased risk of disease, and decreased functional capacity. These changes, however, are neither linear, nor predetermined. An eighty-year-old, may be fit, active and healthy, while another person is

already incapacitated in their mid-fifties, due to a combination of their genetics, lifelong environmental factors, and behaviours such as levels of physical activity, nutrition, etc. (Kirkwood, 2002). However, ageing is not only a physical phenomenon, but also carries with it other significant changes in both individual roles and how someone is viewed by society. There may even be different types of "old age" such as physiological old age, to refer to loss of function and structural deficits; psychological old age, to refer to changes in mental faculties; and sociological old age, to refer to the changed values often bestowed on individuals by their society (Ünal and Özdemir, 2019).

It is equally unclear at what point one becomes "old". While developed countries tend towards 65 as the start of becoming an older person, this may have more to do with legal ages for receiving a pension than any other factors, with this set to rise in many countries in the future. In developing countries however, a definition of 50 or 55 years may seem more appropriate, although issues such as the difficulties of establishing a true chronological age for many people may make this problematic. In many cases, it is the inability to actively contribute to society which is considered a better measure of whether someone is "old" or not (Kowal and Dowd, 2001).

The potential years of being "old" are numerous, and thus a single blanket term does not recognise the considerable differences found between individuals. Although the United Nations has no standard numerical criteria on age, they currently agree upon 60+ as indicating that a person is "elderly" (Kowal and Dowd, 2001). However, several other groups have suggested a more flexible lexicon. The Japan Gerontological Society and the Japan Geriatrics Society recommend a stepped definition whereby those aged 65-75 are considered as "pre-old age", 75-90 years are "old age", and 90+years are "oldest-old", or "super-old" (Ouchi *et al.*, 2017). This latter category may indicate the respect generally held toward older people in Japan, as the term "super-old" would almost certainly be considered pejorative in some other parts of the world!

2.2. Falling

2.2.1 Fall prevalence

An ageing population means that people tend to be living for a considerable period in declining health and with a poorer quality of life, due to a particular set of health problems associated with the ageing process. One particular issue for OAs is falling, an occurrence which is typically defined as "an unexpected event in which the participant comes to rest on the ground, floor, or lower level" (Lamb *et al.*, 2005). The prevalence of falls in the UK is high, and fall-related injuries cost the NHS approximately £4.4 billion every year (Gov.UK Office for Health Improvement and Disparities, 2022). A third of adults in the UK aged over 65 have a fall every year (Gale, Cooper and Sayer, 2015), increasing to 40% for those over 80 years of age (Tinetti, Speechley and Ginter, 1988). Although the study cited is from 1988, it is the most commonly cited reference for fall rates with over 9000 citations. This may be considered as unusual, given that the study had a sample of only 336 participants, and is from the 1980's. However, there have since been many other studies which measure fall rate, and they typically report fall rates of around 30%. The Behavioral Risk Factor Surveillance System (BRFSS) in the United States asks its 400,000 participants "In the past 12 months, how many times have you fallen?". Using this data, fall prevalence is reported as 27.6% in 2020 (Kakara *et al.*, 2023). Individual studies however can report varying fall rates from low single figures (Karter *et al.*, 2015) to as high as 56% (Campbell *et al.*, 1981). The reason for these differences is often due to widely differing methodologies, with differences in age of the population studied, how participants are recruited, and data gathering techniques, making direct comparison between studies difficult.

The age of the population included in a study can vary widely. Some studies include participants as young as 50 years old (Kannus *et al.*, 1999), while others consider only over 65s (Prudham and Evans, 1981), or even divide their participants into age groups, such as 80-89 and 90-99 years (Campbell *et al.*, 1981). While large-scale epidemiological studies often try to standardise rates via measures such as age-adjusted years, this is seldom done in smaller, non-epidemiological studies which tend to report fall rates in age ranges, such as 65-70, 71-75… Fall prevalence increases with age, therefore increasing the upper age range in

the study will make fall rates appear higher as more fallers are included, while decreasing the lower age range could make rates appear lower.

Another factor that must be taken into consideration when analysing these results is the selection of participants. Studies that randomly select participants via the electoral roll or postcodes are more likely to give a true representation of fall prevalence among the general public than those selected from designated elderly housing units, residential homes, out-patient medical clinics, or hospitals, where frailty, poor-health, or dependence make these people much more likely to fall, thus skewing results.

The type of data that is gathered about falls also gives information about how it occurs in a population. Prevalence and incidence are the two measures commonly used to describe this kind of data. Fall data is often presented as a prevalence, or the number of cases of a disease, or incidents of an issue, in a specific population at a specific timepoint or period of time. As most studies ask questions such as “In the past 12 months, how many times have you fallen?”, but do not ask “Have you ever fallen?”, one cannot be certain whether the person is a first-time faller, or a recurrent faller. In addition, we all fall, so the question needs to be considered as to whether people can ever really be a first-time faller.

The study design used to gather data on falls can also influence the accuracy of a study. Either the data is retrospective, whereby participants are asked if they have fallen during a specific preceding period, or prospective, where falls are reported as they happen. However, OAs frequently have difficulty remembering falls, whether due to having forgotten the fall, or a denial of the fall due to a desire to hide signs of frailty (Garcia *et al.*, 2015; Cummings, Nevitt and Kidd, 1988; Peel, 2000). Recall of falls is generally better if the fall was serious and the person suffered a significant injury (Garcia *et al.*, 2015; Peel, 2000), but if the injuries were minor, they too are easily forgotten (Cummings, Nevitt and Kidd, 1988). Therefore, data gathered retrospectively may not be reliable.

Retrospective studies do have some advantages however, notably being quicker and cheaper to carry out (Euser *et al.*, 2009), as data is collected only once, at the end of the period being studied. They are also able to examine rare events, which a prospective study would require

an extremely large sample to “catch” (Powell and Sweeting, 2015). In contrast, prospective studies are time consuming and expensive (Euser *et al.*, 2009), due to the regular individual attention and follow-up given to participants. Sample size, cost, and loss of participants to follow-up, are all problems that need to be minimized in these studies.

2.2.2 The impact of falling on older people

The impact of a fall on the life of an elderly person can be dramatic. The most obvious, and potentially most serious result of a fall is injury. In 2016, the Centers for Disease Control and Prevention (CDC) reported falls to be the leading causes of injury and death among OAs (≥65 years) (Bergen, Stevens and Burns, 2016). Most falls (30-50%) result in only minor injuries such as a bruise, abrasion, or scrape, however 5-10% of falls result in more serious injuries such as fractures (Masud and Morris, 2001; Nevitt, Cummings and Hudes, 1991). Hip fractures have serious on-going implications for an individual, as activity is often seriously restricted for some time, leading to a loss of independence and the need for assistance with their Activities of Daily Living (ADLs). Thus, a fall is a strong predictor for institutionalisation (Scuffham, Chaplin and Legood, 2003), and even death as one in three OAs die within 12 months of a hip fracture (Guzon-Illescas *et al.*, 2019).

In addition to the physical effects of a fall, it is not uncommon for an elderly person to go through psychological, physical, and social changes, unrelated to any physical injury they may have experienced. This is known as a Fear of Falling (FoF) and it can be a serious consequence of a fall. In addition, inactivity, which may be exacerbated by a FoF, actually increases the risk of falling again due to the accompanying loss of muscle and strength, poor gait, and poor balance (Vellas *et al.*, 1997).

2.2.3 Fall risk factors

Falls are usually the result of multiple interacting risk factors (Gillespie *et al.*, 2012), such as a person with poor vision and balance problems slipping on a bathmat during a night visit to the toilet. Tinetti et al (1988) found that there was a linear relationship between the number of risk factors identified, and the risk of falling. The chance of a person with no risk factors falling was only 8%, whereas someone with four or more risk factors had a 78% chance of falling. This suggests that the effects of fall risk factors are cumulative. Although many of the

fall risk factors can be corrected, treated, or reduced, the opportunity to intervene, and modify them is frequently missed. It is often only after a fall and possible injury that risk factors are identified, when potential intervention has less chance of success (American Geriatrics Society, 2001).

Different approaches have been used to classify risk factors, the most common of which is to divide them into intrinsic and extrinsic risk factors. Intrinsic factors are related to the individual, and include things such as chronic disease, advanced age, cognitive impairment, muscle weakness, and gait and balance disorders. Extrinsic factors are not related to the individual and include things such as environmental hazards, polypharmacy, poor lighting, and inappropriate footwear (American Geriatrics Society, 2001; Deandrea *et al.*, 2010).

A more recent systematic review looking at the risk factors for recurrent falls, classified risk factors differently, categorizing them into seven domains: balance and mobility; environmental; psychological; medical; medication; sensory and neuromuscular; and sociodemographic (Jehu *et al.*, 2021). It found that there were differences in the degree of risk conferred by each of these domains. Four of these domains were found to have an increased risk for recurrent falls. Difficulties with balance and mobility, defined by tests of a participant's ability to maintain and move their body within normal spatial bounds, was associated with a 33% increased risk of recurrent falls (95 % CI:[1.11, 1.60]; p = 0.007). The medication risk factor, defined as any treatment that may increase falls, increased the risk by 51% (95 % CI:[1.07, 2.11]; p = 0.025). Psychological factors, or factors that affect performance and learning such as measured by the Mini-Mental State Examination, increased the risk of recurrent falls by 39% (95 % CI:[1.08, 1.79]; p = 0.022). Sensory and neuromuscular factors, including tests of the physiological systems that assist with motor performance, increased the risk by 51% (95 % CI:[1.29, 1.78]; p = 0.001).

The results also suggested that factors that indicate the presence of frailty are strong predictors of recurrent falls. Frailty is a state of increased vulnerability due to decreased function of multiple physiological systems due to age (Clegg *et al.*, 2013; Fried *et al.*, 2001). Loss of muscle mass and function are a particular indicator (Bailey *et al.*, 2023) and thus intervening to reverse this loss of muscle, may have an added benefit of reducing falls.

2.2.4 Fall prevention interventions

Regardless of how risks are classified, the premise of any fall prevention intervention is to identify all fall risk factors that are present, and where possible remove or modify these, thus reducing the risk of the person falling. As there are many known risk factors, there are also a wide variety of potential interventions. Although not all risk factors are modifiable, such as blindness, stroke, and dementia, identifying and improving modifiable risk factors has been shown to reduce fall rate. A Cochrane review looking at the effect of interventions on falls (Hopewell *et al.*, 2018) showed that multifactorial and multiple component interventions may reduce the rate of falls using a rate ratio (RaR 0.77, 95% CI 0.67 to 0.87). However, the lack of confidence in this result is due to the high levels of bias found in many of the studies included in the review, and the high heterogeneity between the different studies. There was however a consistent effect across the data, resulting in their decision to pool the data for examination, although the result is therefore presented with reservations. However, this study agrees with another systematic review by Dautzenberg et al. (2021), who reviewed 192 RCTs with 98,388 participants, and demonstrated that several single and multiple interventions were associated with a lower risk of falls. Exercise (RR 0.83; 95% CI 0.77–0.89) and quality improvement strategies including improving education of patients and staff, motivation, reminders etc (RR 0.90; 95% CI 0.83–0.98) were associated with a reduction in the overall number of fallers, and exercise as a single intervention was associated with a reduction in fall rate (RR 0.79; 95% CI 0.73–0.86). Multifactorial interventions, including components such as exercise, medication review, and environmental assessment and modification, were also associated with a reduction in fall rate (RR 0.87; 95% CI 0.80–0.95).

Interventions can target a single risk factor such as balance training, two or more factors in the same category such as exercise, including balance and strength training, or multiple risk factors in different categories such as exercise, medication review, and visual correction. Interventions that target multiple different risk factors fall into two main groups: multifactorial, where the components of the intervention are chosen on a case-by-case basis, depending on the needs of the individual, or multiple component interventions, where the same intervention components are provided to all older people in the group.

Multifactorial interventions are the gold standard, and the recommended approach in the UK (National Institute for Health Care Excellence, 2013). However, they are necessarily time consuming and expensive due to the one-on-one assessment and need for multiple professional inputs. Multiple component interventions, on the other hand, are more of a one-size-fits-all approach, with no individual assessment included. Instead, the intervention aims to improve the most common risk factors, regardless of the individual risks exhibited by any single person (Hopewell *et al.*, 2018).

The most commonly used single intervention is exercise, which was shown to significantly reduce falls in multiple studies, including in a large-scale Cochrane review (RR 0.34, 95% CI 0.18 to 0.63; 6 trials; 810 participants) (Gillespie *et al.*, 2012). This was confirmed more recently in an updated Cochrane review, which found exercise to reduce the rate of falls by 23% (RaR 0.77, 95% CI 0.71 to 0.83; 12,981 participants) (Sherrington *et al.*, 2020). PA helps to maintain balance, strength, flexibility, and reflexes all of which are important in maintaining postural stability in the face of a perturbation (Myers, Young and Langlois, 1996). Exercise is also important, not only in improving overall physical function, but also mental wellbeing (Martinez-Carbonell Guillamon *et al.*, 2019). Single categories of exercise intervention, such as strength training, are less successful in reducing falls than interventions that include multiple exercise categories, such as balance training, strength training, and general PA (e.g. walking) (Martinez-Carbonell Guillamon *et al.*, 2019). These activities can be delivered either as group sessions outside the home, or to an individual in their own home.

Modification of a person's environment is also an important method of fall prevention as environmental hazards are significant risk factors for falls in the elderly. However, few falls are due to environmental hazards alone, rather these hazards place an individual in a position, from which their postural maintenance mechanisms are unable to recover. For example, poor gait can cause a foot to incompletely clear an electrical cable draped across the floor that was not seen due to poor eyesight. Likewise, slower reaction times delay the hand grabbing at a doorframe for support, and poor balance and weak muscles are unable to redress the body before gravity takes over, and the person falls. Although modifying a person's environment will not address their intrinsic risk factors, it can reduce the precipitating factors of some falls.

2.3. The Ethnic Lens

2.3.1 Ethnicity as a concept

Categorisation is an inherently human trait, a way of making sense of a complex world by recognising similarities and grouping together these similar objects or experiences into an abstract collective. It is an essential cognitive process, without which, we would be easily overwhelmed by the sheer volume of information we process on a daily basis (Rosch, 1999). Making judgements on other humans often begins by placing them into *in-groups*, being like ourselves, or *out-groups,* as being different*,* based on obvious differences such as ethnicity. As a simple exercise in categorisation, this action is functional, neutral, and holds no malice. It is only when these categories are used to represent different levels of value, or for one group to dominate another based purely on their categorisation, that it becomes wrong (Kumar and Naik, 2020).

Academic literature often uses the terms ethnicity, race, and culture interchangeably, although these are social terms with no basis in science or biology. In the past, the term race may have been used to represent differences that, at the time, were incorrectly thought to be based in biology (Flanagin, Frey and Christiansen, 2021), and thus may reflect social injustices perpetrated in the past. The US still relies heavily on this term when collecting data on its citizens, a term which was originally based on groupings due to common physical attributes. However, the United States Census Bureau now states that the racial categories used “reflect a social definition of race recognized in this country and not an attempt to define race biologically, anthropologically, or genetically” (United States Census Bureau, 2022). In contrast, the UK government clearly states its position in using the term ethnicity rather than race (Gov.UK, n.d.), citing their preference for greater consistency in their data. Academic literature now also offers guidance on the use of these terms which it updates regularly (Flanagin, Frey and Christiansen, 2021). Research would greatly benefit from a consensus definition of these terms across different disciplines (Sheldon and Parker, 1992).

The word ethnicity comes from the Latin word *ethnicus*, or the Greek ethnikos “foreign”, or *ethnos* “nation”. “Ethnicity” is a social construct whereby people form groups, linked by a common ancestry, or by shared history, language, religion, or some other cultural factor(s)

(Watt and Norton, 2004; Orhan *et al.*, 2018). Community is a key factor in ethnicity, and one's ethnicity is usually related to the group into which you were born and grew up. It is a construct linking a person to a form of cultural expression and identification, and thus it can be adopted or rejected more easily than racial associations.

All people belong to an ethnic group, and this can lead to ethnocentrism (Watt and Norton, 2004; Bhopal, 2004), where one's own cultural views become the centre of the universe. When a personal culture is seen as the norm, all other groups are measured from this point. Differences become defined by how much they differ from this "gold standard", an unquestionable truth, by definition making all other points of view "wrong". All people experience ethnocentrism to a degree, and have a tendency to see all other people as "ethnic", but themselves as neutral (Hales and Edmonds, 2019).

"Race" is a socially defined construct based on distinctive physical differences between groups of people, such as differences in skin colour, bone structure, and hair texture (Watt and Norton, 2004; Orhan *et al.*, 2018). This difference was historically presumed to be due to biological differences between the groups. However, current knowledge on biological variation and genetics provides no evidence of a genetic foundation for race, as 99.9% of human DNA is common to all, and thus race cannot be detected in the human genome (Redon *et al.*, 2006). There is of course genetic variation, due to ancestry from different geographical areas across the globe, but these variations are clinal, showing a gradual change across a geographical range, such as skin colour changing gradually but continuously, with movement from Northern Europe to Africa (Jablonski and Chaplin, 2000).

Today, race is now seen as a largely social and political construct (Bhopal, 2004). The term itself has become contentious, due not only to historical prejudices, but the current experience of racial differences inciting experiences ranging from social exclusion and discrimination, to social privilege (Watt and Norton, 2004).

"Culture" as a term, refers to the customs and beliefs of a group, learnt through a shared experience, and passed down from generation to generation (Watt and Norton, 2004; Orhan *et al.*, 2018). Edward T. Hall described culture as the "medium in which to move, live, breathe"

(Hall, 1959). It touches all parts of life, from communication to problem solving, and even the structure and function of a political system. Culture also occurs on many different levels. People belong to many different cultural groups at the same time, such as their family, which has its own distinct culture, a different culture within the workplace, and even friendship groups which function within their own particular culture (Weinberg, 2003). This happens due to a shared understanding of the best way for the group to function and has developed over time. Societal norms evolve from these experiences in order to modify the behaviour of the group via social customs and etiquette. These norms allow for a smooth running of the society and common understanding of how to function (Singer *et al.*, 2016). Common values, and beliefs are not innate, but learned from birth through enculturation (Shimahara, 1970). Children are brought up to behave in a way that is acceptable to their culture, yet all this occurs sub-consciously. Culture is never static, it is a dynamic, constantly changing and evolving process, adapting to changing factors within the environment.

While the lexical definitions for race, ethnicity and culture tend to be those shown in Table 1 it is also important not to reinforce rigid categories that do not reflect the dynamic nature of the terms, risking losing their essence.

Table 1: Definitions of race, ethnicity, and culture

Ethnicity	**Race**	**Culture**
A group of people who identify with a shared ancestry, culture and social experience (Kumar and Naik, 2020).	A socially defined category based on distinctive physical differences between groups of people (Bhopal, 2004).	The customs, beliefs, and values of a group, learnt through a shared experience, and passed down from generation to generation (Watt and Norton, 2004).
eg. Black British, British Indian, British Pakistani…	eg. White, Black, Asian, Hispanic…	eg. British, American, Indian…

The choice of term used therefore may depend in part upon the field of enquiry. A project on genetics may choose to use the term *race* as being the most appropriate, an ethnographer may prefer the term *culture*. As health research necessarily covers a plethora of variables from the biological, to the socioeconomic, and the cultural, a term that encompasses all these factors is required. The current school of thought that ethnicity is a social construct, that is dynamic and fluid, evolving with time and experience, while potentially carrying with it, elements of race and culture, is therefore the definition that will be used throughout this thesis.

2.3.2 Immigration and the multicultural UK society

Migration has occurred since the dawn of time and has created the current spread of population around the Earth. It is simply defined as the movement of people from one place to another, for the purpose of settling in the new place for a significant time, or even permanently. People may travel as individuals, families, or even larger groups. Migration is often described as voluntary or involuntary, although these are often difficult to differentiate. Voluntary migration is based on choice, usually a desire for a better life, and is motivated by push factors (the negative aspects of the country of origin that make a person wish to leave, such as poverty or conflict) and pull factors (the attractions of the new country such as better opportunities for education or employment). Involuntary migration occurs when people are obliged to flee situations such as conflict or natural disasters. These people often have no choice over their migration, and their survival depends on it (Verkuyten, Mepham and Kros, 2017).

While the Oxford English Dictionary defined immigration as “to come to settle in a country (which is not one’s own); to pass into a new habit or place of residence”, in 1928 Webster, the author of “An American Dictionary of the English Language” defined it as “To remove into a country for the purpose of permanent residence”. This subtle revision of definition had a profound impact on the attitudes of a nation that persists to this day. It sets up an *us* vs *them* dichotomy, a fear that this permanent residency will logically set up a competition for resources such as employment, and that those who were there first, may lose out in this competition (Shumsky, 2008).

The UK today is a multicultural sovereign country, however this is a comparatively recent phenomenon. Before the twentieth century, immigration to the UK existed only on a very small scale and did little to change the ethnic diversity of the landscape. Following the era known as pre-history where little is known about immigration due to the lack of written records, came the Romans, Vikings, Anglo Saxons, and Normans. There was little immigration during the Middle Ages, and the first substantial wave of immigration came in the sixteenth-century as Britain became a trading power. African immigration increased with the advent of the slave trade, but dropped markedly once the import of enslaved people was banned in 1807. Jewish and Huguenot immigration increased in the late 17th and 18th centuries, following political unrest in Europe, and Asian immigration began in the 18thCentury. In 1851, the census began to record the place of birth of people living in Britain, providing more accurate records (Migration Watch UK, 2014). Following World War II however, considerable immigration was encouraged to help with the rebuilding of the nation. Jobs, both skilled and unskilled, were readily available, and new public services such as the National Health Service and London Transport required workers (Historic England, (no date)). These positions were largely filled by immigrants from the Caribbean and the Indian subcontinent. East African immigrants followed throughout the 1970's and 1980's, escaping political instability in countries such as Uganda and Kenya (Brown, 2022). Bangladeshi immigration reached a peak in the late 1970's following Bangladesh declaring independence from Pakistan (Nash, 2023). Currently, most immigration is made up of people arriving for work and study (78%), with refugees and asylum seekers escaping conflict in their countries of origin making up 13% (The Migration Observatory at the University of Oxford, 2024).

According to the 2021 UK Census, 18.3% of the population was BAME (Black, Asian, and Minority Ethnic) (Office of National Statistics, 2022). While commonly grouped under this single heading, they are in fact a diverse group, with significant differences in their countries of origin, date of arrival in the UK, reasons for migrating to the UK, and socioeconomic status prior to arrival. All of these factors have significant effects on an immigrant's subsequent acculturation, or adaptation to their new country's culture, and thus to their future living conditions.

2.3.3 Ethnicity and health

One of the key differences experienced by ethnic minority groups are health inequalities. Health is a concept that can be defined in many ways. The World Health Organization Constitution defines health as "a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity" (World Health Organization, 1946). A more recent definition considers health as a place on a continuum rather than a simple dichotomy, defining it as "the dynamic balance of physical, mental, social, and existential well-being in adapting to conditions of life and the environment' (Krahn *et al.*, 2021). Health outcomes have been defined by the WHO as "a change in the health status of an individual, group or population which is attributable to a planned intervention or series of interventions, regardless of whether such an intervention was intended to change health status" (World Health Organization, 2021). However, when quantifying disease within a population, conditions are usually reported in terms of presence or absence (Critchley, 2004).

In the UK, most ethnic minority groups have generally poorer health outcomes than White British people, according to the 2020 Marmot report (Marmot M, 2020). The poorest health is seen among Bangladeshi people, followed by Pakistani, Black Caribbean, Indian, and Chinese groups (Nazroo, 2015). Rates of heart disease and stroke are highest among South Asian groups (Williams *et al.*, 2010; Office of National Statistics, 2021), and Caribbean and African people demonstrate high rates of hypertension (Bidulescu *et al.*, 2015). Type II Diabetes is high across all non-White groups (Office of National Statistics, 2021).

Health inequalities are the unjust and modifiable differences in health experienced by people of different ethnicities within a society. The causes of these differences are complex, and may occur due to a combination of factors including but not limited to biological factors such as genetics, socioeconomic status (poor housing, lack of education, or unemployment), individual characteristics (including age, sex, disability, or sexual orientation), the availability and quality of healthcare services, health literacy, and even discrimination within and outside the healthcare system.

2.3.4 Ethnicity and ageing

There is now considerable evidence demonstrating the poorer health, both mental and physical, experienced by ethnic minority populations compared with the majority host

population (Nielsen and Krasnik, 2010). Within the UK, data from the Health Survey for England demonstrated that the number of people aged 61-70 years, describing their health as fair or bad was: 86% for Bangledeshi people, 69% for Pakistani people, 63% for Indian people, 67% for Black people, but only 34% for White English people (Becares, Kapadia and Nazroo, 2020). This study then compared the health of White English people aged 61-70 as being equivalent to Caribbean people in their late 40's or early 50's, Indian people in their early 40's, Pakistani people in the late 30's, and Bangladeshi people in their late 20's or early 30's (Nazroo, 2015).

Within the UK, although there are significant data available on health outcomes experienced in older age, very little is available on OAs from ethnic minorities. There are several potential sources of data to study the later life course. The three birth cohort studies, The National Survey of Health and Development (1946), National Child Development Study (1958), and 1970 British Cohort Study, do not contain substantial numbers of participants from ethnic minorities. The English Longitudinal Study of Ageing (ELSA), in wave 8 had 7265 participants, with less than 150 who were over 65 years of age and from a minority ethnic group (Becares, Kapadia and Nazroo, 2020). The UK Household Longitudinal Study had 570 non-white minority participants aged over 65 from a total of 6470 in 2017-18 (Becares, Kapadia and Nazroo, 2020). These low numbers, even after the Ethnic Minority Boost Sampling was applied, do not allow for any meaningful analyses to be made, or conclusions to be drawn regarding later life outcomes for ethnic minorities. In addition to the low numbers for ethnic minorities as a whole, once these are further divided into smaller groups such as Caribbean, Indian, Pakistani, and Bangladeshi, the numbers become negligible.

Better data on ethnic minorities are required in order to properly address important questions such as how factors affecting ethnic inequalities in health find their origins throughout the life course. How are they affected by migration, and how is this passed onto subsequent generations born within the new host country? Are the issues faced by a migrant generation specific to them and the time of their migration, or are they common to all migrants, regardless of place of origin or era of arrival? While evidence of health inequalities, particularly in older age, is emerging, much needs to be done in the future to unpick these complex underlying factors, and create more equitable health outcomes for all in older age.

2.3.5 Ethnicity and attitudes to ageing

The attitude one has to ageing is defined by one's shared culture and encompasses the ideas, values, and customs held by members of a society towards the ageing process. These attitudes influence the behaviours of the society towards the older person, and the expectations they have of them. Attitudes to ageing are multidimensional and can be positive or negative. Unlike other culturally held attitudes towards factors such as gender, class, or race, attitudes to ageing are unique, in that each person eventually lives the results of their society's judgement (Löckenhoff *et al.*, 2015). What begins as a perception of a group that seems unrelated and different to a young person, becomes ever more relevant as one ages, and thus attitudes to ageing may change and develop throughout the lifespan.

Attitudes to ageing can influence healthy ageing in many different ways. Having a negative attitude towards the ageing process may include fears about declining levels of health, loss of independence, and the loss of social contacts. Negative attitudes to ageing have been associated with decreased cognitive ability, decreases in physical health, both self-reported and objectively measured, higher risk of anxiety or depression, increasing difficulties with ADLs, and a higher risk of mortality (Gale and Cooper, 2018; Parsons *et al.*, 2014).

Healthy ageing is not purely a biomedical concept either. Cultural subtleties are integrated within every aspect and can have significant impacts on the attitudes to ageing by different ethnicities (Thiamwong, McManus and Suwanno, 2013). Cultural influences may determine whether a person is an ageing-denier or an ageing-acceptor. Many South Asian people feel that ageing should simply be accepted as it is an inevitable and unavoidable result of time (Horne *et al.*, 2009). This fatalism over their inability to influence their future health is often also linked to religious aspects of their lives, believing in 'inshallah' or that illness or physical decline is God's will (Horne *et al.*, 2009). OAs roles may also change within the family over time, moving from the carer of children, into the person being cared for by the now adult children (Kolt, Paterson and Cheung, 2006). This may fit with the cultural expectations of filial piety common among Asian cultures, whereas Western cultures embrace the youthful, seeing older age with a much more negative light (Löckenhoff *et al.*, 2015).

2.3.6 Falls and ethnicity

As previously stated, the prevalence of falls is high, commonly reported as being one in three adults over 65 years of age falling every year (Gale, Cooper and Sayer, 2015), and rising to 40% for adults over the age of 80 years (Tinetti, Speechley and Ginter, 1988). However, most of the studies reporting these figures were carried out in Western countries, with other countries reporting differences. China and Japan have considerably lower fall rates, with a systematic review of 21 studies by Kwan et al. (2011), finding a median fall prevalence of 18% in Chinese people. However, there have been very few studies carried out on fall rates in pluricultural populations. This is interesting, as different ethnic groups within a country with potentially different factors related to their ethnicity, would still share many factors due to the common local culture. For this reason, a systematic review was carried out in order to determine whether there are differences in reported fall rates between different ethnic groups. This systematic review is discussed in detail in chapter Four.

2.3.7 Physical Activity and ethnicity

It has already been noted that many OAs are not attaining the recommended levels of PA, and a report from the National Center for Health Statistics and the CDC found that only 12.7% of OAs 65 years and older were meeting the national guidelines for PA (Clarke *et al.*, 2015). In addition, it is now thought that levels of physical inactivity among OAs is higher in industrialised countries (Harrison *et al.*, 2020), which may provide difficulties for migrants from less developed countries. This may be due to the availability of labour-saving convenience options (such as motorised transport, escalators and lifts etc), and/or the urban environment, where green spaces or options for PA in the immediate area are not always available (Mathews *et al.*, 2010). It has been identified that levels of PA are lower in ethnic minority groups (He and Baker, 2005), but the reasons for this are likely to be complex and multidimensional (Mathews *et al.*, 2010).

In the UK, the levels of inactivity are lower than those reported above by the CDC in the US. However, they still remain less than ideal, with notable differences between ethnic groups. In the November 2022-23 report from Sport England (2024) 61% of Black OAs failed to meet recommended guidelines on PA, compared to 55% for Asian, and 47% for White British.

One potential issue is that although minority ethnic groups may demonstrate some awareness that PA confers some health benefits, they seem to be less aware of the recommended levels of PA required to obtain them (Patel *et al.*, 2017). Whether this is due to language issues reducing exposure to public education messages, or wider cultural issues is unclear. Language difficulties do make issues such as understanding instructions, or reducing the ability to ask questions more problematic when trying to increase PA (Patel *et al.*, 2017).

People from ethnic minorities also face many other issues that may impact their ability to participate in PA. They have been shown to be more likely to suffer from other comorbidities (Teagle *et al.*, 2022) which may hinder their participation. They may have less time and fewer resources for recreation due to economic requirements to work and earn. The socioeconomic inequalities of many ethnic minorities also mean that they may live in areas with less opportunities for PA, fewer parks, poorly maintained footpaths, and dangerous neighbourhoods (Mathews *et al.*, 2010).

For some minority ethnic groups, PA is not traditionally a part of their cultural experience, and thus unfamiliar sensations such as breathlessness or sweating may be perceived as negative or unpleasant (Patel *et al.*, 2017). Chinese or Vietnamese cultures value balance and moderation in life, and thus believe that the extremes of physical overexertion are not to be desired (Wilcox *et al.*, 2009).

Aesthetic issues also differ between cultures, such as a more curvaceous figure being associated with affluence, good health, and fertility. This cultural preference has been shown to lead South Asian women to view their own weight as healthy, even when they are overweight (Patel *et al.*, 2001).

Many ethnic minority groups have cultural values that make PA difficult for women. Family and community expectations may prioritise carer roles and have an expectation that a woman remain in the house. Being seen exercising outside the home, or being in exercise classes that are not gender segregated, wearing western exercise clothing, and being exposed to music and images considered inappropriate may be strongly disapproved of (Patel *et al.*, 2017).

2.4. Physical Activity

2.4.1 Definition

PA is defined as any movement of the body carried out by the skeletal muscles, requiring the consumption of energy above that of a resting level (Caspersen, Powell and Christenson, 1985). There are many categories of PA, and these include both everyday activities and more formal exercise. Everyday activities may include such tasks as housework, gardening, and travel (walking, cycling…), while exercise is a subset of PA, and is defined as being planned, structured and repetitive in order to maintain or improve physical fitness. This category may include such activities as dance, swimming, sports etc.

2.4.2 Physical activity guidelines for older adults

The UK Physical Activity Guidelines were updated in 2019, following a review of the scientific evidence published between 2010-2018 (Department for Health, 2019). The importance of PA throughout the life course was reiterated, but particularly for OAs in order to maintain independence, and manage symptoms of disease. It was strongly stated that the benefits of PA outweigh any risks involved. Even if these guidelines are not reached, inactive OAs will benefit from any PA, and if the recommended thresholds are exceeded, OAs can expect additional benefits. Four specific guidelines were identified:

i) OAs should be physically active on a daily basis

Health benefits are provided by even light PA compared with none, while the more activity that can be carried out, the larger the benefits.

ii) Activities that maintain or improve muscle strength, balance, and flexibility should be carried out on at least two days per week

Good strength and balance are essential to confidently be able to perform the normal activities of daily living, and thus maintain independence. Loss of these factors is also related to an increased risk of mortality, and cognitive decline.

iii) OAs should strive for at least 150 minutes of moderate intensity aerobic activity each week

This activity can be broken into as many periods of any length as best fits in with the OAs lifestyle.

iv) Sedentary periods should be broken up as much as possible

Ideally, light activity is ideal for breaking up periods of sedentary behaviour, but even standing for a short time hourly, has health benefits.

2.4.3 Health benefits of physical activity for older adults

The benefits of PA have been acknowledged since the 1950s, when a study on London bus drivers found a lower incidence of coronary heart disease in bus conductors who were active, walking along the bus and up and down stairs, than in the drivers who were sedentary (Morris and Crawford, 1958). Since the 50s, research into PA has grown enormously, and those who are physically active have been shown to have a third lower mortality than those who are inactive, with the largest benefit for those aged over 60 (World Health Organization, 2015). PA helps to maintain functional independence, as even those in good health lose muscle mass and flexibility with age (McMurdo, 2000). Without adequate PA, OAs are particularly at risk of diseases which are related to inactivity, and thus PA is well documented as reducing the risk of many physical diseases including cardiovascular disease, diabetes, cancer, hypertension, obesity, depression, and osteoporosis among others (Warburton, Nicol and Bredin, 2006).

Equally, in recent times, the link between PA and mental health has been investigated. Low levels of PA are frequently linked to social exclusion and loneliness, both of which have a negative effect on mental health. The benefits of PA on mental health are now well documented and may be attributed to several different causes. The psychological effects of PA distract a person from negative thoughts, increase self-efficacy, and improve social interactions (Craft, 2005). Biochemical effects may be due to the release of endorphins which have a similar action to anti-depressants (Peluso and Guerra de Andrade, 2005), and physiological effects may be related to increases in body temperature and decreased muscle tension following PA to create a relaxing and calming effect (DeBoer *et al.*, 2012).

2.4.4 Challenges of increasing physical activity in older adults

There are clear benefits for OAs in being more physically active, however for this to occur, many societal and practical barriers need to be overcome. Many collective ideas need to be challenged such as old age being a time to “put your feet up”, or that any health problems experienced are inevitable. Well-meaning family may take on the burden of housework and

cooking to “spare” their relative, but are in fact doing them a great disservice by removing important opportunities for PA. In addition, many OAs believe that it is only vigorous sporting activities that confer health benefits, and may fail to understand the importance of regular ordinary PA such as walking, housework, dancing, or gardening (McMurdo, 2000).

The psychological and practical obstacles faced by OAs are also numerous. Factors such as fearing injury or falls, depression, inertia, self-consciousness, and a lack of self-efficacy are all common psychological barriers to participating in PA. Practical difficulties such as a lack of time, a lack of support, financial barriers, and problems with inconvenience and community structure are also hurdles that must be overcome in order to promote PA in OAs (Lees *et al.*, 2005; Mathews *et al.*, 2010; King, 2001; Franco *et al.*, 2015).

2.4.5 Physical activity and falling

There are several possible mechanisms by which appropriate PA can reduce fall prevalence. It is commonly accepted that exercise can reduce falls by improving muscle strength, balance, and physical function (Liu-Ambrose *et al.*, 2013). While postural perturbations exist for those of all ages, the key to recovery from them is the ability to maintain the relationship between the body’s centre of balance and base of support. Good muscle strength and balance contribute to this re-stabilisation and therefore, fall prevention (Hita-Contreras *et al.*, 2016).

The FoF common in OAs often results in a reduction of activities due to a lower level of self-efficacy. This in turn leads to reduced functional capabilities, and therefore a higher risk of falling. PA provides a means of breaking this downward spiral by improving confidence, autonomy, mobility, and therefore, functional ability.

2.5. Fall prevention interventions

A health intervention can be defined as any action taken to prevent disease or improve health. The premise of any fall prevention intervention is to identify all fall risk factors that are present, and where possible remove or modify these, thus reducing the risk of the person falling. Although not all risk factors are modifiable, such as blindness, stroke, or dementia, identifying and improving modifiable risk factors has been proven to reduce fall rate

(Martinez-Carbonell Guillamon *et al.*, 2019). The Prevention of Falls Network Europe (ProFaNE) taxonomy (Lamb *et al.*, 2011) has determined the following categories of individual interventions:

- Exercise.
- Medication (drug target), such as the provision of calcium or vitamin D supplements.
- Medication (review), in order to ensure that any medications taken are of the correct dose, still required, and have no undesirable interactions.
- Surgery, such as removal of cataracts, or implantation of a pacemaker.
- Nutrition, to ensure that nutrient intake is adequate, and dehydration is avoided.
- Environmental review, to reduce home hazards, provide assistive technology such as personal alarms, grab bars, or walking aids, and communication technology such as hearing aids, or glasses.
- Social, ensuring that support is adequate, via education for family caregiver(s), or providing home, or telephone support.
- Education on fall prevention encompassing all the categories listed above via written material, videos, or one-on-one explanations.

Interventions can target a single risk factor such as balance training, two or more factors in the same category such as exercise, including balance and strength training, or multiple risk factors in different categories such as exercise, medication review, and visual correction. Interventions that target multiple different risk factors fall into two main groups: multifactorial, where the components of the intervention are chosen on a case-by-case basis, depending on the needs of the individual, or multiple component interventions, where the same intervention components are provided to all older people in the group.

Multifactorial interventions are the gold standard, and the recommended approach in the UK (National Institute for Health Care Excellence, 2013). However, they are necessarily time consuming and expensive due to the one-on-one assessment and need for multiple professional inputs. Multiple component interventions, on the other hand, are more of a one-size-fits-all approach, with no individual assessment included. Instead, the intervention aims to improve the most common risk factors, regardless of the individual risks exhibited by any single person (Hopewell *et al.*, 2018).

2.5.1 Exercise as an intervention

Physically active OAs have been shown to have a reduced risk of falling (Chang and Do, 2015), and PA interventions have been shown to reduce falls by improving muscle strength, balance, and physical function (Liu-Ambrose *et al.*, 2013). This is thought to be due to exercise reversing age-related declines in physical function, thus reducing the impact of major risk factors for falls (Sherrington *et al.*, 2019), but could also be related to a reduction in FoF which is also an important risk factor for falls (Kendrick *et al.*, 2014). Exercise is therefore often used as a fall prevention intervention, and is in fact the most commonly prescribed single component intervention, having been shown to be both effective (Gillespie *et al.*, 2012), and cost-effective in preventing falls (Bruce *et al.*, 2021).

While there is clearly evidence for exercise interventions reducing falls in OAs, they can also bring about adverse outcomes that should always be taken into account. Becoming more active challenges the muscular and cardiovascular systems, and although most reported incidents are musculoskeletal in nature and relatively minor, correct evaluation prior to any exercise intervention, and careful monitoring throughout, is prudent to avoid adverse incidents (Liu and Fielding, 2011). Another risk of exercise interventions is in causing the very problem they intend to reduce. Exercise programmes, particularly those targeted at improving balance, by their very nature often challenge a participant's equilibrium, placing them at risk of a fall. Again, proper monitoring is key, ensuring that support is provided, and that the individual does not become fatigued (Sherrington *et al.*, 2019).

2.5.2 Categories of exercise interventions

As previously discussed, exercise interventions can reduce falls by improving muscle strength, balance, and physical function, however these different improvements are brought about by different types of exercise. In this thesis, exercise interventions will be classified using the Prevention of Falls Network Europe (ProFaNE) taxonomy (Lamb *et al.*, 2011) which has been designed to improve coherence within academic reporting. This taxonomy separates exercise into the following categories:

i) Gait, balance, and functional training

ii) Strength/resistance (incl. power) training

iii) Flexibility

iv) 3D, three-dimensional training, including Tai Chi, Qi Gong, and dance

v) General physical activity

vi) Endurance training

vii) Other types of exercise not previously included

Interventions may include a single category of exercise, or a combination of several categories (Hopewell *et al.*, 2018). A 2019 Cochrane review (Sherrington *et al.*, 2019) sought to assess both the positive and negative effects of different categories of exercise interventions for preventing falls in community-dwelling OAs. They assessed, where possible, each category of exercise intervention as listed in the ProFaNE taxonomy, but also included an "all types" exercise category, and a multiple (more than one of the categories combined) as compared to a control. The control consisted of "usual care", indicating normal activities as usual, without change; or an intervention not expected to reduce falls (general health education, extremely gentle exercise, or "sham" exercise). The reported outcome was "rate of falls", as this was believed to be more sensitive to change than fall numbers, especially for recurrent fallers.

2.5.2.1 Gait, balance, and functional training

Interventions in the category of gait, balance, and functional training, include exercises that change the pace, and direction of walking, possibly also including changes of level, and may correct issues of walking technique if required. This may involve tasks such as walking on the toes/heels, walking backwards and sideways, turning, bending, and stair climbing. Balance components involve weight transfer from one part of the body to another, and may also place demands on the vestibular system depending on the degree of challenge required. These tasks may include changing head and eye positions, standing on unstable surfaces, walking in line, tandem standing, or standing on one leg, and obstacle courses. Functional training is more task specific, designed to improve an individual's function during familiar daily activities (Lamb *et al.*, 2011).

Cochrane reviews are highly regarded studies due to their methodology, which is very specific and systematic, thus reducing bias and error (Cipriani, Furukawa and Barbui, 2011). A

Cochrane review by Sherrington et al. (2019) focused on community-based OAs so is highly relevant for this thesis. It also included a very large sample of 108 RCTs with 23,407 participants living in 25 countries, and compared a broader range of PA interventions than many other reviews, which allows a wider analysis of the benefits of different options. This review found that gait, balance, and functional training interventions reduced the rate of falls by 24% compared to controls (Rate Ratio (RaR) 0.76, 95% Confidence Interval (CI) 0.70-0.81; 7920 participants, 39 studies, I^2= 29%, high certainty evidence). The overall effect of the meta-analysis of the interventions showed a reduction in the rate of falls whether they were delivered by either a health professional or a trained instructor who was not a health professional, although the effect was larger when delivered by a health professional (RaR 0.67, 95% CI 0.58 to 0.65; 2960 participants, 20 studies, I^2 = 37%), vs (RaR 0.82, 95% CI 0.76 to 0.88; 4997 participants, 19 studies, I^2 = 9%) for a trained instructor (the test for subgroup differences: χ^2= 6.72, df = 1, P = 0.01, IS = 85%). There was also no significant difference noted in the effect of these interventions on falls whether they were delivered to groups (RaR 0.73, 95% CI 0.65 to 0.82; 3620 participants, 20 studies, I^2 = 34%), or individually (RaR 0.77, 95% CI 0.70 to 0.85; 4589 participants, 20 studies, IS = 28%), (the test for subgroup differences: χ^2= 0.47, df = 1, P = 0.50, I^2 = 0%).

2.5.2.2 Strength/resistance (incl. power) training

Generally termed “resistance training”, these interventions cover all types of weight training where muscles contract against a resistance in order to strengthen them. In OAs it has been shown to have a positive impact on muscular strength, power, mass, and endurance, as well as overall body posture. This can result in better function in safety related movements such as stair climbing, or recovery from stumbles, thus avoiding falls (Rivera-Torres, Fahey and Rivera, 2019). This type of intervention may involve using weights, resistance bands, the body’s own weight, explosive propulsion movements such as jumping, or more functional training such as carrying shopping bags (Lamb *et al.*, 2011).

The Cochrane review was unable to determine whether resistance or strength training was able to reduce the rate of falls compared with a neutral control (RaR 1.14, 95% CI 0.67 to 1.97; 327 participants, 5 studies, I^2= 67%; very low-certainty evidence).

2.5.2.3 Flexibility

Flexibility training involves stretching exercises that are designed to recover or preserve the optimal range of movement about the joints. This range of movement allows for correct mobility and coordinated movement, helps to improve posture and relaxation, reduces the risk of injury from exercise, and improves other functions essential to carry out normal ADLs (Lamb *et al.*, 2011; Rivera-Torres, Fahey and Rivera, 2019). Unfortunately, the Cochrane review was unable to obtain any data on flexibility and its effect on fall reduction (Sherrington *et al.*, 2019).

2.5.2.4 3D training

3D training refers to exercise programmes based on controlled movements though all three dimensions (forward and back, side to side, and up and down). It often involves weight transfers, postural control, head and gaze changes, and changes of movement speed and pattern. Some examples include Tai Chi, Qi Gong, and different forms of dance (Lamb *et al.*, 2011).

The Cochrane review (Sherrington *et al.*, 2019) reported on Tai Chi and dance separately, with differing results. Tai Chi was found to possibly reduce falls rates by 19%, although the evidence was not particularly strong (RaR 0.81, 95% CI 0.67 to 0.99; 2655 participants, 7 studies, I^2= 74%; low certainty evidence), whereas they were unable to make any determination on whether dance was able to reduce falls rates compared with the control (RaR 1.34, 95% CI 0.98 to 1.83; 522 participants, 1 study; very low-certainty evidence) (Sherrington *et al.*, 2019).

2.5.2.5 General Physical Activity (walking programmes)

General Physical Activity is a general term including any exercise that moves the body via skeletal muscle contraction and increases energy expenditure. These forms of activity in this category of the taxonomy may be work-related (eg. physical labour), involve transporting oneself from place to place (eg. walking, running, or cycling), recreational (eg. golf, tennis, gardening, or carpentry), or practical (eg. cutting firewood) (Lamb *et al.*, 2011). Unfortunately, the Cochrane review was unable to make any determination on whether "General Physical Activity" which were generally walking programmes, was able to reduce fall rates compared

with the control (RaR 1.14, 95% CI 0.66 to 1.97; 441 participants, 2 studies; I^2= 67%; very low-certainty evidence) (Sherrington *et al.*, 2019).

2.5.2.6 Endurance

Endurance exercise programmes, according to the taxonomy (Lamb *et al.*, 2011), refer to aerobic exercises aimed at improving cardiovascular function. Typically, this category might include activities such as running, rowing machines, cycle ergometer, brisk walking or marching, or interval/Fartlek training. Long-term responses to endurance training include: lower blood pressure during exercise, protection of bone mineral density in postmenopausal women, lower resting and submaximal heart rates, lower body fat, better blood lipid profiles and inflammatory markers, and lower risk of cardiovascular disease (Rivera-Torres, Fahey and Rivera, 2019). Unfortunately, again the Cochrane review was unable to obtain any data on endurance and its effect on fall reduction (Sherrington *et al.*, 2019).

2.5.2.7 Multiple categories of exercise

The Cochrane review found that interventions that include more than one of the categories within the ProFaNE taxonomy reduce the rate of falls by 34% compared with controls (RaR 0.66, 95% CI 0.50 to 0.88; 1374 participants, 11 studies; I^2= 65%; moderate-certainty evidence). The most common combination was balance and functional exercise combined with resistance exercises, and when results including only these components were pooled, little difference was found (RaR 0.69, 95% CI 0.48 to 0.97; 1084 participants, 8 studies; I^2= 72%).

Little to no difference was found between interventions delivered by health professionals (RaR 0.65, 95% CI 0.43 to 0.99; 653 participants, 3 studies, I^2= 72%) vs trained instructors who were not health professionals (RaR 0.66, 95% CI 0.44 to 0.99; 751 participants; 8 studies, I^2= 67%) compared with controls (test for subgroup differences: χ^2= 0, df = 1, P = 0.96, I^2= 0%). Likewise, little to no difference was found between interventions delivered in group settings (RaR 0.64, 95% CI 0.46 to 0.89; 1194 participants, 10 studies, I^2= 67%), compared to individual delivery (RaR 0.81, 95% CI 0.56 to 1.18; 210 participants, 1 study), compared with controls (test for subgroup differences: χ^2= 0.86, df = 1, P = 0.35, I^2= 0%).

2.5.3 Important factors to consider

2.5.3.1 Variability of studies

It is clear that exercise does reduce both the rate of falls, and the number of people falling (Sherrington *et al.*, 2019). However, the results above do not always appear to reflect this clearly, in particular the impact of the different types of exercise. It is important to remember that in large systematic reviews such as Sherrington's (2019), the studies all show a high level of variability. The interventions themselves are separated according to the ProFaNE categories, a task which the authors admit is often quite subjective due to the limited descriptions given in the included studies. The duration of the interventions also varied greatly from 5-130 weeks. Perhaps most importantly, the outcome measure of interest, falling was not always clearly defined, demonstrating that the adoption of a consensus definition for research in this field would clearly be beneficial. With the addition of differences in determining whether a fall has occurred, and then reporting, recording, and analysing those falls, it becomes very difficult to compare, and find any significant consensus between studies. The multifactorial nature of falls, is often not taken into account by studies, thus potentially not appreciating confounding issues related to those falls such as medication taken, whether glasses were worn at the time of the fall, location of the fall or external hazards.

2.5.3.2 Duration

The issue of duration can be divided into two areas of interest: the duration of the intervention, and the duration of the study follow-up. There is currently little information in the literature about the ideal duration of exercise interventions for fall prevention (Campani *et al.*, 2021). Most fall prevention interventions are tested via randomised controlled trials, and thus tend to be over shorter, specific time periods. A systematic review by Ng et al. (2019) found that interventions for fall prevention ranged in duration from 2 to 130 weeks, with 51% lasting less than 24 weeks. These short interventions may not have a duration long enough to be effective, and may also not be long enough to create good habits, ensuring that the behaviour lasts long term (Boulton *et al.*, 2019; Ng *et al.*, 2019). Wurzer et al. (2014) looked at participation in the Steady As You Go (SAYGO), peer-led exercise programme for OAs, and although this programme was not developed with fall prevention as its primary outcome measure, they found that OAs who had participated for three years or more had a lower 12-month fall incidence (incidence rate ratio, 0.90; 95% CI 0.82 to 0.99; P = 0.03) than those who

had only participated for 1-2 years. This agrees with an earlier study from Japan which found that it is long-term exercise, that does not necessarily have to be fall-prevention specific, which is effective in preventing falls rather than short-term specialised fall prevention interventions (Fujisawa *et al.*, 2007).

The duration of follow-up is also an important factor in evaluating studies of fall prevention interventions. While interventions may demonstrate short-term improvements in fall risk factors, whether these behaviours and benefits can be maintained long-term following the end of a study is also an important consideration. Much like medication only being effective if taken regularly and consistently, PA can only remain effective if continued. Wahlich et al. (2020) conducted a systematic review and meta-analysis to determine whether improvements from fall prevention PA interventions were maintained 12 months after the end of an RCT. They found a lack of studies that evaluate improvements objectively and that follow-up for longer than 12 months, suggesting that more studies need to include longer follow-ups in their methods. They did however, find evidence that improvements could be sustained beyond 12 months, and even up to 4 years after the intervention RCT. This suggests important advantages for long-term fall prevention outcomes.

2.5.3.3 Adherence

Adherence has been defined by the World Health Organization (WHO) as "The extent to which a person's behaviour … corresponds with … recommendations from a health care provider" (2003). This is a complex issue with many biosocial factors at play. For OAs, adherence to fall prevention interventions is critical for success, but is currently poorly reported and understood. Among the most common methods of reporting adherence, are included: the proportion of participants completing a programme, the proportion of sessions attended or completed per week, number of minutes walked, proportion of individuals meeting guidelines for PA, or the proportion of participants reporting that they exercise regularly (Rivera-Torres, Fahey and Rivera, 2019). No particular measure has been found to be a gold-standard as each one remains an estimate of a person's true behaviour. For each individual, adherence is reliant on both the understanding and expectancy that an intervention will be effective, as well as the belief that they are capable of completing the intervention, the efficacy expectancy (Flegal *et al.*, 2007). Following the Health Belief Model, OAs are more likely to

adhere to fall prevention interventions when they see themselves as susceptible to falling, believe that a fall could have serious consequences, and understand the benefits of the intervention as reducing the chances of this eventuality occurring (Champion and Skinner, 2008). Other factors positively linked with adherence to exercise interventions for OAs are: higher socioeconomic status, higher education levels, low BMI, good health, good physical abilities, better mental health, better cognitive abilities, programmes with supervision, and extrinsic motivation such as financial incentives (Rivera-Torres, Fahey and Rivera, 2019). It is imperative therefore that exercise intervention design fully encompasses the multifactorial issues related to exercise adherence in OAs, if the final programme is to maximise adherence, thus maximising the potential benefits to the participating OAs and the best use of resources.

2.5.3.4 Deliverer of the intervention

The delivery of an intervention is a key step, particularly with OAs, and an effective intervention will fail if not delivered as designed. PA interventions involving behaviour change are heavily reliant on instructors providing the OAs with a crucial link between OAs and the world of PA (Harvey and Griffin, 2020). A charismatic instructor who engages with their participants, learning names and energising the group will facilitate engagement with the intervention (Bender *et al.*, 2019). Treating participants as individuals is key, and details such as learning names, and adapting delivery to participants is crucial. Instructor competence is also extremely important. Adjusting exercises to each individual's level, and teaching OAs correct technique, so they can perform exercises safely and without fear of injury, allows each person to gain the maximum from their PA sessions (Harvey and Griffin, 2020). Sensitivity to the preferences of the group in matters such as music style, also facilitate attendance (Bender *et al.*, 2019). Some literature suggests that OAs may prefer instructors who are similar to themselves (Bender *et al.*, 2019), finding that peer-instructors may be more relatable (Harvey and Griffin, 2020). How other such similarities may be valued, such as similar ethnicity, is unknown at this stage.

2.5.3.5 Group vs Individual

There is considerable disagreement in the literature as to whether group or individual exercise programmes are more successful in reducing falls. Group-based activities have been shown to increase motivation, resulting in better long-term maintenance of exercise, and

increased adherence (Reicherzer *et al.*, 2021; Burke, Carron and Shapcott, 2008). The participants may work at a higher intensity due to competition with the other members of the group, and/or encouragement from the instructor, resulting in better outcomes (Kyrdalen *et al.*, 2014). The presence of an instructor also allows for adaptation of the exercises to each individual's abilities, and their personal encouragement builds self-efficacy in participants, both of which result in making the exercise more acceptable, thus increasing adherence (Reicherzer *et al.*, 2021). Kyrdalen et al (2014), found greater improvements in the Berg Balance Scale from group-based exercise cohorts compared to those doing the programme at home (mean group difference in change of 3.2 points, 95% CI 0.7 to 5.8, p=0.014). The 30 second Sit-to-Stand also improved more in the group-based cohort (2.2 reps, 95% CI 0.7 to 3.6, p=0.004), as did physical health measured by the Short Form-36 (45.0, 95% CI 14.7 to 75.2, p=0.004).

The Cochrane Review however found that with all exercise types combined, both exercise delivery methods were successful at reducing the rate of falls, with little to no difference between group (RaR 0.76, 95% CI 0.69 to 0.85, 8163 participants, 40 studies, I^2=62%) and individual (RaR 0.79, 95% CI 0.71 to 0.88, 4818 participants, 21 studies, I^2=35%) exercise programmes (test for subgroup differences: χ^2=0.21, df=1, P=0.65, I^2=0%) (Sherrington *et al.*, 2019).

While some studies have shown that people appear to prefer exercising with others than alone (Burke, Carron and Shapcott, 2008), it is also accepted that individual preferences are key. Home-based activities may allow for more flexibility on factors such as timetabling, time spent on travel, and lower costs from transport and group classes (Reicherzer *et al.*, 2021), which may make individual exercise the preferable option for some. Preferences in PA have also been linked to adherence, so it appears crucial to take individual circumstances and preferences into account when offering intervention options.

2.5.4 Evaluating the effectiveness of an intervention

In order to evaluate the effectiveness of an intervention, an outcome measure needs to be selected. In the case of a fall prevention intervention, there are two main options: one can measure actual falls to see whether the number of falls has been altered following the

intervention, or an outcome that is a known risk factor affecting fall rates can be chosen rather than measuring falls themselves. Using falls as an outcome measure in a short-term intervention can raise several problematic issues. Falls are typically measured over a 12-month period as fall incidence. This means that for an intervention lasting only 12 weeks, only around 7% of participants will be expected to fall. With the small numbers of participants used in most studies, the numbers of falls would be so low, that any change affected by an intervention would not show as a statistically significant difference. In addition, since falls are reported by individuals, there is also the issue of unreported falls, as discussed previously. However, it has previously been demonstrated that strong OAs fall less, OAs with better balance fall less etc. It has been found that measures based on physical performance may be more sensitive in measuring physical function than patient reports (Welmer *et al.*, 2014). In addition, overall physical function is reflected by measures of balance, walking speed, and muscle strength, and therefore are often used in the assessment of older adults (Tinetti and Kumar, 2010). Therefore, these measures will result in a more accurate reflection of the efficacy of an intervention than falls, since these measures are objective.

2.5.4.1 Tests that are predictive for falls

Tests that are predictive for falls are valuable tools, as although funding for fall prevention has increased in recent years, identifying those at most need allows for a more targeted and cost-effective use of those funds. As already described, falls are the result of an interaction of numerous potential risk factors. This multifactorial situation makes identifying those at risk even more complicated, and the tools available to aid in this identification numerous and wide ranging. A diagram summarising the different tests that are predictive for falls is shown in Figure 2.

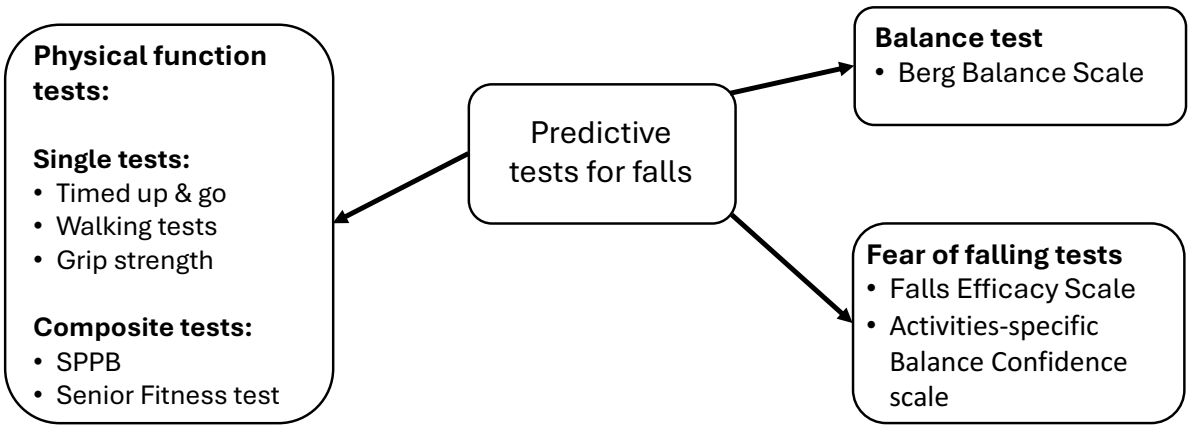


Figure 2: Tests that are predictive for falls

2.5.4.2 Single tests

2.5.4.2.1. The Timed Up & Go (TUG)

The Timed Up & Go (TUG) test is popular as a screening tool for falls, largely due to its ease and rapidity of delivery, zero cost, and limited equipment requirement. It requires a person to rise from a chair, walk three metres, turn, walk back to the chair, and sit down again. This process is timed from the initial command of "go", to the moment the person's buttocks touch the chair again as they return to the seated position. The test subject may use the arms of the chair to rise if necessary, and the walking is carried out with the use of any assistive devices habitually used. A practice run of the process is allowed before the timed test.

This test is a composite test, including aspects of weight transfer (sitting to standing and the reverse), walking, and turning, and thus testing the interactions of strength, agility, and balance of an individual, all within the same test.

The TUG test has been shown to have excellent reliability with Collado-Mateo et al. (2019) reporting intraclass correlation coefficients (ICCs) of repeated tests between 0.87-0.93 (95% CI). There is also evidence of excellent inter-rater reliability (ICC 0.99), and intra-rater reliability (ICC 0.99) (Podsiadlo and Richardson, 1991; Christopher *et al.*, 2021). Criterion validity, whereby confirming that the results correspond to other tests designed to measure the same outcome, are also excellent. Podsiadlo et al. (1991) reported scores of r=-0.81 with the Berg Balance Test, r=-0.61 with Gait Speed, and r=-0.78 with the Barthel Index of ADL.

The cut-off score, after which a person is considered at risk of falling has been considered to be >13.5 sec since the work of Shumway-Cook et al. (2000), although the methodologies used in this particular study have been challenged in more recent work. Barry et al. (2014) queried the potential bias introduced by their selection of the case-control participants. In addition, case control studies potentially include limitations such as recall bias, selection bias, and low internal validity, among others. Only 15 fallers and 15 non-fallers were included, and those who had fallen once or less in the preceding 6 months were excluded. A sensitivity of 80% and specificity of 100% were reported, suggesting a better prediction of falls in high-risk individuals.

Functional tests are important clinical tools, designed to indicate patients that are at risk of a particular outcome, such as falling. The TUG is a popular test for the reasons listed above, although the evidence suggests that its predictive ability is limited (Schoene *et al.*, 2013). A systematic review and meta-analysis from Barry et al. (2014). found that the TUG showed a limited ability to predict falls (OR = 1.01, 95% CI 1.00-1.02, p=0.04). This was supported by Schoene et al. (2013) who concluded the power of the TUG to accurately predict falls was only moderate, although they conceded that it had been designed as a measure of functional mobility, and not intended, or formally validated, as a predictive test. This lack of predictive accuracy may be due to the multifactorial nature of falls. While the test is composite, and measures a few different risk factors, it is not exhaustive, and thus cannot account for the individual risk factor specification of each individual. OAs do not also fall into perfectly discrete groups. Fallers are typically divided into those who have had ≥1 fall, or 2+ falls. This may mean that studies end up comparing groups with extreme differences, ie. non-fallers with highly recurrent fallers. In addition, those who do not fall, or have only fallen once, may be extremely active, whereas those who fall often are frequently less active. It has been suggested that fall location should be taken into account more often, as active OAs may tend to fall more outside during their outdoor activities, whereas less active fallers tend to fall more indoors. This information is usually not controlled for in comparisons and may provide additional insight into potential differences between groups (Schoene *et al.*, 2013).

2.5.4.2.2. Walking tests

Walking tests are simple to administer, safe, have no cost and require little equipment. However, there are a wide range of differing protocols that can make choosing an appropriate test a challenging prospect. Most tests look at walking speed, although there are also quality of gait tests, which are often more specialised and carried out by clinicians such as physiotherapists in order to determine gait abnormalities that may need rehabilitation, or could be indicative of other pathologies. These patients are generally already indicated as having a higher risk of falls due to their gait difficulties, so these specialised tests will not be further discussed here.

Protocols can differ markedly, making the choice of test and their comparison difficult. Very little standardisation exists for the delivery of these tests, and differences in results can occur due to numerous factors such as, the choice of static or dynamic start, the choice of normal or maximal walking speed, the choice of straight or turning paths, the position of the timer while walking, the encouragement given to the individual being tested, and the use of different timing instruments such as a stopwatch, an automatic timer, or a instrumented walkway (Peters, Fritz and Krotish, 2013; Middleton, Fritz and Lusardi, 2015).

The tests using different distances can be further divided into:

- Distance-based tests, where a short distance is walked, and the time to cover that distance is measured.
- Time-based tests, where a certain time is set, and the distance walked in that time is measured. These tests usually cover significantly more distance than the short distance tests.

Time-based tests were initially designed to test endurance but have since come to be considered as a good indication of the overall mobility levels and general physical capabilities of an individual (Soubra, Chkeir and Novella, 2019). The 6-minute walking test (6MWT) involves measuring the distance covered by an individual in 6 minutes, and is the most commonly used, but 2-minute and 10-minute versions also exist. In 2002, standardised protocols for carrying out the 6MWT were produced by the American Thoracic Society (Crapo *et al.*, 2002). The 6MWT has been reported to have excellent reliability, with Steffen et al.

(2002) reporting an ICC of 0.95. Criterion and construct validity have been reported as adequate showing a good correlation with chair stands (r=0.67), and standing balance (r=0.52) (Harada, Chiu and Stewart, 1999). In terms of responsiveness to intervention, Perera et al. (2006) determined that a small meaningful change to be a 20m improvement, and a substantial meaningful change to be 50m. There is less data available on the psychometric evidence of the 2-minute walking test (2MWT), and standardised protocols have yet to be developed, although it has been suggested as potentially being a better option for individuals who are unable to walk for 6 minutes together, or unaided (Pin, 2014).

Distance-based tests were initially designed for more clinical uses, as longer distance tests are impractical in the smaller spaces of most clinical settings. Various different distances are used for this type of test, 2.4m, 4m, 6m, and 10m, however for OAs, the 4m test is the most commonly used and validated (Beaudart *et al.*, 2019). Test-retest reliability is reported as excellent by Peters et al. (2013) on both the 4m and 10m tests (ICC ranging from 0.96-0.98). Inter-rater reliability is also excellent in OAs with Chronic Obstructive Pulmonary Disease (ICC 0.99, 95% CI 0.98-0.99) (Kon *et al.*, 2013). Clegg et al. (2015) reported that when using a cut-off of 0.8 m/s with the 4m walking test for predicting frailty, sensitivity was high (0.99) as was the negative predictive value (0.99). However, specificity was moderate (0.64), and positive predictive value was low (0.26). Overall, this increases the number of false positives, thus limiting the accuracy of this as a diagnostic test.

2.5.4.2.3. Grip strength

Testing of the grip strength in the hands is currently the most commonly used method of testing overall muscle strength as it has been proven to be a good representation of lower limb strength (Lauretani *et al.*, 2003), which has equally been shown to be highly correlated to upper limb strength (Bohannon *et al.*, 2012). Studies have shown that grip strength is predictive for falls specifically, with fallers having lower grip strengths than non-fallers (23.0 vs 26 kg/f) (Moreira *et al.*, 2017).

The test is quick and easy to perform, making it a popular test for use in clinical practice (Beaudart *et al.*, 2019). The only requirement is the purchase of a handheld dynamometer, of which several different models are available. Adherence to standardised testing protocols is

also very important as measured values may be altered by hand size (Gunther *et al.*, 2008), hand dominance (Bohannon, 2003), body position (Hillman *et al.*, 2005), presence of pathologies such as carpal tunnel syndrome, or arthritis (Lauretani *et al.*, 2003), and psychological factors such as the encouragement given, or patient motivation (Jung *et al.*, 1999).

Reliability scores for grip strength dynamometry have been shown to be good to excellent, with a systematic review by Bohannon (2017) showing relative test-retest reliability ICCs of >0.80 for all selected studies, the only exceptions being studies on patients with dementia. Inter-rater reliability has also been reported as excellent (ICC 0.95-0.98) (Beaudart *et al.*, 2019). Equally test-retest values have been shown to be consistent, showing excellent reliability even with up to a three month pause between tests (ICC 0.912-0.954) (Bohannon and Schaubert, 2005).

Normative data for grip strength is often divided into right or left hand, or divided by dominant or nondominant hand. Although hand dominance may be expected to represent the stronger hand, in fact this does not appear to be the case for left handers (Bohannon, 2003). Other common groupings are by gender, side, or age (Bohannon, 2019). In 2016, Leong et al. reported on the results from the PURE Study from over 100,000 people around the world. Their findings suggested that hand grip strength measures changed between ethnic groups and geographic regions, and that therefore interpretation of results should always be based on local geographic or ethnic norms (Leong *et al.*, 2016). This recommendation was further strengthened by Dodds et al. (2016) whose systematic review and meta-analysis of normative data showed that grip strength is lower in developing countries compared to those in developed countries, and that therefore different cut points should be used when conducting measures in developing regions. This suggests that further work is needed to determine whether immigrants from these developing areas to the UK would need different cut points when interpreting grip strength measures, whether they adapt to British norms over time, and if so how long this would take from immigration.

2.5.4.3 Balance testing

Good balance is key for many ADLs and to prevent falls. However, although exercise is linked to fall prevention through increased mobility and improved balance, it has been difficult to collect evidence due to the highly varied outcome measures used to evaluate balance in the literature. A systematic review (Howe *et al.*, 2011) which selected 94 studies looking at the potential of exercise to improve balance in OAs, found over 25 different outcome measures reported for balance. In addition, there was no standardisation in the performance or reporting of these measures, making it difficult to perform any quality analysis, or reach any strong conclusions. This problem can be found across the literature, and the lack of a "gold standard" to measure balance makes arriving at clear clinical recommendations problematic. Of course, balance is a complex, multifactorial function, making the marriage of its individual components into a single analysis, difficult. Sibley et al. (2015) attempted to obtain recommendations for a core outcome set of balance measures, and found only two that their panel agreed upon for use in evaluating the balance of adult populations, the Berg Balance Scale, and the Mini Balance Evaluation Systems Test.

2.5.4.3.1. The Berg Balance Scale (BBS)

The Berg Balance Scale (BBS) is a 14-item measure used to assess an individual's abilities in both static and dynamic balance situations. It has been validated for use in OAs with a number of different conditions such as stroke, Parkinson's disease, various balance disorders, etc., can be used in varied settings from hospitals, to residential care facilities, or in the community (Donoghue and Stokes, 2009), and has been translated into several languages (Sibley *et al.*, 2015). It assesses balance in the three domains of sitting, standing, and changing posture, and includes tasks such as reaching, turning, looking over each shoulder, and transferring from one seat to another. Due to the numerous items tested, the test is longer than some others, taking 15-20 min to administer, however its cost is zero, and the equipment required, minimal. Each test is scored on a 5-point ordinal scale from 0-4, with 0 scored for someone unable to complete the task, and 4 representing an ability to complete the task independently. The maximum score is therefore 56.

Cronbach's α scores have been shown to be high, suggesting good reliability (test-retest reliability, ICC = 0.92, 95% CI 0.87 to 0.97, $p<0.001$; interrater reliability, 0.97, 95% CI 0.96 to

0.99) (Godi *et al.*, 2013). The internal consistency reported is high, with a review by Sibley et al. (2015) reporting a range of Cronbach's α = 0.92–0.98. They also reported construct validity ranges convergent with the Barthel index r = 0.87–0.94.

The cut off score recommended by Berg et al. (1992) was 45, suggesting that those with scores lower than this, were at greater risk of falls. However, Shumway-Cook et al. (1997) have suggested modifications based on scores plus fall histories, so that a score ≤42 would be considered a cut off for fall risk in individuals with no history of falls, but someone with a score <51 would be considered at risk if they also had a history of previous falls. It has also been suggested that when used to evaluate an intervention aimed at improving a participant's function, it is not the initial score a person receives which is important, but rather the change in score that can accurately reflect a real change in their clinical condition. Donoghue and Stokes (2009), set out to determine the minimal detectable change (MDC) at which one could be 95% confident that a measured change is greater than any measurement error. It should be noted that this is different from the Minimally Important Clinical Difference (MCID) which is a change that would be considered important or meaningful by an individual or clinician, but thus carries a degree of subjectivity. The MCID is calculated using mixed methods as it must be determined by the magnitude of improvement in the primary outcome measure for a specific population. This improvement must be evaluated by the participants to determine whether it had any real-life importance. They found that a change in the MDC of 4 points could be considered a real change for individuals who initially scored between 45-56, 5 points for those who scored 35-44, 7 points for scores of 25-34, and 5 points for scores of 0-24.

The main limitation reported for the BBS is its ceiling effect for higher functioning OAs, meaning that this test may not be sensitive to this population, even when they are at risk of falling. More challenging tests may be required to highlight any balance issues within this particular group. Another limitation is that although the BBS tests many of the components necessary for good balance, it does not evaluate some issues of dynamic balance such as reacting to a perturbation, or cognitive factors such as responding to commands or performing other tasks at the same time. This suggests that some potential issues affecting balance may not be assessed, and risks not anticipated (Sibley *et al.*, 2015).

2.5.4.4 Fear of Falling

Fear of falling began to be noticed in the early 80s. The first papers were qualitative in nature, or case studies, and tended to concentrate on the observations and opinions of medical professionals, not the experiences reported by the patients. Murphy and Isaacs (1982) observed 36 patients who demonstrated anxiety related to activity following a fall. They were noted to be tentative and faltering when walking, and also frequently reached out to objects for support. They called this behaviour "post-fall syndrome". Concurrently Bhala et al. (1982) described 3 case studies of patients who restricted their activity following a fall. This phobia was analysed and was determined to be separate from a more general agoraphobia in terms of its ætiology, symptoms, treatment, and prognosis. This new phobia was termed ptophobia.

2.5.4.4.1. Falls Efficacy Scale (FES).

In order to better understand the effect of FoF on the functional performance of OAs, Tinetti et al. (1990) felt it was important to identify the individuals that developed FoF after a fall and why. However, the idea of simply asking the OAs about any fears they may have of falling was dismissed due to perceived subjectivity and unreliability of their responses. Instead, it was suggested that OAs were asked how capable they believed themselves to be in a variety of different situations or activities. This was based on Bandura's model of Social Cognitive Theory (1986) and involved an individual's own evaluation of their self-efficacy. This proposal was named the Falls Efficacy Scale (FES). However, although falls efficacy may allow one to infer a relationship between falls and FoF, these constructs are quite distinct, and can also be influenced by other psychological issues such as depression (Soh *et al.*, 2021), or confused with estimated functional ability rather than a FoF (Yardley *et al.*, 2005). For these reasons, their conflation has been queried. Other issues were also criticised, such as the activities referred to being rather basic, suggesting that only the very old or frail would have difficulties with them. This suggests that the instrument may only have sensitivity for differences and changes among this most disabled category of OAs, and would not be as sensitive for higher functioning OAs, who may still be at risk due to their restriction in activities (Yardley *et al.*, 2005).

Therefore, in 2005, the FES was modified into the Falls Efficacy Scale- International (FES-I), making it more suitable for translation to different languages and cultures, and including

more taxing and social activities (Yardley *et al.*, 2005). Since 2005, the FES-I has been validated in 12 other languages, and in conjunction with several pathologies such as multiple sclerosis, stroke, and osteoporosis in women. It is now the instrument most commonly used to assess FoF (Ruggieri *et al.*, 2018).

The FES-I is a 16-item questionnaire, rating an individual's concern about falling during everyday activities within the home and in the community (eg. dressing, reaching overhead, walking on uneven surfaces…). Concern is rated using a 4-point Likert scale from 1 (not concerned), to 4 (very concerned). These scores are added to produce a total reflecting the FoF, from 16 (no concern), to 64 (high level of concern). Cut-off scores have been recommended as 16-19 (low concern about falls), 20-27 (moderate concern), and 28-64 (high concern) (Delbaere *et al.*, 2010b).

The relationship between FoF and falls is complex as even non-fallers can exhibit a marked FoF, due to a perceived threat of falling, rather than a personal experience of it (Liu, 2015). The association between FoF and future falls has been most frequently attributed to a restriction of PA by an individual who is afraid of falling, leading to a deconditioning and general reduction in physical abilities, thus placing them at a higher risk of future falls (Yardley *et al.*, 2005; Ruggieri *et al.*, 2018; Weijer *et al.*, 2021; Liu, 2015). However, other mechanisms have also been postulated. Psychological elements such as anxiety and balance confidence have been shown to have an impact on balance effectiveness (Carpenter *et al.*, 2006). It may also be that a FoF in an individual, may in fact be a realistic assessment of their physical abilities. Therefore, in terms of clinical evaluation and intervention, the measured FoF must be appraised in conjunction with the person's physical abilities. If the fear is the central issue, then it is the fear itself that needs to be dealt with, however, if the fear is realistic given the physical abilities, then physical rehabilitation would be a better course of action (Hadjistavropoulos *et al.*, 2007). Physical rehabilitation may also be the best intervention in the alternative situation where a FoF is unrealistically low given the individual's physical condition, resulting in the performance of inappropriately risky behaviours which may surpass the body's ability to cope, and result in falls (Delbaere *et al.*, 2010a).

Reliability scores for the FES-I have been shown to be good to excellent, with Yardley et al. (2005) showing excellent internal reliability (Cronbach's α=0.96), and excellent test-retest reliability (ICC=0.96). A systematic review by Ruggieri et al. (2018) also demonstrated good internal consistency with Cronbach's α ranging from 0.78 to 0.98, although it was ≥ 0.90 in 53 of the 55 studies included. Reliability was also good with ICCs ranging from 0.584 to 0.99, although again, almost all studies included were >0.80, and only one was <0.70 but was related to patients with cognitive impairment who self-administered their FES-I.

In terms of the ability of the FES-I to predict falls, the evidence varies. Delbaere et al. (2010a) found that there was a significantly higher risk of having an injurious fall, or multiple falls, with higher FES-I scores (OR=1.05, 95% CI 1.02-1.08, p=0.001). However, Weijer et al. (2021) found that high FES-I scores did not predict falls over the subsequent month or year. Equally they found that a fall did not predict higher FES-I scores a year later, although small increases in concern were present in the month following the fall (1.49 FES-I points, 95% CI 0.74-2.25, p<0.001).

2.5.4.4.2. Activities-specific Balance Confidence scale (ABC)

The Activities-specific Balance Confidence scale (ABC) is a 16 item self-assessed test whereby individuals are asked to rate their confidence at carrying out specific activities without falling. Each item is marked on a scale of 0-100 (0=no confidence, 100=total confidence), and the mean is calculated to provide the final score.

Internal consistency reliability for the ABC has been shown to be strong with Cronbach's α reported as 0.96 (Huang and Wang, 2009) and 0.95 (Talley, Wyman and Gross, 2008). Construct validity has also shown lower ABC scores to be correlated with older age, poorer balance, gait, and mobility, greater activity restriction, higher depression scores, more falls over the preceding year, a higher number of chronic illnesses, poorer self-rated health status, and the use of assistive devices (Huang and Wang, 2009; Talley, Wyman and Gross, 2008).

Reported cut-off scores to discriminate between fallers and non-fallers differ between studies. Lajoie and Gallagher (2004) reported that a cut-off score of 67% allowed individuals to be categorised as fallers or non-fallers with a sensitivity of 84.4% and a specificity of 87.5%. Moiz et al. (2017) also found a significant difference between the mean ABC scores of fallers

and non-fallers (52.6±8.1 vs 73.1±12.2, p<0.001). They reported the need for a lower cut-off score of ≤58.13% in order to differentiate between the two groups, with a percentage test accuracy of 86.87%, a false-positive rate of 12.2%, and a false-negative rate of 13.6%. They concluded that ABC scores are significantly related to future falls (adjusted OR=0.032, 95% CI 0.004-0.25, p=0.001).

The ABC does appear to have a strong ceiling effect with less-frail individuals, resulting in a lack of responsiveness to change. Both Huang (2009) and Talley (2008) found no significant change to ABC scores following a fall prevention intervention, with Talley reporting paired t-tests (t= -0.50, degrees of freedom (df)=103, p=0.62). Both studies attributed this lack of responsiveness to participant attributes, rather than the test itself, as the baseline scores for the participants in both studies were high, and because other studies have shown interventions of this sort to reduce FoF. This suggests that activities that are more challenging to balance should be included in tests for this type of population.

The principal obstacle in choosing the ABC as a test to predict future falls is in the lack of information available in the literature. In the systematic review by Ruggieri et al. (2018), it was noted that none of the articles included in their review reported on predictive values. This paper observed that the literature shows a tendency to create new tools rather than to fully validate the tools already in use, a position with which this author concurs.

In addition, other concerns regarding the ABC address the potential lack of cultural inclusivity. The activities that individuals are asked to rate their confidence about performing, were designed for American OAs. Questions on activities such as cooking or housework may not be relevant to men in some cultures, for whom this type of work is completely unfamiliar. Also, questions regarding walking on surfaces slippery due to snow and/or ice simply do not apply in many parts of the world. There is potentially a need to validate a questionnaire culturally, as well as linguistically, for different countries.

2.5.4.5 Composite tests

2.5.4.5.1. Short Physical Performance Battery (SPPB)

The Short Physical Performance Battery (SPPB) tool was designed as an assessment of physical performance in OAs, particularly the function of lower extremities (Guralnik *et al.*, 1994). Although the SPPB was not initially designed as a test to predict fall risk, it is well understood that poor lower limb performance is often manifested in weakness, gait and/or balance disorders (Masud and Morris, 2001), all of which are also associated with increased fall risk. The SPPB is a composite test which assesses strength, pace, and balance. The battery is quick to perform, carries no costs, and has limited equipment requirements.

The battery consists of 3 components which are each scored out of a maximum of 4 points, for a potential maximum score of 12 points. A score of <10 on the SPPB indicates mobility limitations. The components are:

- Repeated Chair Stands: where the participant is seated in a chair with their arms crossed over their chest. They are asked to stand and sit down again as quickly as they can. They are timed for 5 sit-stand-sit repetitions. The test is abandoned if the participant is unable to perform the test, or if they are unable to perform 5 sit-stand-sit repetitions in 1 minute. Points are scored depending on how fast the 5 repetitions are carried out.
- Balance Testing: where the test is to see if the participant can stand, unsupported, for 10 seconds, with their feet in three different positions. Firstly with their feet together, secondly with their feet in the semi-tandem position (with the side of the heel of one foot touching the big toe of the other foot), and lastly with the feet in the tandem position (with one foot directly in front of the other heel to toe). The first 2 positions score 1 point if successful, no point if unsuccessful. The tandem position scores 2 points if successful, 1 point if the position is maintained for more than 3 seconds, but not the full 10 seconds, and zero points if unsuccessful.
- Gait Speed Test: 2 timed trials of a 3m or 4m walk. The fastest trial is scored, with points given depending on speed.

The SPPB has been shown to have high reliability with Olsen and Bergland (2017) reporting an ICC of 0.92. Criterion validity was reported by Dokken et al. (2020) as excellent, showing high correlation against the Elderly Mobility Scale- Norwegian version, with an r=0.75.

The cut-off score for the SPPB is considered to be ≤10 where a person is considered to be at risk of a mobility impairment at follow-up. However, as far as falls are concerned, those with low scores (0-6) have been shown to be more likely to be recurrent fallers than those who score 10+ (OR=3.46, 95% CI 2.04-5.88, p<0.001 in females; and OR=3.82, 95% CI 1.77-8.52, p<0.001 in males). Even moderate scores (7-9) suggested higher risk of being a recurrent faller, but only in women (OR=2.03, 95% CI 1.28-3.22, p=0.002) (Veronese *et al.*, 2014). Welch et al. (2021) also found a low score (4-6) to be predictive of future falls, both at one year after baseline SPPB testing (RR=3.03, CI 2.04-4.49), and after 4 years (RR=1.53, CI 1.09-2.17). Lauretani et al. (2019) reported receiver-operating characteristics (ROC) analyses that demonstrated association between SPPB scores and falls (AUC 0.676, 95% CI 0.627-0.728, p<0.001).

Other studies have shown contrasting findings, with Minneci et al. (2015) finding that the SPPB was unable to predict future falls (OR=0.95, 95% CI 0.84-1.08, p=0.44). It is possible that these contradictory results may be due to their different methods of ascertaining falls. Minneci et al. used a retrospective 12-month approach, as did Veronese et al. (2014). However, in the Veronese study, the follow-up visit asked about falls during the previous 12 months, while also including information from family members and any medical documentation on falls. Welch et al. (2021) used quarterly phone calls to provide more regular updates on falls. This may suggest that an approach that does not rely on a 12-month memory, but instead includes medical history records, recollections from other family members, and a more regular follow-up on falls may provide a more accurate reporting of falls, and fill in any gaps that may occur within the patient's memory.

The individual components of the test have also been assessed for their ability to predict fall risk, and the impact that each brings to the composite test results. Veronese et al. (2014) found that only the chair sit-to-stand component had a significant association with fall risk in both genders, even after controlling for potential confounders, for those who took longer

than 16.7 sec to complete the task (OR=1.94, 95% CI 1.13-3.32, p=0.002 for women, and OR=2.75, 95% CI 1.21-6.23, p=0.002 for men). Gait speed below 0.75 m/s was associated with fall risk, after controlling for potential confounders, but only in women (OR=2.11, 95% CI 1.04-4.30, p=0.04), as was the inability to hold a semi-tandem position for more than 10 sec (OR=2.33, 95% CI 1.33-4.09, p=0.003). Welch et al. (2021) also found that after adjusting for confounding factors, those with the lowest scores for gait (RR=2.90, CI 1.85-4.55), chair sit-to-stand (RR=1.77, CI 1.11-2.84), and balance (RR=2.86, CI 1.82-4.50), had the highest fall risk over the first year of follow-up. After a four-year follow-up, the only individual test that was significant for fall risk was gait (RR=1.61, CI 1.07-2.41).

Overall, various studies have confirmed the reliability of the SPPB when used to predict fall risk in OAs, and confirm its use as a valuable clinical and research tool (Lauretani *et al.*, 2019; Veronese *et al.*, 2014; Welch *et al.*, 2021).

2.5.4.5.2. Senior Fitness Test (SFT)

The Senior Fitness Test (SFT) was created in 1999 by Rikli and Jones at Fullerton University, hence its earlier name of "The Fullerton Fitness Test" (Rikli and Jones, 1999). This test was designed as most physical performance measures at the time attempted to determine functional limitations through behaviours, in other words, to determine difficulties with specific activities such as bathing or dressing. The problem with these tests is that impairments are not detected until an individual's decline has reached the point of significant loss of functional ability. The SFT was conceived to detect the physiologic declines that are the forerunners of an actual loss of function. It is a functional fitness test battery where functional fitness is defined as "having the physiologic capacity to perform normal everyday activities safely and independently without undue fatigue", and includes measures of aerobic endurance, strength, agility/dynamic balance, and flexibility in OAs.

The SFT is made up of 6 tests (there are two options for the endurance component) to assess the aforementioned components of functional fitness: chair stands (lower body strength), arm curls (upper body strength), chair sit and reach (lower body flexibility), back scratch (upper body flexibility), 6-min walk or 2-min step test (aerobic endurance), and 8-foot up-and-

go (agility/dynamic balance). These battery items are all easy to understand and administer, inexpensive, and require little in the way of equipment.

The continuous scoring structure used in the SFT makes it more discriminating between extreme cases, separating out higher, or lower, functioning individuals. In contrast, other tests such as the SPPB use an ordinal ranking system, making it more difficult to detect gradual change (Rikli and Jones, 2013). The SFT has good reliability, with all items showing R values of between 0.80-0.98 (Rikli and Jones, 1999). Criterion validity estimates for all items ranged from r = 0.71-0.86 (Rikli and Jones, 1999).

In terms of assessing fall risk, physical fitness levels that allow normal functioning during ADLs may reduce the risk of falling, and aid in rehabilitation after a fall has occurred. Scores from the SFT have been shown to be lower among OAs with a history of falls compared with their non-faller peers (Kubica, 2014). In addition, each component of the SFT, with the exception of the back scratch test, has been shown to be linearly associated with a risk of falling as measured by a fall risk questionnaire, suggesting that the SFT could offer predictive guidance of those OAs at risk of falls (Ho *et al.*, 2021). The individual components of the test battery have shown men to have better aerobic endurance, and women better upper body flexibility, although the scores on other tests were similar for both sexes (Kubica, 2014), suggesting the potential need to ensure that fall prevention programmes aimed at improving functional fitness for OAs should include flexibility exercises for men, and strength training for women.

2.6. Conclusion

This literature review has shown that the world population is ageing, bringing with it increased challenges of chronic disease. A common problem in older age is falls which may result in serious injury or death. One of the most successful interventions to reduce falls has been shown to be PA, which allows OAs to maintain their strength, balance, flexibility, and reflexes, all important in the face of postural perturbations. However, many OAs do not adhere to recommended levels of PA.

The review also highlighted that the UK is a multicultural population with 18% of the country identifying as part of an ethnic minority. However, inequalities in health have been demonstrated between the different ethnicities with the UK, with many minority ethnic groups having poorer health outcomes than their White British counterparts. Whether falling also exhibits differences between ethnic groups is currently unclear. What is clear, is that ethnic minorities have lower levels of PA than the White population, although the reasons for this are unclear and likely to be complex.

Finally the review identified that current fall prevention interventions are typically generic or focussed on majority ethnic groups. These are therefore less likely to be adhered to by ethnic minority groups, and therefore are less likely to be effective. By exploring the cultural facilitators and barriers to PA, interventions can be designed that are tailored to better respond to low adherence of fall prevention interventions involving PA. Increased acceptability of an intervention is hoped to increase adherence thus increasing the effectiveness and reducing falls.

3. Thesis Methodology

This thesis has previously reviewed the key topics related to the research aims and objectives within the literature and identified gaps within the current knowledge. This chapter defines the process used to choose the methodology with which to answer these research objectives.

In order to select the most appropriate process, three interrelated factors must be considered: i) the ontological assumptions made by the researcher; ii) the knowledge that is expected to arise from the study, and how this epistemological viewpoint will best fit with the identified ontological stance, and finally; iii) how these two factors lead to an approach that will most effectively allow the research objectives to be addressed.

3.1. Research paradigm

In order to choose the methods most appropriate to try to answer the research questions, first the research paradigm must be selected. Research paradigms are the set of beliefs and practices held by the researcher, which provide the viewpoint, framework, and means by which the acquisition of knowledge is carried out (Weaver and Olson, 2006). This term was commonly used following the work of Kuhn (1962), where he described it as a means for researchers to make sense of their world. This also suggests that a paradigm is necessarily of its own time and society, and therefore evolves over the years (Kuhn, 1962; Kelly, Dowling and Millar, 2018). Numerous different paradigms have been proposed, however only the three paradigms most relevant to this research will be discussed, including: postpositivism, constructivism, and pragmatism.

3.1.1 Postpositivism:

The predominant paradigm that has traditionally moulded scientific thought since the arguments of Plato, is positivism, or more recently, postpositivism. It assumes a single reality or truth, where outcomes are determined by specific causes (Creswell, 2014). Positivism is therefore based on empiricism, as these causes can be identified and assessed via precise experimental observations and measurements, or a quantitative approach. This paradigm is often also referred to as reductionist, due the concept of reducing ideas into small discrete

units for testing. More recently positivist ideas have evolved into postpositivism, where it is understood that empirical observations are influenced by the values, background, and theories of the researcher (Kelly, Dowling and Millar, 2018). As humans are imperfect, they can never discover the essential truth, as knowledge is conjectural. Likewise, hypotheses cannot be proven, one can only fail to reject them.

3.1.2 Constructivism:

Constructivists, or interpretivists, oppose postpositivists, believing that there is no single reality or truth. Instead, they believe that the individual makes sense of the world around them by developing subjective meanings of their observations and experiences (Kelly, Dowling and Millar, 2018). As this is a social and historic construct, dictated by the cultural norms of each individual, these meanings are varied and numerous. Researchers do not attempt to condense these meanings down to small discrete units, but rather to capture the complex viewpoints presented, usually via a qualitative approach (Creswell, 2014). Again, the researchers own background influences their interpretation. This is important, because constructivism does not begin with a theory or hypothesis, but rather one is developed during the course of the study.

3.1.3 Pragmatism:

This thesis is underpinned by an epistemological approach known as pragmatism. This paradigm relies less on pre-existing conditions, as in postpositivism, but on the situations at hand. The research questions drive the methods, and the approach that best addresses the requirements, is the one chosen (Creswell, 2014). Researchers therefore have the freedom to draw on both quantitative and qualitative approaches as necessary, known as Mixed Methods (MM) (Creswell and Plano Clark, 2017; Kelly, Dowling and Millar, 2018). The lack of commitment to the notion of a single reality allows the approach to be constantly evaluated, interpreted, and adapted to respond most appropriately to the changing understanding of the research questions. It is important to note that MM does not replace either quantitative or qualitative approaches, but rather serves to harness the strength of each while also minimising their weaknesses.

3.1.4 Summary of paradigm choice:

A summary of these three research paradigms is shown in Table 2.

Table 2: A summary of the three research paradigms

	Ontology	Epistemology	Methodology	Methods
Postpositivism	A single reality or truth exists, but can only be understood imperfectly as knowledge is conjectural.	Reality can be measured, therefore there is an emphasis on the precision and tools needed to do this accurately.	Quantitative	Empirical measurements, questionnaires, surveys…
Constructivism	There is no single reality or truth. Reality is created subjectively by individuals and modified via societal norms.	Reality is interpreted to understand the meaning extrapolated from various different viewpoints	Qualitative	Focus groups, interviews, participations, observation…
Pragmatism	Reality is constantly re-evaluated in light of its functionality for changing needs at that moment.	The most practical method to address the problem at hand is the one chosen.	Mixed Methods	Combination of the above and more…

From these three paradigms, it is clear that postpositivism is not an appropriate choice for this thesis, as the qualitative component of the methods is incompatible with the premise of a single reality. Likewise, constructivism is equally incompatible with the subjective nature of a constructed reality, and would not be an appropriate choice for the quantitative elements. This mixed methods approach, combining qualitative and quantitative methodologies, aligns best with the paradigm of pragmatism, which is flexible enough to respond equally well to elements of qualitative and quantitative methodologies.

3.2. Research design

Research design involves the choice of inquiry strategies that deliver the most appropriate procedural direction, and are often defined as quantitative, qualitative, or mixed methods (Creswell, 2014). Research into fall prevention and PA is typically quantitative in nature, looking at fall prevalence, time spent in PA, weights lifted, repetitions performed etc., however this does little to increase knowledge of the cultural factors that shape attitudes to lifestyle habits, particularly for minority ethnic groups.

As previously stated, a MM design combines the strengths of both quantitative and qualitative research with each equally offsetting any limitations in the other. However, this form of research can be challenging, particularly due to the time-consuming nature of both the data collection, and the complex nature of the multiple themes it generates. In order to adequately carry out each component of the research, specialist training is often required.

MM itself offers several different approaches, including: convergent, exploratory, explanatory, and multiphase (Creswell and Plano Clark, 2017). Convergent parallel MM involves collecting both quantitative and qualitative data concurrently, and subsequently merging them to obtain a thorough analysis of the issue being researched (Creswell and Plano Clark, 2017). An exploratory sequential MM study involves beginning with a qualitative study to explore the experiences and opinions of participants, before using this data to create a quantitative or experimental study for testing. An explanatory sequential MM study reverses this order, beginning with a quantitative study, before using a qualitative investigation to attempt to explain the findings of the quantitative results. This thesis may be described as using an exploratory sequential MM study, where the multi-phase design gives a process involving the use of sequential study objectives to address separate aspects that have developed from the global aim of the study. This is a method that is commonly found in the design and evaluation of interventions (Creswell and Plano Clark, 2017). In this design, the first part of the study obtains and interprets the views of the participants, then using this information in order to create an intervention, the success of which can be measured quantitatively.

This thesis is composed of five different research objectives as shown in Figure 3:

- As recommended by the Medical Research Council (Craig *et al.*, 2008), the initial focus must be to identify current knowledge on the subject, and to conduct a high-quality systematic review if no recent one exists. Therefore, the first research objective is a systematic review to investigate whether differences in reported fall rates exist between different ethnic groups.
- The second objective involved using data from Electronic Health Records (EHR) and the National Census in order to select the target ethnic group for this study. This approach was important as the choice of ethnic group was data-led, and not chosen randomly or because of personal preference. The NHS promotes targeting of at-risk populations in order to respond appropriately and reduce risks. The use of EHR data permits an assessment of a local population to assess these risk factors (NHS, 2024).
- The third objective is an exploratory qualitative study designed to obtain a deeper understanding of the facilitators and barriers to an exercise-based intervention experienced by the target group (Caribbean OAs) and other interested stakeholders (family, community leaders, religious leaders, medical professionals).
- The fourth objective involves the design of a novel intervention designed specifically for the target ethnic group, Caribbean OAs, using the Behaviour Change Wheel (Michie, Atkins and West, 2014). This approach is consistent with the Medical Research Council's guidelines for developing complex interventions, whereby it is specified that interventions should be based on evidence and theory (Skivington *et al.*, 2021).
- The fifth and final objective is the design of a protocol for a quantitative feasibility study which is intended to test the feasibility of the new intervention, in order to assess appropriate outcome measures, feasibility of recruitment, retention of participants, and will allow the sample size requirements for a full-size trial to be determined. The protocol will describe a study in which physical, physiological, and psychological factors will be tested in an empirical fashion, both before and following the intervention, thus allowing for statistical analysis. In addition, adherence to the intervention will be determined using attendance and participation measures, in order to determine whether the intervention is suitable for further full-scale testing following this study.

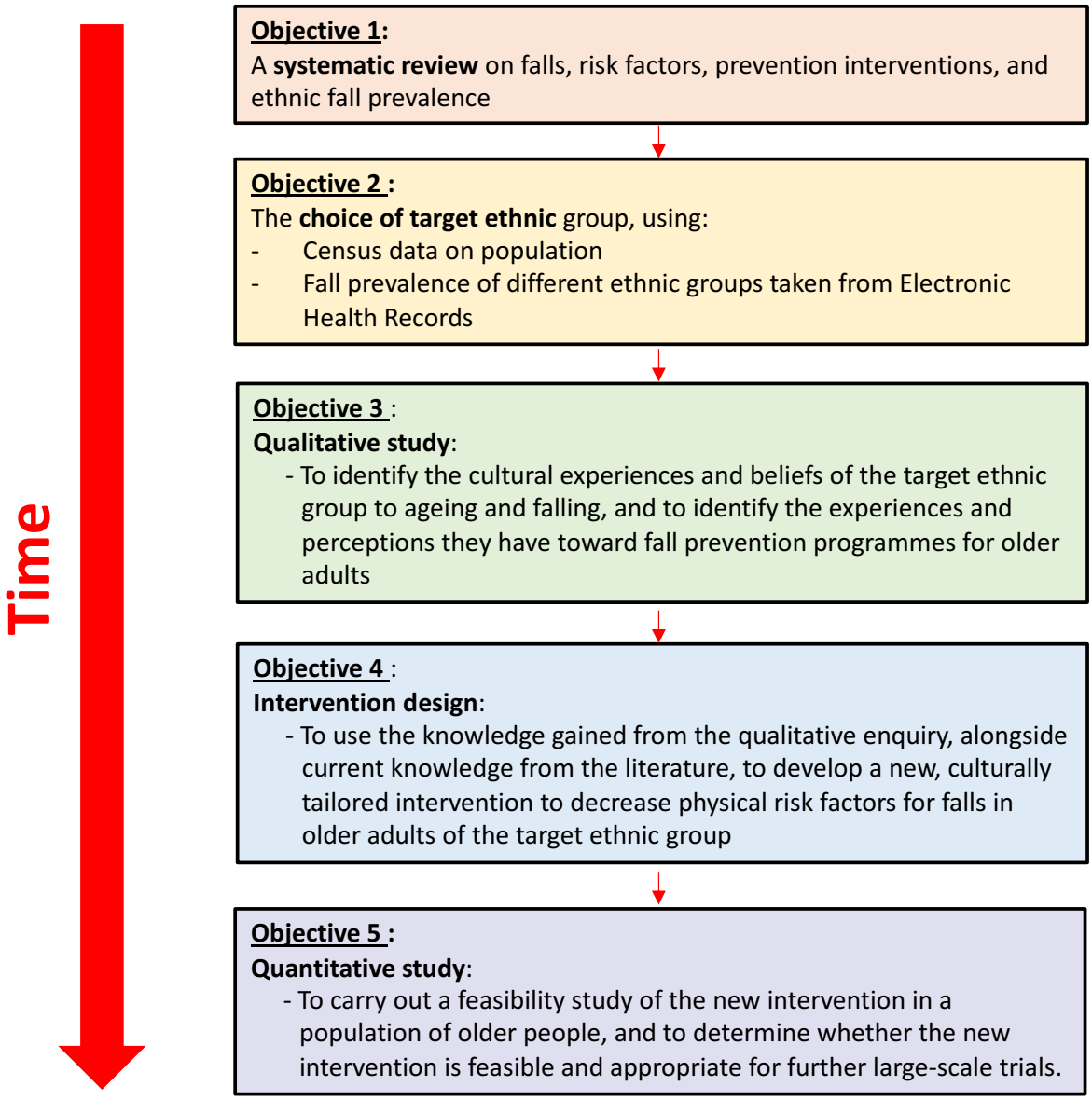


Figure 3: Mixed methods design

The first two objectives are foundational, determining whether ethnic differences exist in reported fall rates, and which ethnic group should be studied within the UK population. Once these factors have been determined, the chosen Caribbean community needs to be the subject of a qualitative study to determine the cultural influences and beliefs they have to ageing and falling, in order to identify the facilitators and barriers toward fall prevention programmes. The information from this study will inform the use of the Behaviour Change Wheel in designing a more ethnically tailored intervention for fall prevention. Finally, a protocol will be created to determine the feasibility of carrying out this intervention.

3.3. Development of a complex health intervention

The Medical Research Council (MRC) developed a model for the development of complex health interventions in 2006 (Craig *et al.*, 2008), updating their advice in 2021 (Skivington *et al.*, 2021). An intervention becomes complex when it involves the interaction of several different factors. The complexity may depend on the number of different components required, the behaviours involved and targeted, the knowledge and skills of both those delivering and receiving the intervention, the numbers of people involved, and the flexibility that can be allowed in delivering the intervention (Skivington *et al.*, 2021). Falls are generally considered a complex area necessitating complex interventions to address issues involved in their prevention (Francis-Coad *et al.*, 2018), and thus this framework is an appropriate approach to use in developing an intervention in this case.

The MRC guidelines include four phases which can be used in a non-linear process, as shown in Figure 4. These include:

- Developing or identifying the intervention
- Feasibility testing
- Evaluating the intervention
- Implementing the intervention

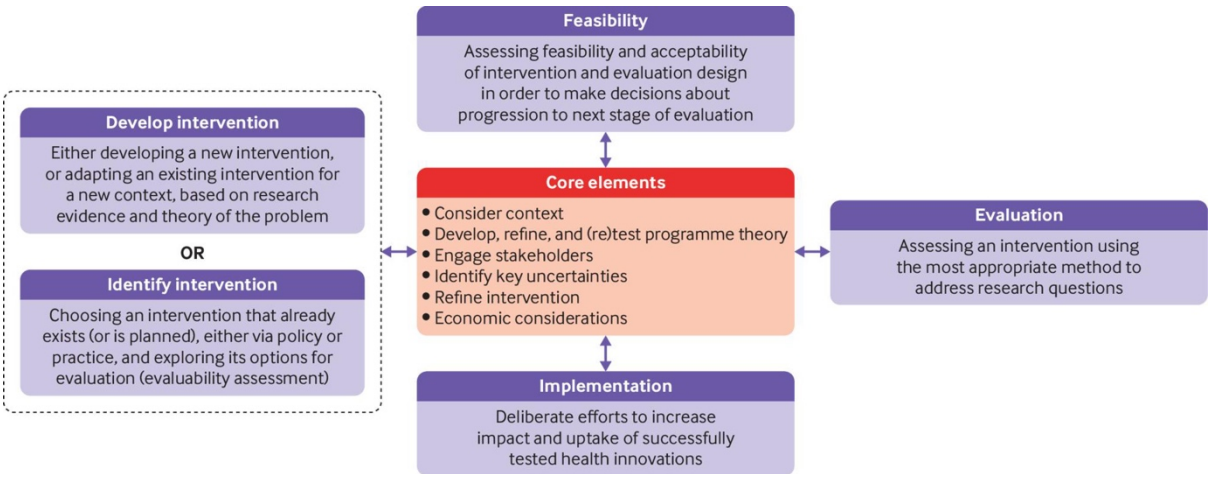


Figure 4: MRC guidelines for the development of a new intervention

In order to respond appropriately to the complexity of the issue and intervention targeted in this study, this study was broken down into the objectives already described in Figure 3. These

objectives fit within the MRC guidelines as follows. The first MRC phase involves the identification of an appropriate evidence base, and in this thesis this was performed via an original systematic review (Wehner-Hewson *et al.*, 2022). It also involves the identification of relevant theory on which to base the novel intervention, as this ensures that the intervention is more likely to be effective than those designed without a foundational theory (Michie *et al.*, 2009). In addition to theory, the qualitative study also takes into account many of the core elements at the centre of the MRC guidelines, including context, stakeholders, uncertainty, acceptability, as shown in Figure 4. In this thesis, the Behaviour Change Wheel was chosen in order to tailor the intervention specifically to the target group. The second MRC phase involves testing of the intervention via a feasibility study, the protocol of which is described in this thesis. This allows for potential weaknesses in the intervention to be identified and refined before committing to a full-scale trial.

This thesis, therefore, is concerned mainly with the first two stages of the MRC guidelines, the development and feasibility stages, as the process of this entire model is greater than the practical restrictions of a PhD, both in terms of time and resources.

3.4. Choice of methodology for the qualitative study

The adoption of qualitative methods provides insight into the rich and complex lived experiences of individuals, providing a greater understanding of the meanings and cultural attitudes towards the issues in question (Braun and Clarke, 2006). Qualitative research methods can be flexible, responding to what is said in each interview, and thus able to allow the development of ideas that are raised by each individual's own personal experience (Creswell, 2014). More specifically, qualitative methods allow the close examination of the "how" and "why" of attitudes and behaviours, allowing the researcher to find meaning in complex phenomena. This insight is particularly important in health research, and is commonly used in developing intervention, and creating explanatory health models and theories (Renjith *et al.*, 2021).

3.4.1 Participant sampling

Although randomised sampling, in which every individual in a population has an equal chance of being selected for interview, is best able to provide results that can be generalised to a population, this is less applicable to qualitative research where depth and understanding are sought rather than generalisation. Purposive or non-random sampling techniques are preferred as they allow in-depth exploration of specific phenomena, thus maximising the information-rich cases applicable to the population in question. By targeting certain populations of participants based on the aims and objectives of the study (Campbell *et al.*, 2020), in this case people who self-identify as Caribbean, a purposive sampling technique was necessary.

The difficulty of even making contact with potential participants during a pandemic, meant that a more pragmatic approach of snowball sampling by using personal contacts of participants to act as gatekeepers and introduce other participants directly, was the only viable option in the circumstances. Snowball sampling is traditionally used to find 'difficult to reach' populations, or where random sampling may not obtain a sufficient sample (Kennedy-Shaffer, Qiu and Hanage, 2021). Fortunately, the need to use several different go-betweens, provided a wide-ranging sample and added variation, thus reducing concerns over bias or a lack of representation in the sample (Stratton, 2021). These participants were then asked to contact any friends who may have been interested in participating to further increase the reach to other potential participants.

3.4.2 Choice of method for data collection

This study initially planned to use focus groups to identify the cultural influences and beliefs of the target ethnic group to ageing and falling, and to identify the facilitators and barriers they have toward fall prevention programmes for OAs. However, with the impact of the Covid-19 pandemic requiring OAs to shelter at home, focus groups were replaced by the semi-structured interview option.

The intention for the qualitative study was to carry out focus groups in order to ascertain their beliefs, attitudes, perceptions, and individual lived experiences of ageing, falling, and PA by OAs within the Caribbean community. This was deemed an appropriate option as the topic

was not a sensitive issue requiring privacy and anonymity, such as sexual health, illegal behaviours, traumatic experiences etc. In addition, focus groups allow for a natural discussion between people with similar characteristics. Ideas build through discussion, a phenomenon known as “piggybacking”, often revealing unexpected information, or encouraging quieter members of the group to participate (Leung and Savithiri, 2009). Unfortunately, the Covid-19 pandemic and subsequent lockdowns meant that these groups were no longer possible. Focus groups were also technologically difficult for this population, as the OAs were not confident with IT, and thus semi-structured interviews had to be conducted by telephone. Semi-structured interviews are also an effective way of exploring the experiences, attitudes, perceptions, and beliefs of individuals (DeJonckheere and Vaughn, 2019), and fortunately, the researcher was experienced in interviewing techniques after many years as a healthcare professional.

3.4.3 Qualitative data analysis

Different methods exist for analysing qualitative data, each with different strengths and weaknesses, which need to be considered before selecting the most appropriate option for the data at hand. The three most common analysis methods for research such as this are grounded theory, framework analysis, and thematic analysis.

3.4.3.1 Grounded theory

Grounded theory is a method of data analysis used to develop a new theory (or theories), through a series of repeated revisions (Renjith *et al.*, 2021). Although it could also be described as a type of research design, it is commonly used as a method of data analysis. One premise of this method is that the researcher should approach analysis with an open mind in order to avoid bias, allowing theory to develop from the *ground up,* or be *grounded* in the lived experiences of the participants, as the name implies (Renjith *et al.*, 2021). However, this means having as little prior knowledge as possible about the population in question and the research question, which may be unwise and impractical. Generally speaking, it is difficult to approach research without a good understanding of the current literature on the subject, and therefore researchers may be required to examine the influence of previously held knowledge on their analysis (Giles, King and de Lacey, 2013). Alternatively, this method may have more use for new and unstudied areas with little previous research in the literature. In this case,

the previous stages of this research, and the existing knowledge and evidence on the topic from many previous studies, made it impossible to begin from a neutral knowledge base, and so this method of data analysis was not used.

3.4.3.2 Framework analysis

Framework analysis (FA) is a method particularly popular for applied or policy-related research due to its focus on the specific research question (Smith and Firth, 2011). This focus differentiates this method from other more inductive approaches, which do not predefine the research, but allows it to develop through the analysis of the data. The *a priori* approach of FA and its highly systematic process allows for transparent processes, increasing the rigour and thus the validity of findings. However, this prior identification of themes makes it an inappropriate choice for this research question, which necessarily required a more inductive approach.

3.4.3.3 Choice of Thematic analysis

Thematic analysis (TA) identifies patterns in the data and linking these to create themes. It is flexible, practicable, and easily accessible for all participants (Braun and Clarke, 2006). This method was chosen as the analysis method for this thesis. Not only does this method fit with the epistemological stance of the researcher, but it is also commonly used in exploratory research. This inductive method allowed for the generated data to represent the beliefs of the target group, rather than relying on pre-determined themes (Nowell *et al.*, 2017). This helps to reduce bias by the coder, ensure that the themes generated reflect the data obtained, and offers the possibility of generating new theory form the data (Bradley, Curry and Devers, 2007). This was particularly important in this instance, as the beliefs and attitudes of this target group to PA and falls is under-researched.

The patterns, or themes, in the data were identified using an inductive approach, where themes are often described as “emerging” from the data. In simple terms, this means that the TA is driven by the data, rather than being moulded into a pre-existing framework. However, in reality data patterns do not “emerge” spontaneously, but are influenced by the researcher themselves, how they choose to interpret the data, their ontological and epistemological positions, preconceptions, and personal perspectives. This means that the process is

necessarily reflexive, requiring an iterative system where the data is reviewed several times, allowing new patterns and connections to be found, and resulting in a more profound understanding of the meaning (Srivastava and Hopwood, 2009).

The process described by Braun and Clarke (2006) was followed in analysing the data from the qualitative interviews. This is a 6-step process, although not a linear one as previously discussed, and progress through the stages may be forward or backwards as required (Braun and Clarke, 2006). These stages were followed as described below:

Stage 1: Familiarising yourself with your data: The researcher carried out all interviews thus bringing a degree of acquaintance with the data from the start. Transcription of all interviews was also done by the researcher. The concentration on the exact words spoken in order to transcribe faithfully the interviews, brought an additional layer of awareness of the data. The transcription of all verbal utterances, including slang terms and "Caribbean" turns of phrase allowed the "music" of the conversation to be preserved, and a greater confidence with the content. Finally, all transcribed interviews were actively read several times before passing to the next stage.

Stage 2: Generating initial codes: Open-coding was carried out using NVivo12 software, allocating codes to segments of text in order to classify all the aspects of the data. A second researcher independently coded three randomly selected interviews, and the results were compared. Any significant differences were discussed, and this informed the coding of the interviews as a whole.

Stage 3: Searching for themes: This stage involved taking the long list of codes created in Stage 2, and finding the broader patterns between them to identify themes. Again, this stage was carried out in collaboration with a second researcher in order to reach a consensus on the themes identified.

Stage 4: Reviewing themes: This stage concentrates on refining the themes generated in Stage 3 and has two central objectives. The first was to review the data within each theme, identifying themes with little data to substantiate them, or where the data within the theme

was not particularly homogenous. Once the themes were confirmed to accurately reflect the data within them, the second objective was to verify the cohesion of the themes between each other, making sure that each one was distinct without too much similarity with other themes, and that they were a good reflection of the data as a whole.

Stage 5: Defining and naming themes: This stage involved further refining the themes, and taking into account their hierarchies. How each theme related to the others, and how together they reflected the overall phenomenon being studied, determined how well they answer the research objective. Larger themes could be broken into subthemes, giving structure and meaning to an otherwise cumbersome theme. It was also important that this stage began to examine the language used to name each theme. It is important that the name accurately described the meaning of the theme and the data content. There can be significant movement back and forth between Stages 3, 4, and 5 in order to obtain good clear themes.

Stage 6: Producing the report: The writing up of qualitative results was a task that took a considerable amount of information collected from the participants lived experiences, and presented it in a way that convinces the reader of the legitimacy of the researcher's analysis. It should be a logical and concise description of the data, evidenced by examples of the data that "illustrate" the validity of the themes obtained.

3.5. Health Behaviour Change Theories

While changing behaviour is clearly a challenging process, failures may often be due to "intuitive" methodologies whereby an intervention may be based on a favoured theory or personal experience. Instead, using interventions that have been informed systematically, and with appropriate theory are more likely to be effective (Michie *et al.*, 2009). Choosing the most appropriate behaviour change theory assists in identifying the central factors in the intervention that are related to behaviour, and thus more effectively targeting the intervention to improve its impact. Behaviour change is notoriously difficult, and by including behaviour change theory into the creation of a fall prevention programme, it is possible to improve exercise adherence (Meade *et al.*, 2019). Behaviour change theory has been used to

better understand a number of health-related behaviours, and the principal theories (Sulat *et al.*, 2018) are summarised below.

3.5.1.1 The Theory of Planned Behaviour

The Theory of Planned Behaviour (TPB) by Ajzen (1985) built on the Theory of Reasoned Action which he created in 1975 with his colleague Martin Fishbein (1975). It states that behaviour, or action, is created by one's intentions. Intentions are described as being determined by three factors: attitude, subjective norms, and perceived behavioural control (PBC). Attitude is related to the individual's evaluation of the potential outcomes of performing the behaviour. If they believe that the behaviour will have a positive outcome, then they will have a positive attitude towards the behaviour. If their beliefs toward the outcome are negative, then their attitude will be also. Subjective norms are related to the societal pressures (approval or disapproval) perceived by the individual as to whether they should perform the behaviour or not. A person is more likely to perform a behaviour if they perceive that significant others feel that they should, or the reverse if they feel that the behaviour is disapproved of. Perceived behavioural control refers to the belief that a person has, as to how likely they are to be able to carry out a certain behaviour. When they feel more likely that they will be successful, they will have a stronger intent to perform it.

The use of the TPB for PA is widespread. In a study of the motivations of Australian OAs for participating in exercise, both attitude and PBC had a significant effect on the autonomous motivation on intention, but not subjective norms (Arnautovska *et al.*, 2019). Similarly, a study from Malaysia among sarcopenic elderly demonstrated that components of the TPB were predictive of exercise intention, although the components differed with gender. Men's intention to exercise was predicted by attitude and PBC, whereas subjective norms were the best predictor for women (Ahmad *et al.*, 2014).

There do appear to be limitations to the use of this theory, however. A systematic review by Hardeman et al (2002) was unable to find adequate evidence among a review of 24 studies, to comment on the effectiveness of the theory. In addition, other experimental studies have identified variations in the components of the TPB (attitude, PBC, and subjective norms), which have not resulted in the expected behaviour change (Chatzisarantis and Hagger, 2005;

Sniehotta, 2009). This is possibly due to the so-called "intention-behaviour gap" where intention does not always cause people to follow through with the desired behaviour (Sniehotta, Presseau and Araujo-Soares, 2014). This may indicate that the likelihood of behaviour change may not be accurately predicted by intention. Overall therefore, it appears that while the TPB provides valuable insights into understanding behaviour change, a more comprehensive approach to behaviour change should be adopted.

3.5.1.2 Social Cognitive Theory

Social Cognitive Theory (SCT) is a theory (Bandura, 1986) that builds on the earlier Social Learning Theory. It states that learning occurs via the observation of others through social interactions, experiences, or media. By observing a behaviour performed by another, and seeing its consequences, that information can be used by the individual to guide their own future behaviour. The theory proposes that learning occurs via a reciprocal triadic relationship between behavioural factors, environmental factors, and personal cognitive factors. Behavioural factors refer to the behaviour performed and the response received, positive or negative, reward or punishment. Environmental factors refer to the social and physical factors that impact the ability of the individual to carry out the behaviour successfully. Personal cognitive factors refer to the individual's ability to determine and regulate their own behaviours, the beliefs they hold about their ability to successfully carry them, out and to analyse their experience.

SCT has been a popular choice in studies related to PA, but with varied results. In a study where it was used to evaluate the individual, social, and environmental correlates of PA among African-American OAs, both self-efficacy and outcome expectations were found to be important correlates of PA (Gothe, 2018). However, although a systematic review and meta-analysis by Sansano-Nadal et al (2019) investigating strategies to improve the long-term sustainability of PA in OAs found that most strategies were based on SCT, the results were inconclusive and heterogeneous as to its benefit.

Given the complexity of the theory, it does have limitations which should be considered when deciding to choose it. It is a complex theory with many different components. This makes it difficult to determine the contribution of each component in any given situation, and many

studies simply concentrate on one or two, such as self-efficacy, without taking the theory in its entirety into account. Learning by observation can occur without any notable change in behaviour, making it difficult to quantify. The theory also fails to account for behaviours due to emotional, biological, or hormonal responses, which may influence behaviour in spite of past experience.

3.5.1.3 The Transtheoretical Model

The Transtheoretical Model (TTM) was developed following the observation of addictive behaviours, in this case smoking, and why some people were able to stop their behaviour on their own (Prochaska and Diclemente, 1982; Prochaska and DiClemente, 1986; Prochaska, Diclemente and Norcross, 1992). It is not a theory, but a model of intentional change, focussing on the decision-making of the individual, and their ability to make positive choices. Behaviour change is not viewed as an event, and thus is not expected to be an immediate or rapid process, but rather one that moves through a cyclical process. Relapsing or recycling where individuals fall back to an earlier stage, before resuming the forward path through the stages again, often occurs throughout the process.

There are five phases in the cycle based on behaviour and intention. They are:

- *Pre-contemplation*: people have no intention of changing their behaviour in the future, and are often unaware that their behaviour is problematic. They often underestimate the benefits of changing, and overestimate the difficulties.
- *Contemplation*: people are intending to change their behaviour in the future. They recognise that their behaviour is harmful, but may still feel ambivalent about the change.
- *Preparation*: people are ready to begin the process of change imminently. They begin to make small changes in their lives, and to believe that change will lead to a healthier life.
- *Action*: people have recently changed their behaviour and intend to continue.
- *Maintenance*: behaviour change has now been sustained for some time and the intent is to continue this new behaviour. People continue to work to avoid relapsing to earlier phases.

A sixth stage of termination exists, where there is no risk of the person returning to their unhealthy behaviours. As this is extremely rare, most people remain in stage 5.

The Transtheoretical Model is based on four interrelated constructs which are considered essential to bring about successful behaviour change: processes of change, decisional balance, self-efficacy, and temptation. While the phases of change describe the changes that take place during the process of changing behaviour, there are also ten Processes of Change which explain how these changes happen, including both cognitive and affective experiential processes, and behavioural processes. Decisional balance refers to the pros and cons of behaviour change as seen by an individual. At the start of the process, the cons outweigh the pros, and thus the individual is not prepared to make any changes to their behaviour. As the decisional balance begins to shift, the pros begin to increase, and eventually outweigh the cons, leading to positive behaviour change. Self-efficacy refers to the degree of confidence that an individual has in their ability to maintain the behaviour change. This increases as they progress through the different phases. Temptation is somewhat linked to self-efficacy in that it describes the individual's confidence in maintaining their behaviour change in the face of temptation, or difficult situations. Relapse occurs when feelings of temptation trump self-efficacy, leading the individual to engage in the unhealthy behaviour.

While the TTM has appeared frequently in health research, its results have been mixed. Although some studies have found a positive effect from the use of TTM, such as increasing PA levels and lowering fall risk in OAs (Kosma and Cardinal, 2016), a systematic review of the use of TTM on health behaviour interventions, found limited effectiveness for stage-based interventions as a basis for behaviour change (Bridle *et al.*, 2005).

There are several criticisms of this model (West, 2005). The first is that the essential building blocks of the theory, the "stages" are arbitrary, and a more coherent definition of the stage is needed. There is also a lack of clarity on the timeframe of each stage and how long an individual can remain in each stage. The TTM also infers that individuals make clear and logical decisions about their behaviour, when in fact, intentions related to behaviour change seldom appear to be precisely developed in advance. The model also ignores the social contexts in which change takes place, such as socioeconomic status and income.

3.5.1.4 The Health Belief Model

The Health Belief Model (HBM) is a model whereby a person's belief of perceived threat of a disease, together with their belief in the effectiveness of a health behaviour or action, predicts the chances of that person adopting the behaviour. There are six central constructs to the HBM:

1. Perceived susceptibility: the person's feeling of vulnerability to a disease, or in this case to falling (Meredith *et al.*, 2023).
2. Perceived severity: how severe the person believes the disease to be. Often both medical (eg. chance of death, permanent disability…) and social (eg. personal relationships, loss of employment…) consequences will be taken into account when determining this. For OAs FoF, can significantly impact their engagement in PA (Sales, Levinger and Polman, 2017), and is correlated with fall risk (Singh, Belanger and Thomas, 2018).
3. Perceived benefits: how effective the person believes the change of behaviour will be in reducing the threat of the disease. OAs view PA as highly effective in maintaining good health and staying independent (Sandlund *et al.*, 2017).
4. Perceived barriers: this allows a cost/benefit evaluation where the person weighs up the effectiveness of the behaviour against their negative perceptions that it may be expensive, unpleasant, time-consuming… Many OAs have concerns about the potential risks of PA such as it actually causing a fall, or having other unpleasant side-effects (Sandlund *et al.*, 2017).
5. Cue-to-action: this is the stimulus that triggers the decision-making process, and may be internal (eg. medical symptoms such as chest pain) or external (eg. advice from a GP, a family member falling ill…). For fall prevention, cues such as experiences of falls by friends, opinions of family, and TV advertisements were not shown to have an effect on behaviour in Chinese OAs (Li *et al.*, 2019).
6. Self-efficacy: the person's confidence that they are able to successfully carry out the behaviour change. This has been shown to predict both PA and fall risk (Kosma and Cardinal, 2016).

The HBM has been widely implemented to alter health related behaviours by targeting different aspects of the central constructs. In terms of fall prevention, it has been used mainly

to discover the areas that should be targeted such as educating OAs on the benefits of fall prevention programmes, and improving the accessibility of resources (Li *et al.*, 2019).

The HBM does have several important limitations however, as it fails to take several important factors into account that also strongly influence behavioural choices (Janz and Becker, 1984). These include factors such as personal attitudes or beliefs (eg. cultural or religious), environmental or economic factors, behaviours that are habitual, or behaviours that are performed for reasons other than health such as social acceptability. The model also assumes that individuals all have equal access to accurate information about the disease in question, and that behavioural decisions are always made with health as the main goal. Overall, it is more of a descriptive tool than an explanatory one. For the work of this thesis, cultural attitudes and beliefs are core to understanding the perspectives of a specific ethnic group to falls and PA, and as such, this model is less adapted to the aims of the study.

3.5.1.5 The Social Ecological Model

The Social Ecological Model (SEM) was first introduced in the 1970s by Bronfenbrenner in order to describe human development (Bronfenbrenner, 1977; Bronfenbrenner, 1979), but has since become popular for describing health promotion and behaviour change. The model is based on systems theory, in which complex systems cannot be properly understood without a clear picture of all the component parts from the micro to the macro level, and how they interact with, and change each other. Each level or system is nested within the next and encompasses the microsystem, the mesosystem, the exosystem, and the macrosystem.

The SEM was subsequently developed for use in health promotion by McLeroy et al (1988). Here, health behaviour is shown to be influenced at five levels. At the intrapersonal level, the knowledge, beliefs, attitudes and self-efficacy of the person are included. The interpersonal level includes their relationships with family and friends. The organisational/institutional level includes workplaces, community groups, churches etc, all of which have their own rules and regulations that may either promote or inhibit healthy behaviours. The community level is where culture and norms that influence behaviour are formed, and finally public policy is the outermost layer, where laws and policies that influence health behaviour are created. The influences in this model are dynamic, and multi-directional, and their influences on behaviour

can be used to predict the ease with which behaviours will be selected. For desired behaviour change to occur, individuals must be well educated and motivated, appropriately supported both by close social networks, as well as policy and environmental factors, and surrounded by a climate of positive social norms.

In relation to PA among OAs, the SEM is popular due to its attention to the multiple layers of influence on the specific facilitators and barriers to PA for this group. It is therefore considered useful in developing interventions to increase PA (Voss, Pope and Copeland, 2020), or determining the importance of different planning choices in the promotion of PA to this age group (Wang *et al.*, 2019).

While the SEM has shown its utility in understanding why people behave the way that they do, it does have its limitations. While the model highlights numerous factors that contribute to a particular choice of behaviour, these factors are not compared by the importance of that contribution. This makes the targeting of an intervention to change an unhealthy behaviour choice to a healthier option, difficult. At the higher levels of influence, there is a notable lack of motivation to make change, due to the costs and complexities of making changes to national laws or policies (Sallis *et al.*, 2006).

3.5.1.6 Choice of the Behaviour Change Wheel

The Behaviour Change Wheel (BCW) was created by Michie et al (2011) following a systematic review of 19 different theories of behaviour change. At the hub of the wheel are three essential conditions comprising the COM-B system, as shown in Figure 5. Changing behaviour involves having the *Capability* to carry out the new behaviour, including both the physical skill and the knowledge and psychological skills necessary. The *Motivation* to make the change is necessary, including both reflective motivation (eg. intentions and beliefs), and automatic motivation (eg. emotional reactions, impulses and desires). Finally, one must have the *Opportunity* to carry it out, including the physical opportunity (eg. resources, and time), and social opportunity (eg. societal cues, norms, and interpersonal influences). These can all differ greatly between individuals, situations, and the behaviour to be changed. Encircling the central hub are nine different intervention functions which are used to intervene to improve capability, motivation, or opportunity, where appropriate, and finally the whole is surrounded

by seven policy categories that could facilitate interventions. Failure to take any one of these factors into account can weaken the quality of the intervention produced, and therefore decrease adherence.

The BCW uses a three-step process to aide in the creation of a new intervention. The first step is to develop as deep an understanding of the behaviour to be changed as possible. Next, the intervention functions and policy categories are used in order to determine the options that would be the most effective in bringing about a change in the target behaviour. The final step establishes the behaviour change techniques necessary to bring about that change that allows successful intervention selection, and also details exactly how that intervention will be delivered.

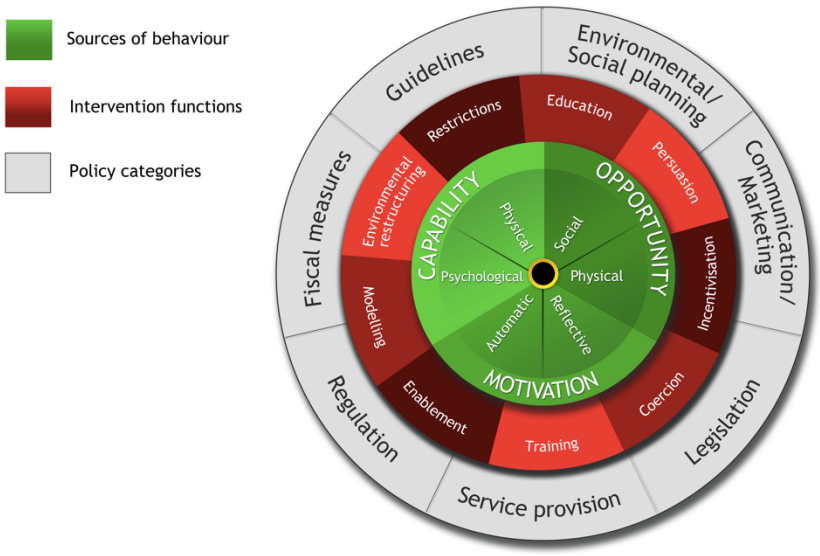


Figure 5: The Behaviour Change Wheel

Reproduced from (Michie, van Stralen and West, 2011).

Therefore, the first stage in developing a fall prevention intervention for a particular ethnic group is to understand the issue of falling from their perspective. Fall prevention is the desired outcome of this intervention, but the behaviour being targeted in order to achieve this outcome is increased PA. This has been shown in the literature review to be the most effective intervention to prevent falls, and therefore it is important that this behaviour of increasing

PA is addressed in behavioural terms, in order to target the specific behaviour(s) that is/are likely to address the problem or falling. In order for the intervention to be effective, adherence to PA must be maximised (Simek, McPhate and Haines, 2012), and therefore the specific facilitators and barriers for the group in question must be determined (Horton and Dickinson, 2011). It is also important to observe these factors from the point of view of all the stakeholders involved. While the older people will be the ones taking part in the intervention, the opinion of religious leaders, community leaders, and relevant health professionals will also have an impact. Not only will they provide a rich source of information on which to base the intervention, they could also lend an authority to the project, granting a seal-of-approval that could provide a catalyst to both uptake and adherence by the community as a whole (Rosenkranz *et al.*, 2013).

The use of a MM design in this research project, combining both qualitative and quantitative components, has been particularly recommended for understanding cultural and contextual impacts in intervention design (Nastasi and Hitchcock, 2016). The research paradigm underlying the choice of a mixed methods approach is one of pragmatism. This eschewing of the notions of truth and reality, and relying more on what works, offers a more flexible approach to problem solving which is in line with the flexibility encouraged in the MRC guidelines (Skivington *et al.*, 2021).

4. Systematic Review and Meta-analysis

This systematic review was carried out in accordance with the MRC framework, the first stage of which specifies that existing evidence be identified. If no recent systematic reviews of relevant evidence can be identified, or if their quality is inadequate, then it is recommended that one should be carried out as a first phase in the development of a complex intervention.

4.1. Introduction

As previously discussed in the literature review, falls are a common problem for OAs, and consequences can be wide-ranging (James *et al.*, 2020). From minor bruising, to hip fracture, institutionalisation, and even death, the costs are not only personal, but also considerable for the care system (Scuffham, Chaplin and Legood, 2003; Salkeld *et al.*, 2000; Khow and Visvanathan, 2017). Considerable evidence already exists on fall risks, demonstrating higher risks for women and with increasing age (Deandrea *et al.*, 2010), however, less is known about differences in the prevalence of falls between ethnic groups.

Health inequalities between different ethnic groups are well documented. In Europe for example, ethnic groups such as South Asians, Black Africans and Black Caribbeans experience higher rates of obesity, diabetes and cardiovascular disease, compared to White Europeans (Patel *et al.*, 2017; Bhopal, 2009). These inequalities are due to underlying causal factors such as socio-economic factors, including lower levels of education, income, employment and even the built environment, although the contribution each factor plays, and exactly how they interact is difficult to determine. In addition, these inequalities often persist after controlling for socioeconomic disadvantage, suggesting that structural influences such as disparity and discrimination in access to health and social care (Evandrou *et al.*, 2016), or cultural differences in behaviours or beliefs may be important factors (Hui *et al.*, 2020).

Health inequalities occur across all age groups, but the greatest differences in health between ethnic groups are among OAs (Sproston and Mindell, 2006). Health inequalities in older people are likely to increase due to population ageing in countries of all income groups (World Health Organization, 2015). People are now living for a considerable period in declining

health, due to age associated health conditions such as frailty (Clegg *et al.*, 2013). Falls in particular have been shown to increase throughout 'older age' although it is not well understood how ethnic minorities are affected by life course health inequalities as they enter old age (Brothers, Theou and Rockwood, 2014; Herd, Robert and House, 2011).

As noted previously, the worldwide annual prevalence of falls is high, commonly reported as being a third for adults aged over sixty-five (Gale, Cooper and Sayer, 2015), increasing to 40% for those over eighty years of age (Tinetti, Speechley and Ginter, 1988). However, the commonly reported fall prevalence of one-third is usually associated with studies carried out in Western countries, whereas other countries have reported differences in fall prevalence. For instance, China and Japan have noticeably lower reported fall rates than those seen in the West. A systematic review by Kwan et al. (Kwan *et al.*, 2011) reported a median fall prevalence of 18% in Chinese people from a sample of 21 studies. However, there have been very few studies looking at fall rates in pluricultural populations. Different ethnic groups within a country share common local cultural factors, while potentially differing in specific factors related to ethnicity. For example, within a community, obesity may be more prevalent in a particular ethnic group, even though all members of the community can be expected to be exposed to the same public health messaging about its risks via various media. This may be due to cultural attitudes to PA, food preferences, and body image (Blankinship *et al.*, 2021).

As the evidence clearly demonstrates differences in health outcomes between different ethnic groups, and there may be evidence to suggest that there are also differences in fall prevalence, it is important to understand whether there are in fact differences in fall rates between different ethnic groups. This could allow resources to be targeted to groups that fall more, to try to reduce fall risk factors in these groups.

The aim of this systematic review is therefore to determine whether differences in reported fall rates exist between different ethnic groups worldwide.

4.2. Methods

4.2.1 Search Strategy

The search was performed and reported following the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) (Liberati et al., 2009). Searches were carried out on the following databases: Medline, Cumulative Index to Nursing and Allied Health Literature (CINAHL), Scopus and Web of Science. Other relevant studies were also identified following individual searches of the reference lists in the articles selected. There was no limitation in publication date, and any articles that satisfied the search criteria were selected, up to the date of search, the end of December 2020. The Cochrane Population, Intervention, Comparison, Outcome (PICO) methodology was used to determine the keywords to be used in the search (Lockwood, Munn and Porritt, 2015). A summary of the PICO search strategy is shown in Table 3.

4.2.2 Selection Criteria

This review included studies of community-dwelling participants, while studies including institutionalised people (hospitals, care homes…) were excluded. All participants were aged 60 + years, and any studies including younger participants were excluded. To be included, studies needed to provide results separately either for all ethnic groups in the same country, or the same ethnic group in multiple countries. Studies where ethnic identity was not specified, contained mixed ethnic groups, groups titled ‘other’, or had only single ethnic groups with no comparison to others, were excluded. Studies needed to report fall prevalence, either as number of falls, rate of falls or number of participants who experienced at least one fall, to be included. Only studies written in English were included.

Table 3: PICO Search Keywords and MeSH terms

PICO Term	Description	Keywords/MeSH	Search location
P – Population	Participants aged 60+	Elder* OR older	Title/Abstract
		Aged	MeSH heading
	Community-dwelling	-	
	Ethnically or culturally homogenous population	Ethni* OR culture* OR rac*	Title/Abstract
I - Intervention	None	-	N/A
C – Comparison	Studies must include a comparison between two or more ethnic/cultural/racial groups	-	N/A
O – Outcome(s)	Primary: Fall prevalence	Fall*	Title/Abstract,
		Fall	MeSH heading
	Secondary: Fall with injury prevalence	-	N/A
T – Time	Unlimited	-	N/A
S – Study Design	Any quantitative study	-	N/A

4.2.3 Data Extraction

Keyword searches were carried out on all four databases. The results were imported into EndNote X9 (Clarivate Analytics, Philadelphia, PA, USA), and all duplicates were removed. All titles and abstracts were reviewed independently by two researchers to determine relevant studies. Full text versions of each paper were obtained for detailed review and extraction of data, also by two researchers independently. Selected data from each study were entered on an Excel template, with extracted data including participant demographics such as age, ethnicity, country of study, living situation, whether the group was ethnically homogeneous, comparison of two or more ethnic groups, fall prevalence and study design. Selected studies were critically assessed using the 'Quality Assessment Tool for Observational Cohort and Cross-Sectional Studies' (National Heart Lung and Blood Institute). Fourteen questions were answered as 'yes', 'no' or 'Other (cannot be determined, not applicable, not reported)'. Two reviewers assessed all articles independently, and any disagreements were resolved following

discussion with a third party. A score was generated as a percentage, without considering any 'not applicable' responses. Scores rated < 50% were considered to be 'poor', with 50–74% considered to be 'fair', while those rated ≥ 75% considered to be of 'good' quality.

4.2.4 Meta-Analysis

Following the systematic review, quantitative meta-analysis was carried out in order to provide an overall fall prevalence for the largest groups present in the literature. The different ethnic groups were combined, where possible, under four general headings: Asian (including Asian, Chinese, Filipino and Japanese), Black (including African-American, Afro-Caribbean, Black, and Black-African), Hispanic (including Latino and Hispanic) and White (including Australian-born Australian, Caucasian, European-American, Italian-born Australian and Non-Hispanic White). These groups were chosen based on the NIH definitions for racial and ethnic Categories (National Institutes of Health, 2015).

The heterogeneity of the selected studies was evaluated using the I^2 statistic, with boundaries of 25%, 50% and 75% taken to represent low, moderate and high heterogeneity, respectively (Higgins *et al.*, 2003). Due to the high heterogeneity found across the studies with a fixed model, a random effects model was used for all meta-analyses. The meta-analysis was performed using a Microsoft Excel spreadsheet adapted from Neyeloff et al. (2012). Fall prevalence rates were weighted across ethnic groups using the inverse variance for each study. Data were reported as mean prevalence rates and 95% confidence intervals, with statistical significance taken to be $p < 0.05$. Forest plots were used to visualize the distribution of the fall prevalence data from the different studies included.

Sub-group analysis was performed for the four ethnic groups of Asian, Black, Hispanic, and White, using the methods recommended by Borenstein and Higgins (2013) A plural effects model was used for the subgroup analysis, which consists of a random effects model within subgroups, and a pooled estimate of τ^2T2 across all groups owing to the small number of studies in the Hispanic subgroup (Borenstein *et al.*, 2009). A Q test based on analysis of variance was used to compare groups.

4.3. Results

4.3.1 Article Selection

The article selection PRISMA flowchart for this systematic review is included in Figure 6. A total of 9653 articles was identified during the database searches, which decreased to 6339 following removal of duplicates. After title and abstract screening, 6272 articles were removed leaving 67 articles for full-text appraisal. A further 44 articles were excluded due to reasons including lack of ethnic comparison, the inclusion of participants under the age of 60, non-English language articles, ethnic groups that were not homogeneous or participants who were not community-dwelling. The final selection consisted of 23 articles, the characteristics of which are shown in Table 4, including quality appraisal scores.

4.3.2 Article Description

The selected articles included 5,727,024 participants overall, with study sample sizes ranging from 114 (Sampaio *et al.*, 2013) to 5,519,341 (Stevens *et al.*, 2008). Studies were conducted with many different ethnic groups in several countries. There were 13 studies in the USA; two studies in Australia, Japan, Malaysia and Singapore; and 1 study from Brazil, Hong Kong, The Netherlands, South Africa and Taiwan. The 23 articles included nineteen retrospective studies, three prospective studies and one Electronic Medical Record study. Of the retrospective studies, 16 reported falls in the previous 12 months, two reported falls in the previous 24 months, while one study looked at falls in the previous 3 months.

4.3.3 Quality Assessment

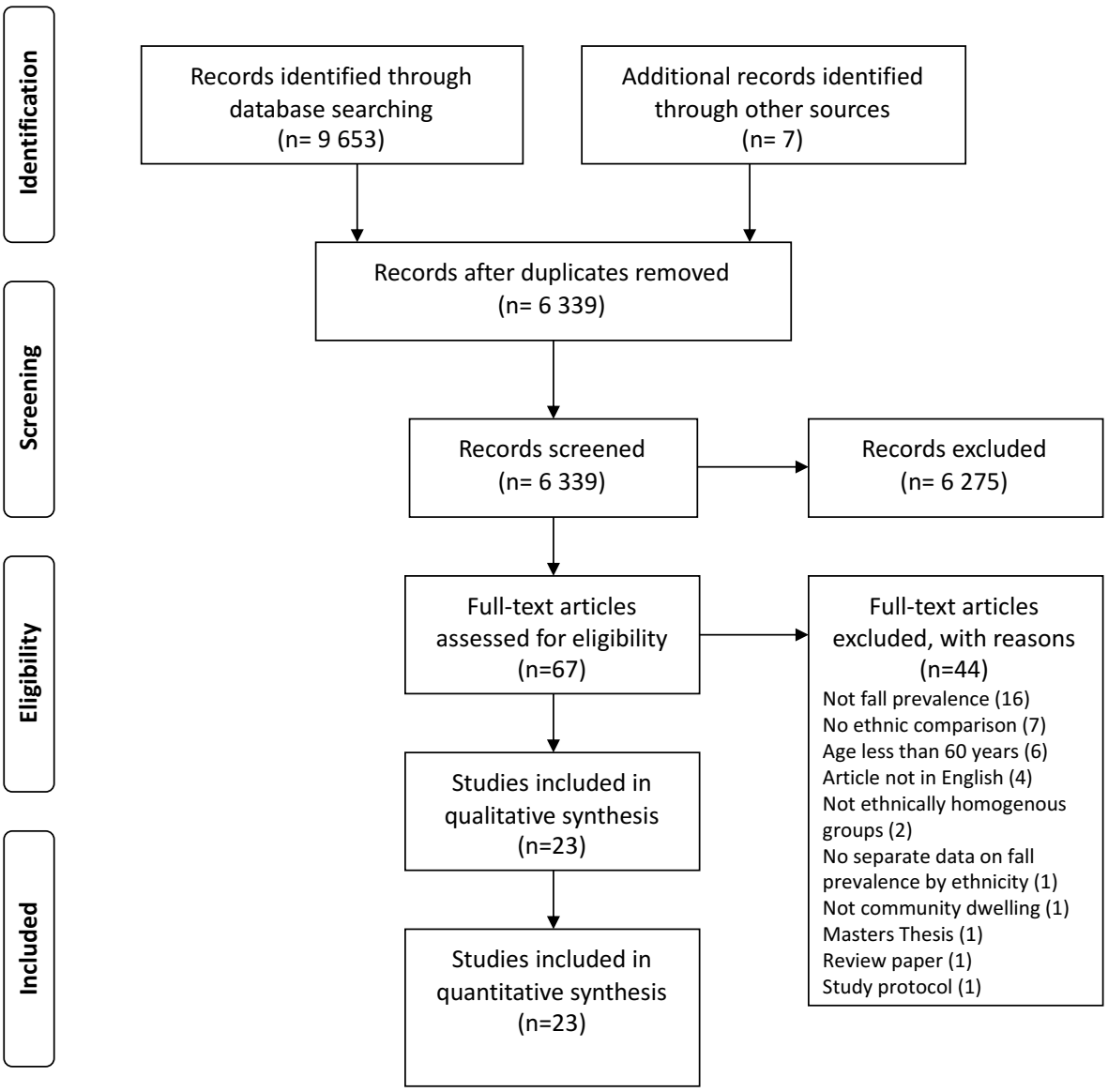
The quality appraisal scores ranged from 60 to 100% of the maximum score for each article. Of the 23 studies included, 6 were rated as fair, with the remaining 17 articles rated as good.

4.3.4 Fall Prevalence

Fall prevalence was reported for 22 of the 23 studies and is shown in Table 5. Prevalence varied widely across the studies, from 2.9% (95% CI: 0.1, 5.6) for Chinese people in Malaysia (Yeong *et al.*, 2016), to 44.5% (95% CI: 37.8, 51.2) for Malays in Malaysia (Leong Joyce *et al.*, 2020).

A meta-analysis of fall prevalence was undertaken only for those 16 retrospective studies that reported falls in the previous 12 months, with Forest Plots shown in Figure 7, Figure 8, Figure 9, and Figure 10.

The subgroup analysis showed that there was a significant effect of ethnic group on fall rate (Q=48.49, df=3, p<0.0001). The Asian group had the lowest fall prevalence at 13.90% (10.69, 17.11). The Hispanic group had a fall prevalence of 18.54% (12.95, 24.13), closely followed by the Black group at 18.60% (13.27, 23.93). The White group had the highest prevalence at 23.77% (18.66, 28.88). Heterogeneity of studies included in the meta-analysis was low for the Black, and White groups, with I^2 v measures of 17.57, and 18.96 respectively. It was high for both the Asian group at 56.63 and the Hispanic group at 55.49.



From: Moher D, Liberati A, Tetzlaff J, Altman DG, The PRISMA Group (2009). *P*referred *R*eporting *I*tems for *S*ystematic Reviews and *M*eta-*A*nalyses: The PRISMA Statement. PLoS Med 6(7): e1000097. doi:10.1371/journal.pmed1000097

For more information, visit www.prisma-statement.org.

Figure 6: PRISMA flowchart of the article selection process

Modified from (Liberati et al., 2009)

Table 4: Characteristics of selected articles

Authors	Country	Ethnic group	Age	Fall reporting	Quality Score (%)
Aoyagi et al. (1998) [27]	Japan	Japanese	≥65 years	Retrospective 12 months	60.0
	USA	Japanese			
Chan et al. (1997) [28]	Singapore	Chinese, Indian, Malay	≥60 years	Retrospective 12 months	60.0
Chen et al. (2018) [29]	Singapore	Chinese, Indian, Malay	≥65 years	Retrospective 12 months	87.5
Davis et al. (1999) [30]	USA mainland	White	≥65 years	Prospective 24 months	90.0
	Hawaii	Japanese	≥65 years		
de Rekeneire et al. (2003) [31]	USA	Black, White	70-79 years	Retrospective 12 months	87.5
El Fakiri et al. (2018)	The Netherlands	White, Moroccan, Surinamese, Turkish	≥65 years	Retrospective 12 months	70.0
Faulkner et al. (2005) [32]	USA	Black, White	≥65 years	Prospective every 4 months for up to 5.7 years	88.9
Geng et al. (2017) [33]	USA	Asian, Black, Hispanic, White	65-90 years	Retrospective 12 months	80.0
Hanlon et al. (2002) [34]	USA	Black, White	≥65 years	Retrospective 12 months	90.0
Kalula et al. (2015) [35]	South Africa	Black African, White	≥65 years	Retrospective 12 months	72.7
Karter et al. (2015) [36]	USA	Asian, Black, Filipino, Hispanic, White	≥60 years	EMR data only	100.0
Kwan et al. (2013) [37]	Hong Kong	Chinese	≥65 years	Prospective 12 months	100.0
	Taiwan	Chinese		Prospective 24 months	
	Australia	Chinese		Prospective 12 months	
	Australia	White		Prospective 12 months	
Kwon et al. (2018)	USA	Asian, Black, Hispanic, White	≥65 years	Retrospective 12 months	77.8
Leong Joyce et al. (2020) [38]	Malaysia	Chinese, Indian, Malay	≥60 years	Retrospective 12 months	80.0
Means et al. (2000) [39]	USA	Black, White	≥65 years	Retrospective 12 months	66.7

Table 5: Prevalence of falls

Authors	Country	Ethnic group	Sample size	Type of fall	Fall prevalence (%)	95% Confidence Interval
Aoyagi et al. (1998)	Japan	Japanese	1534	Single fall	15.2%	(13.2, 17.1)
	USA	Japanese-American	1054	Single fall	14.6%	12.3, 16.9)
Chan et al. (1997)	Singapore	Indian	24	Single fall	4.2%	(0.0, 12.2)
	Singapore	Chinese	333	Single fall	17.1%	(13.1, 21.2)
	Singapore	Malay	31	Single fall	35.5%	(18.6, 52.3)
Chen et al. (2018)	Singapore	Malay	327	Injurious	4.6%	(2.3, 6.9)
	Singapore	Chinese	1446	Injurious	4.8%	93.7, 5.9)
	Singapore	Indian	202	Injurious	6.4%	(3.1, 9.8)
	Singapore	Chinese	1446	Single fall	11.7%	(10.0, 13.3)
	Singapore	Malay	327	Single fall	17.4%	(13.3, 21.5)
	Singapore	Indian	202	Single fall	20.8%	(15.2, 26.4)
de Rekeneire et al. (2003)	USA	Black	1270	Single fall	18.8%	(16.7, 21.0)
	USA	White	1780	Single fall	23.2%	(21.2, 25.2)
El Fakiri et al. (2018)	The Netherlands	White	7952	Recurrent falls	13.1%	(12.4, 13.9)
	The Netherlands	Moroccan	165	Recurrent falls	17.0%	(11.2, 22.7)
	The Netherlands	Surinamese	587	Recurrent falls	21.0%	(17.7, 24.2)
	The Netherlands	Moroccan	165	Single fall	30.3%	(23.3, 37.3)
	The Netherlands	Turkish	188	Recurrent falls	20.7%	(14.9, 26.5)
	The Netherlands	White	7952	Single fall	32.5%	(31.5, 33.5)
	The Netherlands	Surinamese	587	Single fall	37.1%	(33.2, 41.0)
	The Netherlands	Turkish	188	Single fall	32.4%	(25.8, 39.1)
Faulkner et al. (2005)	USA	Caucasian	1665	Single fall	24.7%	(22.6, 26.8)
	USA	Black	156	Single fall	27.6%	(20.6, 34.6)
Geng et al. (2017)	USA	Asian	684	Single fall	20.0%	(17.0, 23.0)
	USA	Black	463	Single fall	23.3%	(19.5, 27.2)
	USA	Hispanic	425	Single fall	27.8%	(23.5, 32.0)
	USA	White	4705	Single fall	28.5%	(27.2, 29.8)
Hanlon at al. (2002)	USA	Black	1049	Single fall	20.2%	(17.8, 22.6)
	USA	White	1947	Single fall	23.2%	(21.3, 25.1)
Kalula et al. (2015)	South Africa	Black African	283	Single fall	6.4%	(0.0, 14.6)
	South Africa	White	140	Single fall	42.9%	(40.0, 45.7)
Karter et al. (2015)	USA	Filipino	8162	Single fall	3.7%	(3.3, 4.1)
	USA	Asian	11275	Single fall	5.3%	(4.9, 5.7)
	USA	Black	11417	Single fall	5.7%	(5.3, 6.2)
	USA	Latino	14324	Single fall	6.8%	(6.4, 7.2)
	USA	Non-Hispanic White	63509	Single fall	8.5%	(8.3, 8.7)
Kwan et al. (2013)	Hong Kong	Chinese	201	Single fall	26.4%	(21.2, 31.5)
	Taiwan	Chinese	280	Single fall	28.9%	(22.8, 35.0)
	Australia	Chinese	211	Single fall	28.9%	(22.8, 35.0)
	Australia	White	764	Single fall	32.1%	(29.4, 34.7)
Kwon et al. (2018)	USA	Asian	1199	Recurrent falls	7.6%	(6.1, 9.1)
	USA	White	10527	Recurrent falls	12.8%	(12.2, 13.4)
	USA	Hispanic	1423	Recurrent falls	14.8%	(13.0, 16.7)
	USA	Black	595	Recurrent falls	14.1%	(11.3, 16.9)
Leong Joyce et al. (2020)	Malaysia	Malay	209	Single fall	44.5%	(37.8, 51.2)
	Malaysia	Chinese	49	Single fall	34.7%	(21.4, 48.0)
	Malaysia	Indian	50	Single fall	14.0%	(4.4, 23.6)
Means et al. (2000)	USA	Black	118	Single fall	32.2%	(23.8, 40.6)
	USA	White	180	Single fall	32.8%	(25.9, 39.6)
Nicklett and Taylor (2014)	USA	Black	1326	Single fall	26.8%	(24.4, 29.2)
	USA	White	8429	Single fall	29.2%	(28.2, 30.2)
	USA	Hispanic	729	Single fall	31.6%	(28.2, 34.9)
Qin and Baccaglini (2016)	USA	Black	583	Recurrent falls	9.8%	(7.4, 12.2)
	USA	Asian	1193	Recurrent falls	10.1%	(8.4, 11.9)
	USA	White	10359	Recurrent falls	13.0%	(12.3, 13.6)
	USA	Hispanic	1395	Recurrent falls	14.3%	(12.5, 16.2)
Sampaio et al. (2013)	Brazil	Brazilian	74	Single fall	27.0%	(16.9, 37.1)
	Japan	Japanese	40	Single fall	32.5%	(18.0, 47.0)
Stanaway et al. (2011)	Australia	Italian-born Australian	335	Recurrent falls	11.3%	(7.9, 14.7)
	Australia	Australian-born Australian	848	Recurrent falls	22.4%	(19.6, 25.2)
Stevens et al. (2008)	USA	Black	346155	Single fall	13.0%	(12.9, 13.1)
	USA	White	4643692	Single fall	15.8%	(15.8, 15.8)
	USA	Hispanic	457096	Single fall	17.4%	(17.3, 17.5)
	USA	American Indian/Alaskan Native	72398	Single fall	27.8%	(27.5, 28.1)
Sun et al. (2016)	USA	Black	1662	Single fall	27.1%	(24.9, 29.2)
	USA	White	5186	Single fall	33.8%	(32.5, 35.1)
Vieira et al. (2015)	USA	Afro-Caribbean	109	Single fall	23.9%	(15.9, 31.9)
	USA	European-American	222	Single fall	38.7%	(32.3, 45.1)
	USA	Hispanic	113	Single fall	38.9%	(29.9, 47.9)
	USA	African-American	106	Single fall	39.6%	(30.3, 48.9)
Yeong et al. (2016)	Malaysia	Chinese	140	Single fall	2.9%	(0.1, 5.6)
	Malaysia	Indian	28	Single fall	3.6%	(0.0, 10.4)
	Malaysia	Malay	631	Single fall	4.1%	(2.6, 5.7)

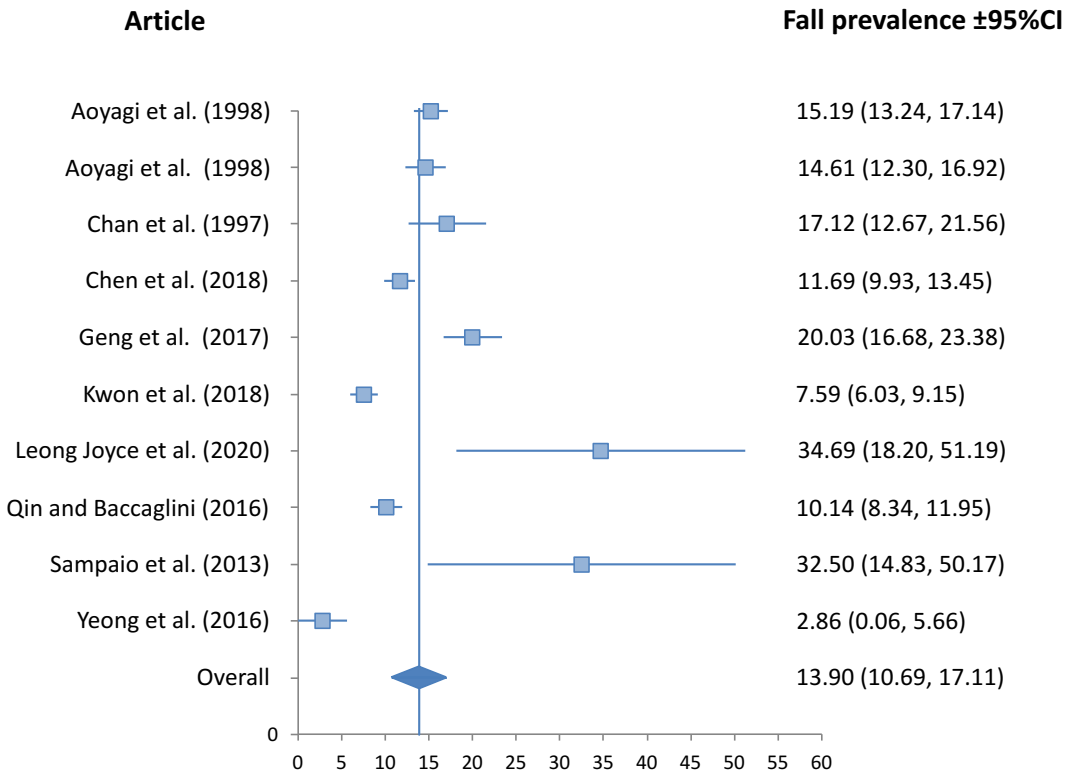


Figure 7: Fall prevalence for Asian ethnicity

(I^2 v=56.63, p<0.001, Qv=20.75)

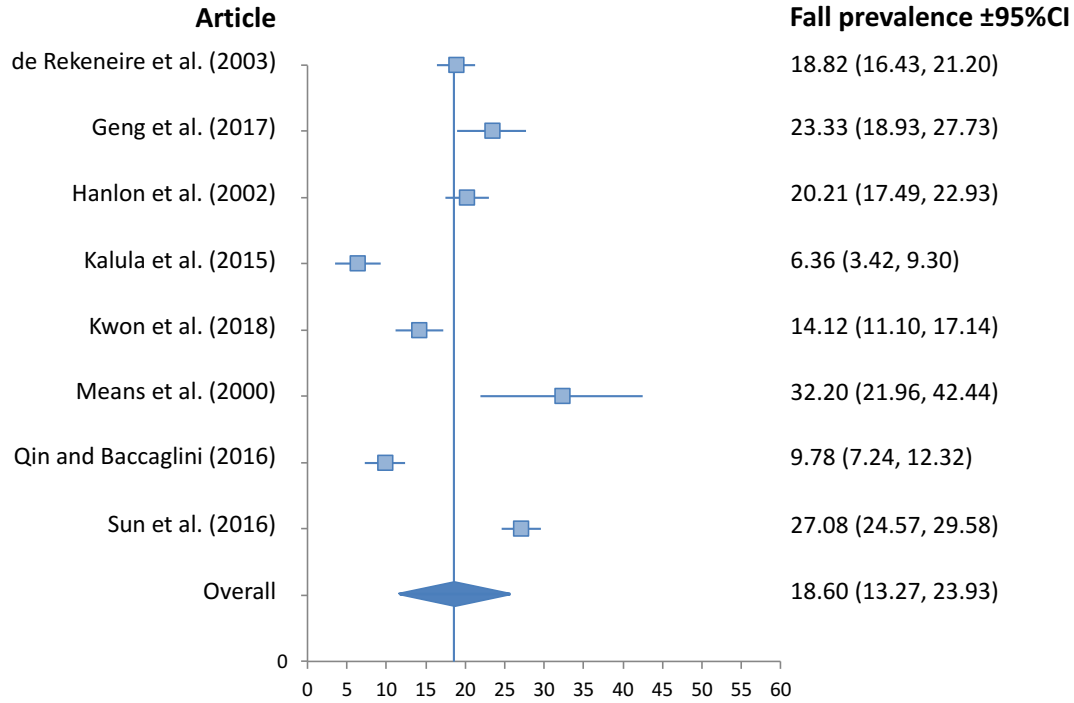


Figure 8: Fall prevalence for Black ethnicity

(I^2 v=17.57, p<0.001, Qv=8.49)

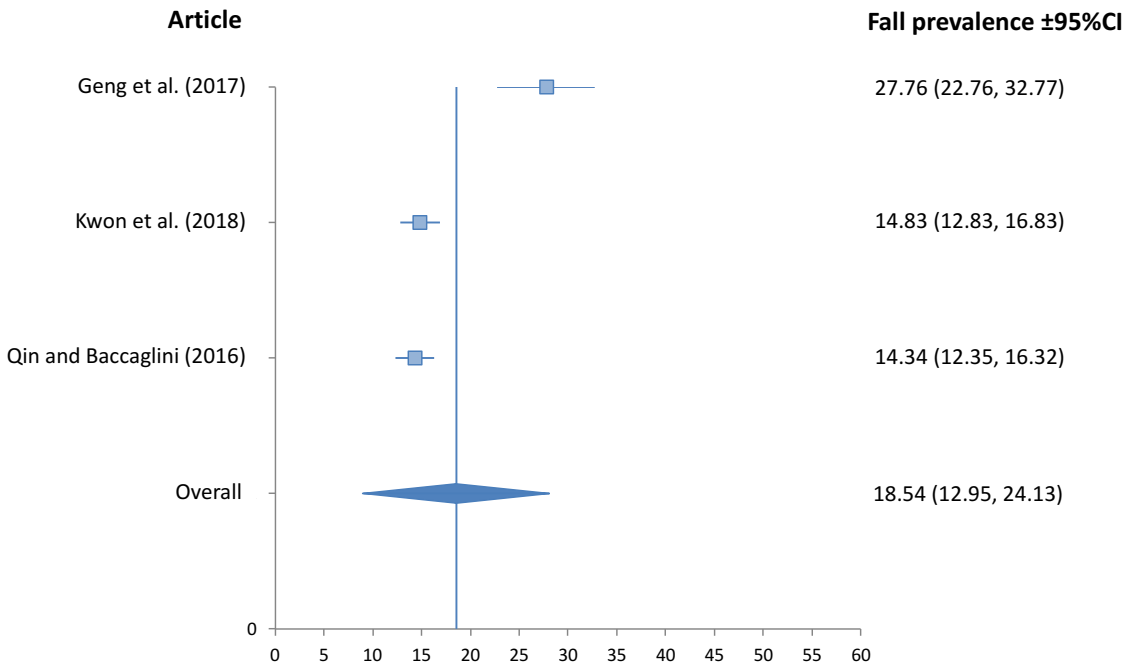


Figure 9: Fall prevalence for Hispanic ethnicity

(I^2 v=55.49, p<0.001, Qv=4.49)

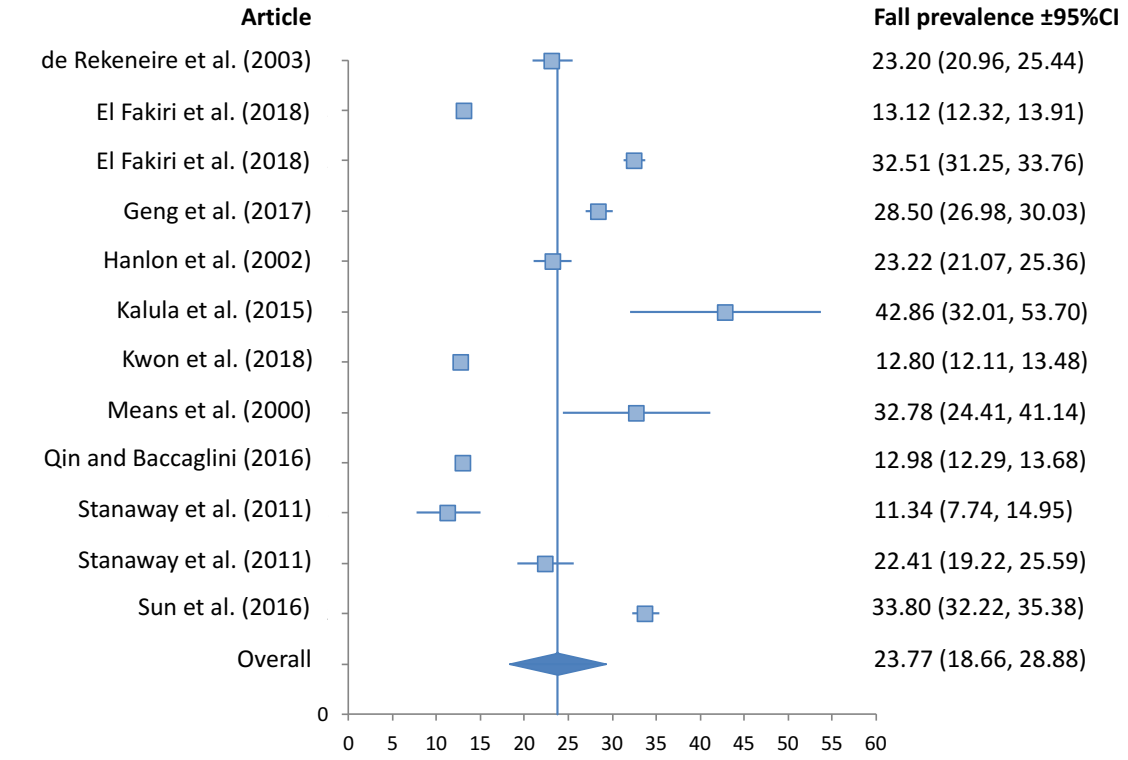


Figure 10: Fall prevalence for White ethnicity

(I^2 v=18.96, p<0.001, Qv=13.57)

4.3.5 Fall Risk

4.3.5.1 Unadjusted Odds Ratios/Relative Risk

Most studies included comparisons with white participants (seven studies in the USA, one in Australia and one in South Africa), with only a few comparing fall prevalence with other ethnic groups. The unadjusted effect statistics of these comparisons for single falls are shown in Table 6. Overall results followed those of the fall prevalence meta-analysis, suggesting that White OAs tend to fall more than other ethnic groups (Black, Asian, Hispanic, Caribbean, Japanese, Filipino). There was some evidence of other differences in Asian countries, but the results were variable.

4.3.5.2 Adjusted Odds Ratios/Relative Risk

Some studies provided adjusted estimates of effect statistics for the odds/risk of falls. These adjustments included a range of factors such as co-morbidities, depression, mobility limitations, functional tests and sociodemographic characteristics. These adjusted effect statistics are shown for single falls in Table 7, and recurrent falls in Table 8.

These data show differences in the odds/risk of falling still existed between some ethnic groups even after adjusting for other risk factors. For single falls, seven of the eight studies reported a statistically significant difference in the risk of falls between ethnic groups, generally showing the White people tend to fall more than Black and Asian OAs, but did not differ from Hispanics. When observing differences in recurrent falls for the two studies in which this was reported, there was again a reduced risk of falling observed for Asian OAs compared to White in the study of Kwan et al. (Kwan *et al.*, 2013).

Table 6: Unadjusted odds ratios/relative risk

Authors	Ethnic group	Gender	Sample size	Effect size
Aoyagi et al. (1998)	Japanese (Japan)	Male	624	-
	Japanese (Hawaii)	Male	436	1.1 (0.7, 1.6)
	Japanese (Japan)	Female	910	-
	Japanese (Hawaii)	Female	618	0.8 (0.6, 1.1)
Chan et al. (2017)	Chinese (Singapore)	Male & Female	333	-
	Malay (Singapore)	Male & Female	31	2.66 (1.21, 5.86)*
	Indian (Singapore)	Male & Female	24	0.21 (0.03, 1.59)
Chen et al. (2018)	Chinese (Singapore)	Male & Female	1446	-
	Malay (Singapore)	Male & Female	327	1.45 (1.05, 2.00)*
	Indian (Singapore)	Male & Female	202	2.01 (1.40, 2.88)*
Davis et al. (1999)	Japanese (Hawaii)	Female	690	-
	White (USA)	Female	9689	1.8 (1.6, 2.0)*
Faulkner et al. (2005)	White (USA)	Female	1665	-
	Black (USA)	Female	156	1.17 (0.78, 1.75) §
Geng et al. (2017)	White (USA)	Female	4705	-
	Hispanic (USA)	Female	425	0.97 (0.74, 1.27)
	Black (USA)	Female	463	0.77 (0.59, 1.00)
	Asian (USA)	Female	684	0.63 (0.50, 0.80)*
Hanlon et al. (2002)	White (USA)	Male & Female	1947	-
	Black (USA)	Male & Female	1049	0.77 (0.62, 0.94)*
Kalula et al. (2015)	Black (South Africa)	Male & Female	283	-
	White (South Africa)	Male & Female	140	1.04 (1.01, 1.08)*
Karter et al. (2015)	White (USA)	Male & Female	63509	-
	Black (USA)	Male & Female	11417	0.64 (0.59, 0.70) §*
	Asian (USA)	Male & Female	11275	0.65 (0.59, 0.71) §*
	Filipino (USA)	Male & Female	8162	0.49 (0.44, 0.56) §*
	Hispanic (USA)	Male & Female	14324	0.84 (0.78, 0.90) §*
Kwan et al. (2013)	White (Austalia)	Male & Female	764	-
	Chinese (Taiwan)	Male & Female	280	0.39 (0.3, 0.49) §*
	Chinese (Hong Kong)	Male & Female	201	0.28 (0.19, 0.41) §*
	Chinese (Australia)	Male & Female	211	0.5 (0.37, 0.67) §*
Sun et al. (2016)	White (USA)	Male & Female	5186	-
	Black (USA)	Male & Female	1662	0.7 (0.6, 0.8) §*
Vieira et al. (2015)	Afro-Caribbean (USA)	Male & Female	222	-
	White (USA)	Male & Female	109	1.57 (1.08, 2.29) §*
	African-American (USA)	Male & Female	106	1.63 (1.07, 2.47) §*
	Hispanic (USA)	Male & Female	113	1.62 (1.07, 2.44) §*
Yeong et al. (2016)	Malay (Malaysia)	Male & Female	631	-
	Chinese (Malaysia)	Male & Female	140	0.68 (0.24, 1.99)
	Indian (Malaysia)	Male & Female	28	0.86 (0.11, 6.59)
	Indigenous (Malaysia)	Male & Female	12	4.65 (0.97, 22.33)

Results are listed as Odds Ratio unless specified, § Relative Risk

* significantly different from reference group ($p<0.05$)

Table 7: Adjusted odds ratios/relative risk (single falls)

Authors	Ethnic group	Gender	Sample size	Effect size	Covariates
Chen et al. (2018)	Chinese (Singapore)	Male & Female	1446	-	Age, sex, marrital status, cognitive function, self-reported pain, comorbidities, depression, BMI, difficulties with ADL, social network, mobility difficulties, grip strength
	Malay (Singapore)	Male & Female	327	4.76 (1.21, 18.68)*	
	Indian (Singapore)	Male & Female	202	4.50 (0.73, 27.64)	
Davis et al. (1999)	Japanese (Hawaii)	Female	690	-	Age, height, weight, functional tests
	White (USA)	Female	9689	1.8 (1.5, 2.1)*	
de Rekeneire et al. (2003)	Black (USA)	Male & Female	1270	-	Age, race, study site, BMI
	White (USA)	Male & Female	1780	1.4 (1.2, 1.6)*	
Faulkner et al. (2005)	White (USA)	Female	1665	-	Grip strength, number of chronic conditions, and depression
	Black (USA)	Female	156	1.20 (0.80, 1.81) §	
Geng et al. (2017)	White (USA)	Female	4705	-	Age, co-morbidities, poor health, and mobility limitations
	Hispanic (USA)	Female	425	0.94 (0.71, 1.24)	
	Black (USA)	Female	463	0.73 (0.55, 0.95)*	
	Asian (USA)	Female	684	0.64 (0.5, 0.81)*	
Kwan et al. (2013)	White (Austalia)	Male & Female	764	-	Age, sex, incontinence, Parkinson's, education, FES-I
	Chinese (Taiwan)	Male & Female	280	0.98 (0.45, 2.11) §	
	Chinese (Hong Kong)	Male & Female	201	0.55 (0.17, 1.79) §	
	Chinese (Australia)	Male & Female	211	0.6 (0.23, 1.59) §	
Nicklett and Taylor (2014)	White (USA)	Male & Female	8429	-	Adjusted for sociodemographic and health characteristics
	Black (USA)	Male & Female	1326	0.65 (0.53, 0.80)*	
	Hispanic (USA)	Male & Female	729	0.91 (0.69, 1.20)	
Yeong et al. (2016)	Malay (Malaysia)	Male & Female	631	-	Age, sex, total income, physical activity level, living alone, number of co-morbidities, number of medications
	Chinese (Malaysia)	Male & Female	140	0.61 (0.2, 1.86)	
	Indian (Malaysia)	Male & Female	28	0.77 (0.1, 6.16)	
	Indigenous (Malaysia)	Male & Female	12	6.06 (1.10, 33.55)*	

Results are listed as Odds Ratio unless specified otherwise; § Relative Risk, * significantly different from reference group (p<0.05)

Activities of daily living (ADL), Body mass index (BMI), Falls efficacy scale- International (FES-I)

Table 8: Adjusted odds ratios (recurrent falls)

Authors	Ethnic group	Gender	Sample size	Effect size	Covariates
El Fakiri et al. (2018)	White (Netherlands)	Male & Female	7952	-	Age, sex, education, income, deprived neighbourhood, living alone, health (overweight, inactivity, alcohol, perecived health, hearing, sight, mobility limitations, multi-morbidity, loneliness, depression)
	Moroccan (Netherlands)	Male & Female	165	0.54 (0.27, 1.06)	
	Turkish (Netherlands)	Male & Female	188	0.84 (0.42, 1.64)	
	Surinamese (Netherlands)	Male & Female	587	1.05 (0.68, 1.64)	
Kwon et al. (2018)	White (USA)	Male & Female	10527	-	Age, sex, marital status, poverty, BMI, chronic diseases, functional limitation
	Black (USA)	Male & Female	595	0.82 (0.51, 1.30)	
	Asian (USA)	Male & Female	1199	0.63 (0.43, 0.92)*	
	Hispanic (USA)	Male & Female	1423	0.98 (0.72, 1.34)	

Results are listed as Odds Ratio, * significantly different from reference group (p<0.05)

Body mass index (BMI)

4.4. Discussion

This systematic review was limited to only those studies in which fall prevalence was compared between two or more ethnic groups in an attempt to increase the heterogeneity of study design. Studies in which fall prevalence was only reported for a single ethnic group were excluded. However, the wide range of countries in which the studies were carried out, the ethnic groups observed, and the differing methodologies used all gave substantial variability to the data.

This variability is evident in the wide range of fall prevalence reported, which ranged from 2.9 to 44.5%. In order to synthesise the data from these multiple studies, a meta-analysis was carried out, using a random-effects model due to the variability of the data. This analysis showed that differences were apparent between the reported fall rates of Asian, Hispanic, Black and White populations, listed here from lowest to highest fall prevalence. This observation was confirmed by unadjusted measures of fall risk, which suggested that White people tend to fall more than other ethnic groups. Even when adjusted for a wide range of contributing factors, White populations had a higher risk of falling than other ethnic groups, both for single and recurrent falls. This is an interesting finding, as the majority of these studies were in the USA where African-American populations have poorer health and living conditions than White Americans in the same area (Cunningham *et al.*, 2017), and yet when their risk of falling was adjusted for these inequalities, it was still lower than that for the White OAs. This is also contrary to other age-related conditions such as frailty, in which higher rates of frailty have been reported for African Americans in the USA (Caldwell, Lee and Cagney, 2019; Hirsch *et al.*, 2006).

There are many potential reasons for the differences observed in these studies. It has been shown that there may be a difference in attitudes to fall risk and participation in risk-taking behaviours between Asian and White groups (Kwan *et al.*, 2013). Lower fall rates in Chinese groups may be due to greater fear of falling as evidenced by their higher scores in FES-I tests, as well as different cultural behaviours such as greater use of walking sticks. These two factors could result in lower levels of risk-taking behaviours. In addition, increasing fall prevalence with increasing age may affect results in different countries and ethnic groups due to differences in local life expectancy.

In reality, differences in fall prevalence are probably due to a complex interaction of factors including culturally specific behaviours and beliefs, general health characteristics and sociodemographic elements. Culturally specific behaviours may include differences such as those who wish to avoid losing face or showing weakness associated with older age (Huang, Tsai and Subeq, 2020), compared with those who are more willing to accept assistance (Kwan *et al.*, 2013). Health beliefs could involve issues such as having a fatalistic attitude towards falls and potential prevention interventions (Horne *et al.*, 2009; Horton and Dickinson, 2011).

Health issues may include chronic illnesses, functional impairments including visual problems or walking difficulties, or common geriatric conditions such as cognitive impairments (Huang, Tsai and Subeq, 2020). BMI is also a risk factor for falls as those with high BMI measures often show altered gait patterns, and postural instabilities that make it difficult to recover from a perturbation (Lockhart *et al.*, 2019). The most important sociodemographic elements for falls are sex and age (Gale, Cooper and Sayer, 2016; Chang and Do, 2015). All these issues have considerable impacts on fall prevalence and may influence the results either by directly causing differences in the prevalence of falls, or by contributing to differences in how falls are perceived and reported by members of different ethnic groups.

The variability in this study was its main limitation. Heterogeneity was quite high, limiting general conclusions, but this is not surprising given factors such as the disparities within the general groups used. For example, the group termed Asian included Japanese, Chinese, Filipino, and 'Asian'. These nationalities are all inherently very different, with differences in all the individual factors discussed above as contributing to differences in fall prevalence.

The studies included were carried out in different countries, and with varying methodologies, which naturally cause variance. For example, study design included retrospective data, prospective data and EMR data. Most studies used a retrospective design of between 12 and 24 months. However, OAs frequently have difficulty remembering falls, whether due to having forgotten the fall, or a denial of the fall due to a desire to hide signs of frailty (Garcia *et al.*, 2015; Cummings, Nevitt and Kidd, 1988; Peel, 2000). Recall of falls is generally better if the fall was serious and the person suffered a significant injury (Garcia *et al.*, 2015; Cummings, Nevitt and Kidd, 1988; Peel, 2000), but if the injuries were minor, they too are easily forgotten (Cummings, Nevitt and Kidd, 1988). Therefore, data gathered retrospectively may not be reliable.

The sample sizes used in the different studies also varied greatly. From studies using EMR data of 5,510,341 individuals (Stevens *et al.*, 2008), to small studies containing only 114 (Sampaio *et al.*, 2013). These extremes could have very different effects on the results of individual studies, with smaller sample sizes failing to identify relevant effects, and larger ones finding significant differences that are insubstantial. However, the use of a meta-analysis in

this paper allowed a single estimate to be obtained for each ethnic group. Even though the larger studies using survey or EMR data were not included in the meta-analysis, the largest study in this analysis with 17,784 individuals (El Fakiri *et al.*, 2018), still differed greatly from the smallest indicated above.

The covariates used to adjust the data also showed considerable variation. Some studies only adjusted for basic variables such as age, race, study site and body mass index (de Rekeneire *et al.*, 2003), while others adjusted for numerous factors such as age, gender, education, income, neighbourhood deprivation, living alone, health (being overweight, inactivity, alcohol consumption, perceived health, hearing, sight, mobility limitations, multi-morbidity, loneliness, depression) (El Fakiri *et al.*, 2018). Studies in which more covariates are adjusted for, increases the validity of the findings where any differences in fall prevalence between ethnicities remain. The studies in this paper showed that differences in ethnic groups remained even when ten or more covariates were included in the analysis, showing that there are differences in fall rates due to ethnicity.

The key finding of this study is that fall prevalence differs between ethnic groups, even after adjusting for multiple covariates, which underlines the importance of moving away from a 'one size fits all' approach to Public Health. Falling is a significant issue for OAs which carries considerable cost on both the personal and financial front. By identifying the most at-risk groups, resources can be targeted to where they are most needed, such as providing education and fall prevention interventions to those identified as being at risk of falls, ideally before a fall occurs. By appreciating racial and ethnic differences in fall prevalence, there can also be an equal appreciation of the different barriers and requirements of fall prevention interventions for different ethnic groups. The proposal of more ethnically tailored responses to these public health challenges may provide the answer to the low adherence of certain groups to interventions involving PA. Further research is needed to indicate exactly how fall prevention interventions could be better tailored to the needs of different ethnic groups, particularly in multicultural societies.

4.5. Conclusion

Differences in fall prevalence do appear to exist between different ethnic groups. Further research is required to determine the reasons for these differences, and to increase the amount of information available on fall rates of different ethnic groups.

Given this identification of differences in fall rates between ethnic groups on a global level, it now remains to be confirmed whether this difference can also be seen within the multicultural UK society.

5. Choice of Ethnic Group

5.1. Introduction

The ethnic group chosen for this thesis was not one chosen at random. This choice was led by the data, with the rationale being that an ethnic group was sought that was at high risk of falls, but also had a large enough population to both respond to the greatest need, and also to ensure ease of recruitment for the study. The population was measured using UK census data, and the fall prevalence by analysing EHR data from an East London Primary Care Service.

5.2. Analysis of Census Data

In order to ascertain which ethnic groups have the largest populations of OAs, population data was collected from four East London boroughs (Newham, Hackney, Tower Hamlets, and Barking & Dagenham) from the 2011 census, for all adults aged 65 years and over. These boroughs were chosen as being local to the area intended for the study, near to the University of East London. This objective was begun before the latest Census was carried out in 2021, and so data from the 2011 Census was used at this stage. Comparison with more recent data from the 2021 Census is made in the final discussion section at the end of the thesis.

5.3. Analysis of EHR Data

In order to evaluate the fall prevalence of the different ethnic groups, anonymous Electronic Health Records (EHR) data were obtained from AT Medics, one of the largest providers of Primary Care services to the NHS in England. They have 42 Primary Care sites, with 270,000 patients across 16 London CCG areas. The NHS Data Opt-Out, which has been in place since the 25th of May 2018, requires patients to opt out if they do not want anonymised data from their EHR to be shared with researchers. The variables extracted from the EHR contained basic demographic information (age, sex, ethnicity, height, and weight) and the number of falls in the previous 12 months. A proxy for socioeconomic status was used based on the geographical location of each participant. Postcodes were used to determine the Income Deprivation Affecting Older People Index (IDAOPI), which is a subset of the income component of the Index of Multiple Deprivation (IMD), which has been used as a proxy of socioeconomic status in health research in the UK. Deciles were used rather than the individual ranks of each geographical area.

This EHR data was gathered on the 28 February 2020, from the previous 12 months of all patients 65 years old and over in the database, and who had not opted out of the scheme. All data were anonymised at the point of extraction to ensure participant anonymity, including hashed postcodes that were replaced by Lower Super Output Areas, from which the IDAOPI was obtained.

The combination of a population group of large enough size, that also demonstrate high fall prevalence was used to determine the group to be studied.

5.4. Results of Census Data

The population of each non-White ethnic group is shown in Figure 11. The ethnic group with the greatest population over 65 years of age is the Black Caribbean group, followed by the Bangladeshi, Indian, and Black African groups. The smallest ethnic group is the Pakistani group. The age distribution of each ethnic group is shown in Figure 12, with the population grouped into two age groups (65-74, 75+ years) for this presentation. Population pyramids for the two largest population groups, Caribbean and Bangladeshi, are shown in Figures 13 and 14, respectively.

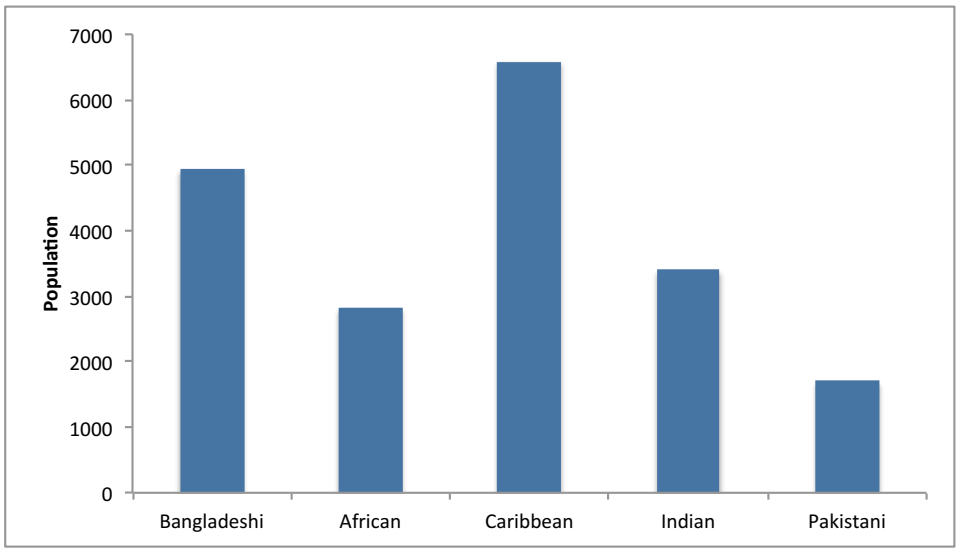


Figure 11: Population of East London aged 65 years +

(2011 census data)

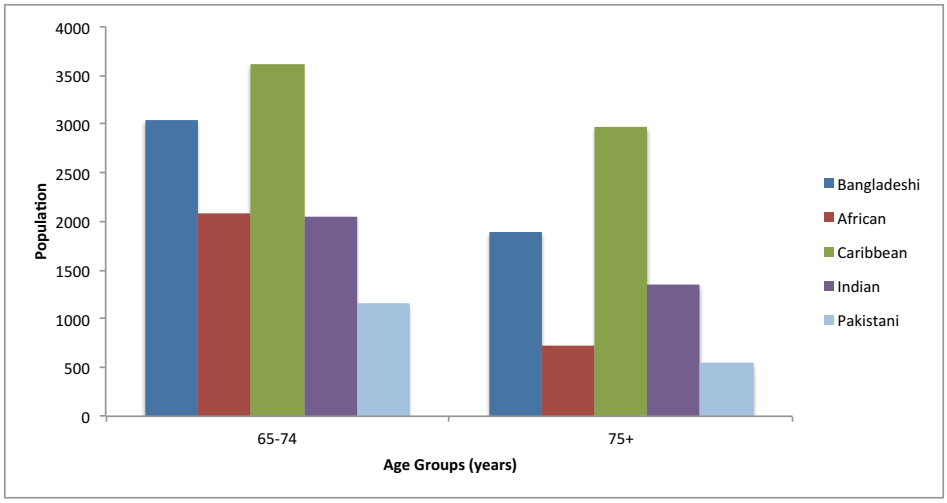


Figure 12: Ethnic populations of East London

(2011 census data)

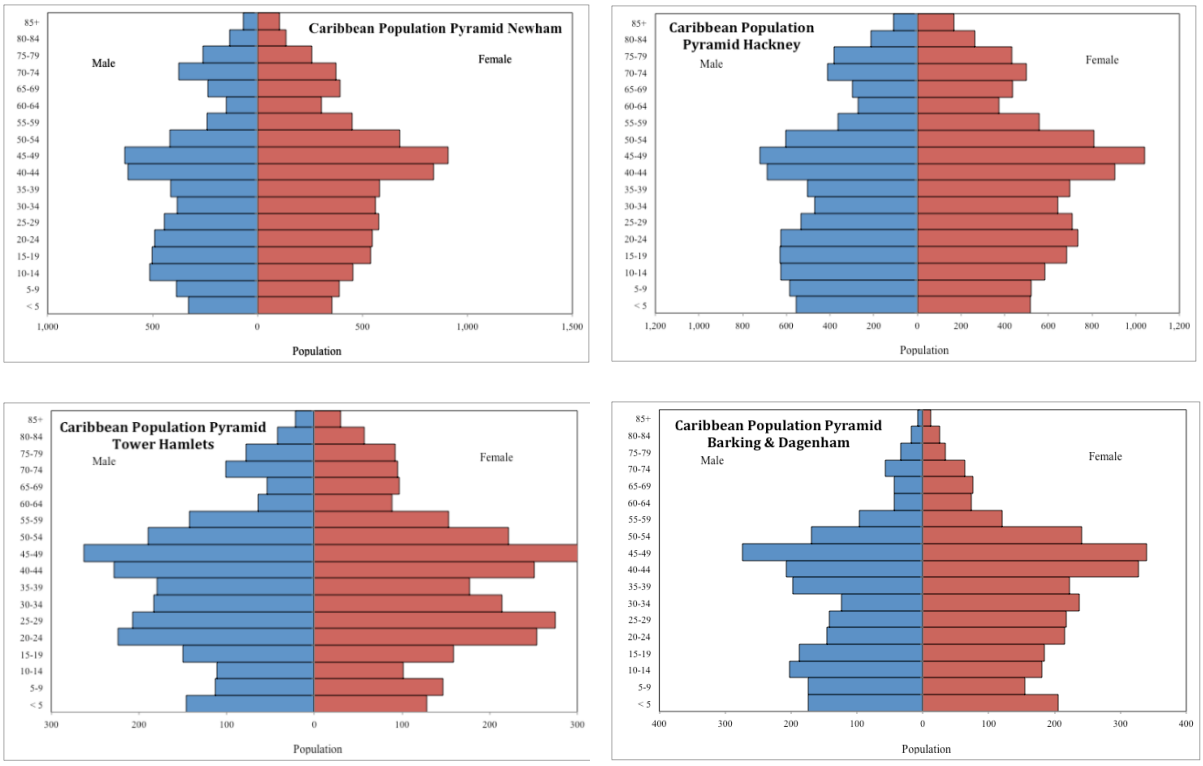


Figure 13: Caribbean population pyramids for the four East London boroughs

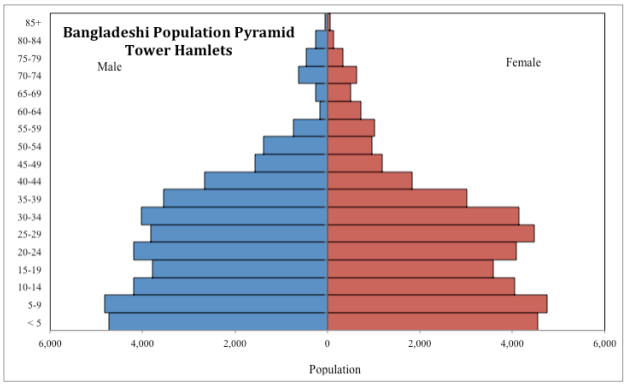


Figure 14: Bangladeshi population pyramids for Tower Hamlets

5.5. Results of EHR Data

EHR data was gathered on the 28 February, 2020 and included data from the previous 12 months of all patients 65 years old and over in the database, and who have not opted out of the scheme. All data were de-identified at the point of extraction from the EHR to ensure participant anonymity, including hashed postcodes that were replaced by Lower Super Output Areas, from which the IDAOPI was obtained.

A total of 11,662 records were obtained. Of these records, 55% of patients were female, 45% male, with an average age of 74.29 ±7.42 years. The distribution of patients by age group is shown in Figure 15.

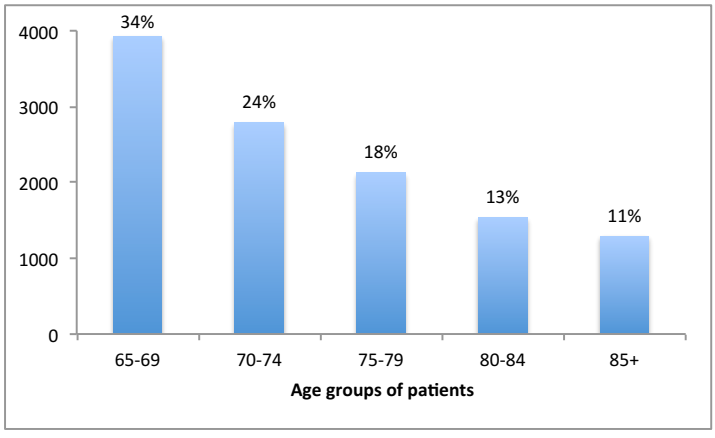


Figure 15: Distribution of patients by age group

5.5.1 Ethnic distribution

The ethnicity data included over 100 different ethnic classifications, which were grouped into the categories recommended by the Office for National Statistics (ONS). These categories were Bangladeshi, Black African, Black Caribbean, Indian, Pakistani, White, as well as Mixed, Other, and Unknown.

The ethnic distribution of the patients is shown below in Figure 16. The five largest non-White ethnic groups in the UK, are marked in darker shades and are Black African (11%), Black Caribbean (9%), Indian (8%), Bangladeshi (6%), and Pakistani (3%). All subsequent analyses of the effect of ethnicity on falls used only these six ethnic groups.

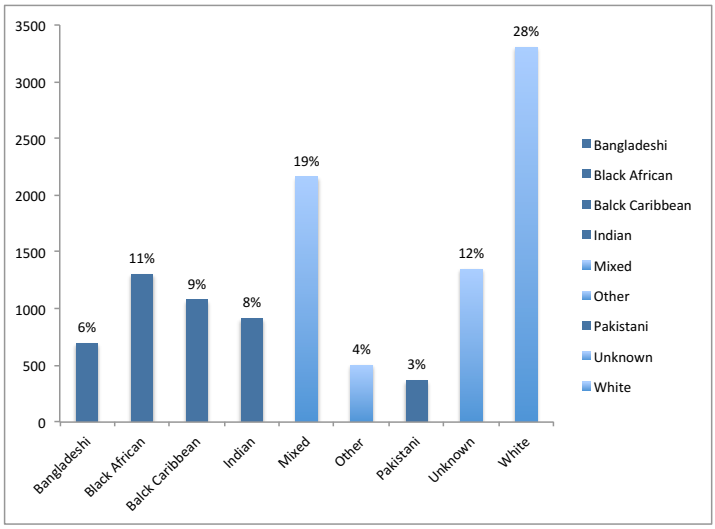


Figure 16: Distribution of patients by ethnicity

5.5.2 Fall prevalence

The fall prevalence of the entire sample of patients was 24.0%, while 11.7% of patients were recurrent fallers, with two or more falls in the previous 12 months.

5.5.3 Data analysis

A logistic regression analysis was carried out for each single risk factor for falls, with results reported separately. A multivariate logistic regression in which all risk factors were combined was also performed, where the model was adjusted for age as a continuous variable, while sex, IMAODI, and ethnicity were used as categorical variables in the model.

5.5.3.1 Sex

The fall prevalence of females was 26.6%, while males had a fall prevalence of 20.8% (see Figure 17). Logistic regression analysis showed that female patients were significantly more likely to fall than males (OR= 1.38, 95%CI 1.27, 1.51; χ^2 =54.012, df=1, p=0.000).

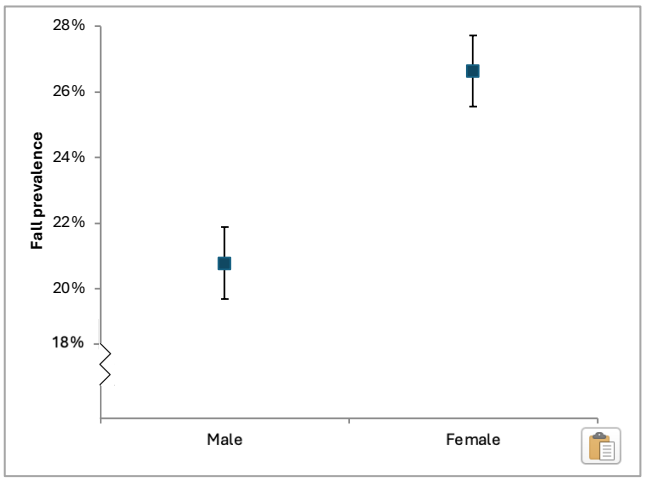


Figure 17: Fall prevalence by sex

5.5.3.2 Age

Patients were grouped into age groups covering 5 year ranges (64-69, 70-74, 75-79, 80-84), with a single age group for those aged 85 and over. The fall prevalence for each age group is shown in Figure 18. Fall prevalence increased with each increase in age, from a prevalence of 5.9% for the 64-69 year age group to 60.2% for the 85+ age group. Logistic regression analysis showed that there was a significant increase in fall prevalence between each age group, as shown in Table 9 below.

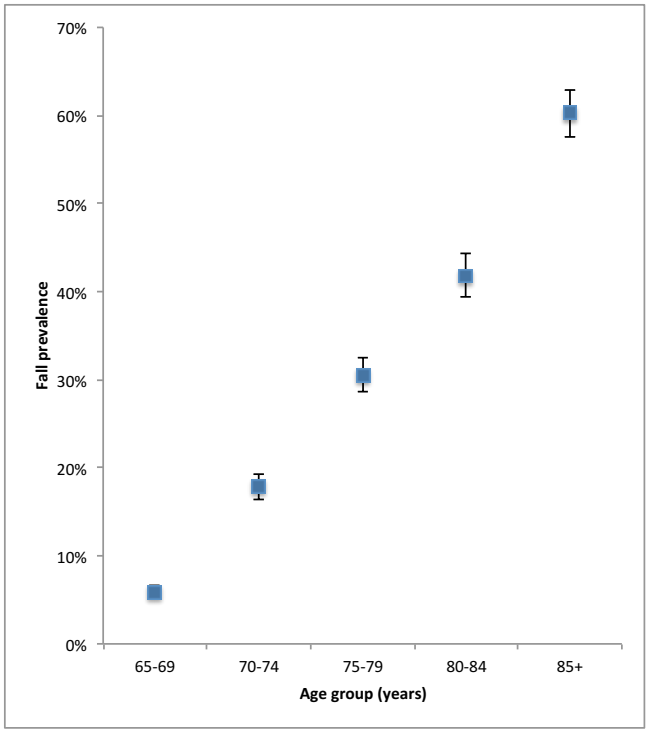


Figure 18: Fall prevalence by age group

Table 9: Logistic regression results by age group

	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
					Lower	Upper
65-69 (ref)	1580.95	4.00	0.00			
70-74	217.10	1.00	0.00	3.43	2.91	4.05
75-79	557.18	1.00	0.00	6.98	5.94	8.21
80-84	818.55	1.00	0.00	11.40	9.65	13.46
85+	1294.57	1.00	0.00	23.99	20.17	28.52

5.5.3.3 Ethnic group:

Fall prevalence for the six ethnic groups retained for this analysis are shown in Figure 19 below. The results of the logistic regression analysis using the White group as the reference are shown in Table 10. A significantly higher risk of falling occurred among the Bangladeshi and Black Caribbean groups. However, there was no significant difference between the White, Indian, and Pakistan groups, while there was a significantly lower risk of the Black African group falling compared to the White group.

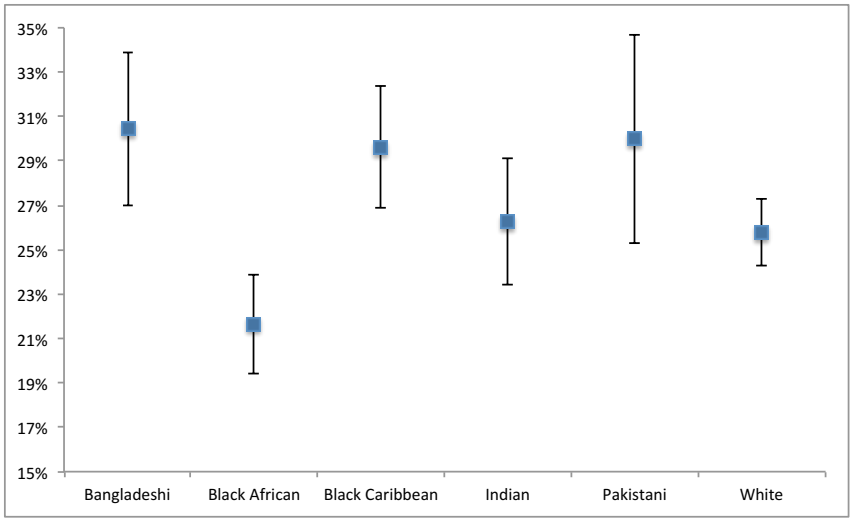


Figure 19: Fall prevalence by ethnic group

Table 10: Logistic regression results by ethnic group

	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
					Lower	Upper
White (ref)	29.77	5.00	0.00			
Bangladeshi	6.32	1.00	0.01	1.26	1.05	1.51
Black African	8.67	1.00	0.00	0.79	0.68	0.93
Black Caribbean	6.11	1.00	0.01	1.21	1.04	1.41
Indian	0.10	1.00	0.76	1.03	0.87	1.21
Pakistani	3.00	1.00	0.08	1.23	0.97	1.56

5.5.3.4 IDAOPI Decile

The IDAOPI decile values were used to create three groups: low (decile groups 1-3), medium (decile groups 4-6), and high (decile groups 7-10). Fall prevalence for each IDAOPI group is shown in Figure 20. The logistic regression analysis showed a significant effect of poverty on falls (Table 11), with the fall prevalence increasing significantly as the IDAOPI Decile group lowered.

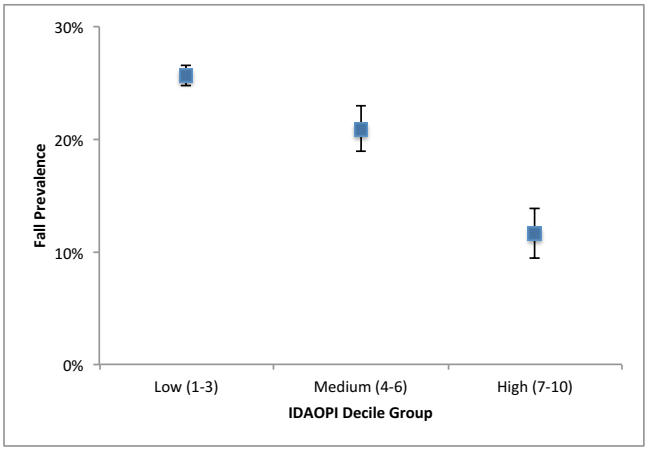


Figure 20: Fall prevalence by IDAOPI decile group

Table 11: Logistic regression results by IDAOPI decile group

	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
					Lower	Upper
IDAOPI High (ref)	84.65	2.00	0.00			
IDAOPI Low	73.92	1.00	0.00	2.61	2.10	3.25
IDAOPI Med	30.67	1.00	0.00	2.01	1.57	2.57

5.5.3.5 Adjusted Model

The results for the adjusted model are shown in Table 12. The adjusted model still showed a significant effect of age, sex, and poverty on falls, following the same patterns as reported for the univariate analysis above. In contrast, the relationship between ethnicity and fall rates changed in the adjusted model, with higher fall rates reported for only Indian and Pakistani OAs when compared to the White reference group.

Table 12: Multiple binary logistic regression results

	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
					Lower	Upper
Age	1173.734	1	0.000	1.156	1.146	1.165
Female	19.312	1	0.000	1.298	1.155	1.458
White (ref)	25.074	5	0.000			
Bangladeshi	3.372	1	0.066	1.210	0.987	1.482
Black African	1.659	1	0.198	0.893	0.753	1.061
Black Caribbean	2.741	1	0.142	0.863	0.726	1.027
Indian	5.217	1	0.022	1.248	1.032	1.509
Pakistani	7.972	1	0.005	1.460	1.123	1.899
IDAOPI High (ref)	52.355	2	0.000			
IDAOPI Low	48.368	1	0.000	3.680	2.549	5.313
IDAOPI Med	27.685	1	0.000	1.156	1.146	1.165

5.6. Choice of ethnic group conclusion

From a fall prevalence perspective, the highest fall risk compared to the white reference group were seen in the Bangladeshi and Caribbean groups: 1.26 (1.05, 1.51) and 1.21 (1.04, 1.41) respectively. Interestingly, the adjusted model showed that the higher fall rates reported in older Bangladeshi and Caribbean groups could be explained by a combination of age, sex, and IMAODI. It seems likely that the higher average age of Caribbeans could be a contributing factor to their high fall rates, while the lower IDAOPI of Bangladeshis could be a contributing factor to their high fall rates. However, given that the aim of this component of the thesis was to identify a group with a high fall rate, irrespective of the reasons for that fall rate, the rationale of selecting a group with a high fall rate and a large enough population still holds when selecting the target for this intervention.

In terms of population size the Caribbean population is the larger at 6,586, compared to the Bangladeshi group at 4,933. Although these figures are now nine years old, they serve as an indication of the populations we can expect today. In addition, as the population pyramids for the four East London boroughs show (Figure 13), in each case the Caribbean group has an unusual pattern. Most ethnic groups are young, due to immigration at a young age in search of work and/or education. The Caribbean group shows a larger group clustered around the 70-80 years age range, and again between the ages of 40-50. These are most likely the children brought over by the Windrush generation, and their children, born in the UK. As a

comparison, the Bangladeshi group in Tower Hamlets (Figure 14) has most of their population under the age of 45, with fewer older people.

Therefore, the conclusion of this objective is that the chosen group for this thesis will be Caribbean.

5.7. Discussion

The aim of this statistical analysis was to identify the ethnic group to be studied in this PhD study. The chosen group must have a population of large enough size to make recruitment and testing practical, while also demonstrating high fall prevalence.

This statistical analysis was necessary as the systematic review in the previous chapter used very broad categories of ethnicity: White, Black, Asian, and Hispanic. Not only does the breadth of these categories overlook considerable differences between ethnic groups such as African and Caribbean, who were all grouped together as “Black”, it also does not take into account the ethnic make up of different countries. The “Asian” group from the systematic review referred to East-Asian groups such as Chinese or Japanese. No South Asian studies were found to include in the review. The UK population has a considerable proportion of the ethnic minority population that are South Asian, and so it is important to determine the fall prevalence specifically within the UK.

The “Black” group from the systematic review had moderate fall prevalence, and yet within the UK, the African population were found to have very low reported fall rates, while the Caribbean group had very high reported fall rates. This further supports the need for local risk factors to be determined to ascertain which groups have the highest risk factors.

There are however limitations with the use of EHR records. The data only include reported falls, which as discussed in the literature review, may not always be accurate due to the OA having forgotten the fall, or not wishing to disclose having fallen due to concerns about being seen as unable to care for themselves, or be put into a home. In addition, even if a fall is

reported, it may not be recorded by the medical professional due to time constraints, or the fall not being the central concern of the visit.

Caribbean people are considerably under-represented in the research. A search of the PubMed database elicited 859 results from a search for titles including the UK and constituent countries, with “South Asian” OR India* OR Pakistan* OR Bangladeshi*”. However, only 145 results from a similar search with “Caribbean”. The reasons for this are unclear. While immigration from the Caribbean to the UK was high in the 50-70s, it has declined in recent years, being overtaken by other ethnic groups such as those from South Asia which appear to be the subject of research more often than those groups who have been in the UK for longer.

Given that Caribbean people are also at higher risk of all-cause mortality, and diseases such as prostate cancer (Raleigh, 2023), more attention should be paid to under-researched ethnic groups to better respond to these high risks, and to redress health inequalities.

6. Qualitative study

6.1. Introduction

It is clear that levels of PA decrease with age (Lachman *et al.*, 2018), and many OAs do not achieve recommended levels of PA (Arnautovska *et al.*, 2019; Maula *et al.*, 2019; Sport England, 2023). The percentage of women meeting PA guidelines drops from 52% aged 65-74 years, to 21% aged 75-84 years; and for men 57% aged 65-74 years, to 43% aged 75-84 years (Scholes and Mindell, 2012). As discussed previously in the literature review (section 2.5.2), OAs who are physically active have a lower risk of falling (Chang and Do, 2015), potentially due to having better muscle strength, balance, and physical function (Liu-Ambrose *et al.*, 2013).

The level of PA among OAs varies among different populations. For instance, in multicultural societies such as the UK, members of ethnic minority communities, who form an increasing percentage of the population, 18% at the last census in 2021 (Office of National Statistics, 2022) do appear to show differences in activity levels compared to White British populations (Saffer *et al.*, 2013; Williams *et al.*, 2010). For example, in the UK, South Asian adults aged 55 years+ are less likely to meet recommended levels of PA than European whites, with only 11% of men and 8% of women meeting these targets (Sproston and Mindell, 2006; Horne *et al.*, 2018). Exactly how exercise-based fall prevention programmes are perceived by different ethnic groups is often uncertain, and the differences in PA levels could be due to differences in cultural norms, religious beliefs, socio-economic factors, psychosocial factors, health constraints, language barriers, and the availability of culturally and religiously appropriate activities and resources (Williams *et al.*, 2010).

There is very little information available in the literature specifically on Caribbean OAs and their attitudes to health behaviours including PA. Howitt et al. (2016) found that PA among adults in Barbados aged 25-54 years, reduced with increasing socio-economic status. PA was found to be often related to employment, thus raising concerns for OAs who may no longer be in jobs requiring daily PA. Also in Barbados, a study by Alvarado, Murphy, and Guell (2015)

on overweight and obese women aged 25-35 years, found structural barriers to PA such as having few opportunities for active commuting, limited indoor space for PA at home, and little access to convenient and affordable PA classes. Within the UK, it was found that older Afro-Caribbean women had higher levels of sedentary time than South Asian and "other" groups (Castaneda-Gameros, Redwood and Thompson, 2018). Attitudes to PA included issues surrounding physical limitations and pain, changing physical abilities, and weight and time barriers. However PA was seen to be a means of maintaining independence and better mental health. Overall, the relevant research coming from the Caribbean itself currently includes only younger adults, and those with comorbidities such as obesity. The current research within the UK, designates the group of interest as being "African-Caribbean", opening the possibility of the results not being true to only Caribbean outcomes. There are currently no studies looking specifically at Caribbean OAs and their attitudes to health behaviours including physical activity.

Qualitative research can provide important insight and understanding of these issues, and the experiences and attitudes of both the potential OA participants, and those people in their lives who may also impact decisions to engage with programmes. This information and understanding is critical to designing programmes that are not only effective, but also acceptable and adhered to by -OAs.

6.2. Aims:

To identify the cultural influences, preferences, attitudes, facilitators, and barriers with respect to PA and ageing among Caribbean adults aged 65 years or older. This is based on the findings of the literature review showing that PA is the most effective fall prevention intervention. The information from this qualitative study will subsequently be used in the following chapter in order to design a more culturally tailored fall prevention intervention programme based on PA.

6.3. Methods:

6.3.1 Participants

6.3.1.1 Eligibility criteria

Participants were sought from groups of Caribbean OAs, but also from their immediate social networks/contacts, including family members, health professionals, religious leaders, and community leaders. Full details of the inclusion and exclusion factors are shown in Table 13.

6.3.1.1 Recruitment

Sampling for this study was necessarily purposive, selecting participants who were specifically related to the aim of the study at hand, in this case being both OAs and Caribbean. Initially this involved targeting specific groups such as Caribbean Community Centres with programmes specifically designed for OAs, in order to make contact with potential participants. Unfortunately, as discussed in more detail in the section on adaptions made due to the Covid-19 pandemic, these organisations were all shut down, making recruitment extremely challenging. Gatekeepers were then used to access potential recruits via personal or family relationships. This convenience sampling technique, based on availability, was more successful but limited in number. A similar approach was used with a local organisation, Age Concern Luton, who offered to identify potential participants among their members and provide contacts. In addition, snowballing techniques were used with each participant being asked to pass on information sheets to friends who may have been interested in participating.

Table 13: Eligibility criteria for participants

Eligibility criteria for participants:	
Inclusion factors	Exclusion Factors
Self-identify as Caribbean and are aged 65 years or over Have a parent who self-identifies as Caribbean and is aged 65 years or over Are a health professional in a related field (eg. geriatrician, GP, falls co-ordinator, physiotherapist…) who has experience working with Caribbean people aged 65 years or over Are a community leader who has experience working with Caribbean people aged 65 years or over Are a religious leader who has experience working with Caribbean people aged 65 years or over Note: Health professionals, community leaders, and religious leaders were preferentially sought who identified as Caribbean themselves, but if not, this was not a cause for exclusion	Caribbean adults under the age of 65 Health professionals, religious leaders, or community leaders who do not regularly work with Caribbeans 65 years or older

6.3.2 Ethics

Ethical approval for this study was obtained from the Research Integrity and Ethics Team at the University of East London on the 21st October 2020 (approval number ETH2021-0020). The Interview Topic Guide, Participant Information Sheet, and Consent Form, and the approval letter are included in the appendices.

All interviewees were sent a personal thank you card with a £10 voucher as recompense for their participation.

6.3.2.1 Informed consent

The Participant Information Sheet (Appendix 2) and Consent Form (Appendix 3) were mailed, or emailed, to participants well ahead of the interview to give them time to read the contents and ask any questions if desired. During the early days of lockdown in the UK, and in accordance with Covid-19 regulations, and OAs shielding at home, consent was obtained orally to avoid unnecessary contacts for OAs having to visit the Post Office. The consent form was used as a script, and each question was read out and consented to one-by-one, orally, by the interviewee while being recorded on the Teams platform. This recording was then kept separately from the interview, in accordance with the requirements of the UEL Research Integrity and Ethics Team. If preferred by the interviewees however, the consent forms could also be completed and emailed back, ahead of the interview.

6.3.2.2 Data collection

Semi-structured interviews were held remotely either via Microsoft Teams if the interviewee had access to a device, or by telephoning them via the Teams platform. Both options allowed recording of the interview on the Teams platform, as required by the UEL Research Integrity and Ethics Team, but the telephone options would be voice-only. As many OAs did not have access to technology, this more traditional option was required.

Prior to commencing the recorded interview, a brief overview was given, participants were reminded that their participation was voluntary, and another chance offered for participants to ask any questions. The semi-structured interviews followed a pre-prepared topic guide, using prompt questions if required to obtain more detailed information. Participants were asked about their opinions regarding the activity levels of the older Caribbean community, whether PA was considered to be appropriate in older age, the kinds of PA preferred, and their knowledge of the benefits of PA in later life. They were asked what kinds of things made it easier for them to be physically active, and what made it difficult. Practical details were also sought such as the preferred time of day for PA, the time they felt they could give to PA, preferences for the gender mix of classes, or indoor/outdoor PA, and whether there were any things that they would not consider participating in. Full details can be seen in the topic guide shown as Appendix 1, and in addition, demographic information was also collected on age and gender and is listed in Table 14.

6.3.3 Data management

All interviews were recorded on the Teams platform, subsequently transcribed by NW-H, and then destroyed as soon as transcription had been completed. The online recordings of oral consent were stored as proof of the participant's consent. All data was stored on a cloud-based service, the UEL OneDrive for Business. All participants were allocated a "participant code" to anonymise them on all data collection formats (transcription of audio, transfer to Excel, NVivo…). Data was anonymised at the point of transfer to electronic format, and the master copy of participant name and code, was kept, with physical separation from all data, in a locked cabinet until the end of the study.

6.3.4 Data analysis

The anonymised transcripts were uploaded to the Computer-Assisted Qualitative Data Analysis Software (CAQDAS) NVivo12 to facilitate data analysis. Data were analysed using thematic analysis (Braun and Clarke, 2006), following an iterative process (Srivastava and Hopwood, 2009) as described in more detail in Chapter 3.

6.4. Results:

A total of 19 interviews were carried out, 7 with Older Adults (OA), 2 with Family Members (FM), 2 with Community Leaders (CL), 1 with a Religious Leader (RL), and 7 with Health Professionals (HP), six of whom were physiotherapists working in a fall prevention clinic, and one who is a gerontologist. The demographic information of each interviewee is shown in Table 14.

6.4.1 Interpretation of findings

The process of thematic analysis of qualitative data involves firstly familiarising oneself with the data. This was accomplished quite effectively via the process of transcription, but a re-read of all transcripts was carried out again prior to thematic analysis. Coding was then carried out in partnership with another researcher by hand. All codes were grouped by their similarities into themes. This was an iterative process with many evolutions, as themes were reviewed and adapted, until the researchers were satisfied that the themes produced accurately represented the data and the codes.

Table 14: Demographic information of interviewees

Category	Identifying code	Sex	Age	Identify as Caribbean?
Older adults	1OA	Female	85	Yes
	2OA	Female	72	Yes
	3OA	Female	77	Yes
	4OA	Female	66	Yes
	5OA	Male	67	Yes
	6OA	Female	65	Yes
	7OA	Female	65	Yes
Family Members	1FM	Female	39	Yes
	2FM	Female	59	Yes
Health professionals	1HP	Female	44	Yes
	2HP	Female	23	No
	3HP	Female	30	No
	4HP	Male	25	No
	5HP	Female	32	Yes
	6HP	Female	56	No
	7HP	Female	64	No
Community Leaders	1CL	Male	68	Yes
	2CL	Female	56	No
Religious leader	1RL	Female	64	Yes

The results of the interviews are presented within the themes derived from the analysis of the data. The major themes are shown in Table 15.

Table 15: ***Themes identified***

Theme	**Sub-theme**
Attitudes to ageing	PA and successful ageing
	Differences in the ageing identity
	The ageing body
Impact of Caribbean life and culture	PA and the Caribbean culture
	An active Caribbean childhood
Factors promoting PA	PA as a habit and focussed on enjoyment
	Social connectiveness and a sense of belonging
	PA as a tool for wellbeing
Obstacles to PA participation	Practical obstacles:
	Financial restrictions
	The importance of class location
	The effects of poor weather
	Limitations caused by physical health issues
	Deconditioning due to Covid
	Time constraints
	The impact of low levels of digital literacy
	Psychological obstacles:
	Low levels of motivation
	Mental health obstacles
	Fears of negative consequences from PA
	Fatalism
	A retirement identity
Understanding of PA and health	Varying definitions of PA
	Lack of understanding of guidelines and the link between PA and health
	Missed opportunities for messaging on PA
Need for trust in the group leader	Fun, knowledgeable, and caring group leader
	Demographics of the Group Leader
Preferred PA activities	

6.4.2 Attitudes to ageing

6.4.2.1 PA and successful ageing

In order to age successfully keeping active does appear to be seen as a key element. It is presented as very acceptable, even desirable, for OAs within the Caribbean community to remain active. OAs certainly appear to want to remain active, and see this as a way of remaining "young" for as long as possible. It is clear from the interviews, that people generally do not feel their age, and do not wish to be defined by it. This seems to be considered a positive time in life:

> "*Elderly people do things, they have sex, they think, they do, so if they do those things, why can't they do yoga? I like to*." 4OA

> "*It keeps them active and it keeps them thinking and it keeps them, umm looking agile, them wanting to look smart and wanting to look good. You have to have a reason why you don't, you, you, you keeping yourself going. If you don't have a reason to keep yourself going, what's the point now?*" 2OA

> "*Being 60 is not old, being 70 is not old*" 2OA

However, concerns were expressed regarding declining health and independence:

> "*I'm living on, I'm living on prayer and pain killers!*" 1OA

> "*I think all people are terrified of being a burden*" 2CL

6.4.2.2 Differences in the ageing identity

The health concerns expressed above may explain the generational/age-related differences noted. While younger OAs hope to remain as active as possible, for as long as possible, older OAs seem more likely to view their later years as a time for rest, something that they deserve after many years of hard work.

> "*You've worked hard, like a lot, of us have worked very hard, and you know, you just feel, well, this is your time to rest […] but you know to go out jogging or running and things like that, you know I can't see us doing that*." 1OA

OAs themselves recognise this change in attitudes that has occurred over the last few years. Longer lifespans mean that there are often different generations, both over 65, so younger-OAs view older age differently to their parents who are older-OAs.

> "*Well, I think attitudes towards being old is changing now. When I was a child being old means you just didn't do a lot, unless you had to you didn't, and society was different*." 2OA

> "*I mean, I, I've never seen my Mum exercise*." 4OA aged 66, whose mother is aged 88.

These societal changes continue to evolve and have even been noticed between the younger OAs and their grandchildren, as OAs notice that childhoods today are much less active than the childhoods they had.

> "*Well, yes, it's a different attitude towards activity. We have computers, we have the umm or things that the children sit in front of the computer, or the, the iPhone or whatever. You didn't have that in those days*." 3OA

6.4.2.3 The ageing body

One issue that does seem to affect the attitudes of OAs to PA is the changes to their bodies and what those bodies can do that older age brings. This can make comparisons with younger, more "perfect" bodies especially difficult and demotivating. The gym environment seems particularly associated with images of youth and physical perfection, making it a place where OAs do not feel a sense of belonging, and may not feel very comfortable.

> "*Yeah, you're going into gym, you see young, fit, tanned looking, flat stomach, and here they're like, oh I'm in my mid 60s, I have, I come here I have baggy legs you know, that is what, is just what you see […] you don't see people your size that, your physique in there and all that*." 7OA

"*Somewhere they feel safe, somewhere they feel like they're not gonna be ridiculed you know? Maybe, maybe that's why a lot of them them, you find the younger people are all gym-y 'cause they have nice flat stomach and and thing. But the older generation I think are conscious that they're older, are conscious that the body is not how it used to be*." 4OA

"*You know young people in their 20s, you know, I mean, you don't even have to be pretty in your 20s. It's enough to be in your 20s. The body, everything stays where it should*." 2CL

6.4.3 Impact of Caribbean life and culture

6.4.3.1 PA and the Caribbean culture

Some of the OAs interviewed were initially hesitant to "represent" the Caribbean population. Most participants reported that they had been in the UK since childhood or early adulthood, and felt that they had been in the UK for so long, that they were now culturally more "British", feeling that remaining too-Caribbean might suggest that they had not integrated into the culture. However, further questioning did elicit some specific cultural attitudes that persisted, and impacted on attitudes to ageing and PA.

"*Well, I can't speak for everybody. I know the people that I move around umm, they're not mainly Caribbean people, because I've been here for such a long time, that most of my friends are English people, Irish people or whatever, right? […] you know it's it's, it's, it's, it's different, you know you can't compare all Caribbean people live in the Caribbean, and all, all Caribbean people living in this country*." 3OA

An active older age appears to be very desirable among Caribbean participants, even being a way of keeping your vitality or easing the aches and pains of some medical problems. However, some express concerns about the cumulative effects of a lifetime causing a depletion of their physical resources and leaving them at risk of injury.

"*I think they should be out doing something […] Now that's what they're doing now because we find out now that, when you reach certain age, you need to, because it's almost like you're seizing up*." 5OA

> "*I think after you go over certain age group, you're more of a higher risk. Because I know people have been active during the time, but as they get older their bone structure has deteriorated, probably. What your, what your, what your, your body could take at the age of 20, that jump on that age, that movement, when you're 50 and over, you can't*." 7OA

While those interviewed had mostly positive attitudes to PA, one OA did describe a conversation she had had with a young man at her church who felt that her participation in a yoga class was not appropriate. While he was reacting to a specific form of PA, it was not clear whether his objection was due to the activity, or her age, however she did believe that it was specifically related to her gender. The young man in question was visiting from abroad, and his reaction does not appear to be shared at all by British Caribbeans, and nothing like it was brought up in any other interviews

Back in the Caribbean, a traditional role of grandparents is to look after the grandchildren, especially as living in multi-generational households is more common. This is seen as maintaining a certain level of activity, even though it may not be viewed as work.

> "*Well, at home when we get old, usually old people are usually looking after the grandchildren in the home, they're usually babysitters […] This section of the community would be inactive, but you know, […] you get grandmothers or aunts or cousins, the elderly would look after the kids*." 1OA

> "*Children in the house, 'cause you lived in the house with multiple ages, and you had like hierarchy thing. So for old people like my grandma, she didn't do a lot, but she was active. We didn't see what she was doing as work*." 2OA

6.4.3.2 An active Caribbean childhood

Almost all the participants reported having been extremely active when living in the Caribbean in their youth. The physical geography of many of the islands, meant that hills were a daily obstacle to be tackled, and farming chores combined with a lack of public transport at the time, all united to provide a very active childhood. Even OAs swept their yards, tended

their gardens for food, and often walked through the communities in the evening or early morning to avoid the heat, and to socialise.

> "*You know my father would tell you before he went to school, he'd have to get the donkey milk, get the get the water from the well, bring the donkey in, you know, and then walk half a mile to school, half a mile back, and then do the same thing when he gets home and repeat that everyday. So there was a lot of physical activity implemented back then in the younger generation, but this still happens in the older generation*." 1FM

> "*Say, Jamaica and a couple of the other islands I've been to. If they're a farming community, the tendency is that everybody is far more active than, than normal, and in fact, if you, they always recommend that you do 10,000 steps a day, but I guarantee that people who live in a farming community do far more than that. And if they're farming in areas right, which is far from home, which may be hilly, maybe valleys, they're after to carry the stuff on their shoulders, on their back to take you from a low point to a high point to get out of a valley that they may be farming in. So, a lot of people who are embracing the farming community, yes, they are far more active."* 1CL

> "*You see back in the Caribbean, we, you know our lifestyle and work is already very active, because you find most people are, if they're not, you know farmers, but they're relying on the land to live. You know you may not have a so many acres of land to farm on, but you would have a little spot. So, so we used to do activities to dig to pull out, or weeds to, to, to, to do things like that, and then to reap, you know? We are usually very active by the nature of just life*." 1OA

> "*In Jamaica, about 5:00 o'clock in the morning, she goes for her walks. She meets up with her friends, them, and they all go for a walk and they're all around the same age*." 2FM, speaking about a family OA

Another marked difference between PA in the UK and the Caribbean is in the reason for the activity. Caribbean PA is much more integrated into daily life. Running is not going jogging, it is to catch a bus, groceries are carried home from the shop, rather than weights being lifted in a gym… Being physically active in the completion of daily tasks seems more logical to the participants interviewed, but arbitrarily integrating PA into a day as an entity unto itself, makes little sense.

> "*Yeah, and I think, I also think that the exercise, um, exercising at a gym for older Caribbean people, it's not something that they would automatically turn to like going to the gym exercise. They are more likely to do your walking, do your riding, do your gardening, do your painting and you know all of these*." 6OA

> "*Back home in the country, they would have been running all the time, swimming in the sea, going up and down, climbing rocks, that was fun. So here now, the information OK exercises, this, this, this, it doesn't connect really at all.*" 1HP

In the UK however, while walking remains popular, it is influenced by higher access to cars and public transportation, reducing the amount of PA built into daily activities.

> "*However, here in the UK we have so much access to transportation, and vehicles, buses, trains umm so you know, and then we have things like online-shopping so you don't have to go out and do this walk to, to the shops and things like that*." 1FM

6.4.4 Factors promoting PA

Participants were asked about things that made them want to be physically active, what did they see as the benefits of PA that made them want to continue with it?

6.4.4.1 PA as a habit and focussed on enjoyment

Those who already had the habit of PA, seem to have acquired it over many years. They continue activities that they have done throughout their lives, even from their youth.

Integrating activities that were carried out when younger, may be more likely to be continued in later years.

> "*So maybe they had a habit of being active when they were young, they are more likely to be active later. If they had a habit of not being active that sticks as well.*" 2FM

> "*When she comes and visits us, she's […] in the garden, 'cause she's got the habit of being in the garden so, so she always goes to find a garden*." 6OA

Although many people may be aware that PA is good for their health, they admit they do not participate for this reason. Most people are active simply because they enjoy the activity, and they feel good, both mentally and physically afterwards.

> "*Listen, every step you take, 250 muscles are gonna work. Muscles love work and every time you smile it's a facelift we can all do which costs no money. Yeah it is wonderful and, and a shower you have after you've been active is the best shower in the world you know. It's so invigorating, it makes you feel so good, and when you can get those happy hormones running around your body, guess what? You feel like telling the world about the fact that you did a walk, that you went up a hill*." 1CL

> "*They're not really aware of these things. They do things because they like to do it, not because they feel it's going to benefit my health. So I gotta bring my blood pressure down low, you know, make me more active […] they don't look at activities like that, they look at the activities as pleasure*." 3OA

6.4.4.2 Social connectiveness and a sense of belonging

The social aspect of PA seems key to the acceptability and appreciation of any PA offered. This places a high value on group activities which are the most likely to provide this. HPs have reported a good success rate when PA is offered in a group format, and groups made up of similarly aged people seem particularly popular. This provides a degree of comfort for those who are adapting to the physical changes in their bodies due to age, and may also inspire OAs, especially seeing active lifestyles modelled by other OAs, which could give them the

confidence that they too can be more active in their daily lives. People report the need for mental and social support as being as important as physical support. Encouragement is vital whether it be from group members, leaders, or friends and family outside the PA group, as it motivates both the beginning and the continuation of a PA programme.

> "*We used to do that (group sessions) and, and that was quite successful. I think that the key is coming together as a group. So it's really about that social aspect of things […] I think groups work really well*." 1HP

> "*Yeah, yeah, I would prefer that (being in a group of people their own age)*." 4OA

> "*Well, when you're with your friends, you're more relaxed and you can talk about things, and if you got something bothering you, you could share it, and you listen to them and they listen to you*." 2OA

> "*It's about it's about all that connectedness that makes exercise worth taking*." 2CL

The social aspect is even reported to continue outside the groups, with people forming connections, supporting each other, checking in on each other, and joining together for more social non-PA activities.

> "*And on one of the groups that we started three years ago, they're still meeting. They're doing their own thing now. We were with them for about 3 months, and they're still friends and even through the Covid, you know, they've kept in contact over the phone, they're checking each other and getting out when they can. And they're still very active, and a few of them have had a fall here and there, but the thing we've found with that is that they are still continuing. Even though they had a fall, they've encouraged each other to, you know, get your confidence back and let's keep going. So that was, it's been a really good success*." 6HP

In addition to physical health, mental health can be fragile in older age. Loss of identity after retirement, can make it difficult to find connection with others. Loneliness caused by a loss of work contacts, loss of a partner or friends, and more recently, lockdowns due to Covid-19, all have a negative effect on mental health. PA can be an antidote to all these factors.

> "*People use activity as a way of life to keep them in contact with other people because they have their friends that they do things together and whatever. They, they do it as a means of umm. not umm, thinking about their health, but thinking about their, their social life and other things like that*." 3OA

> "*It's good for your, for your mind and stress*." 4OA

There was no clear consensus on the preferred gender make-up of PA groups. While some enjoy the dynamics of mixed gender classes, others would prefer a single-sex option. Both Health Professionals and Community Leaders reported good results from mixed classes, whereas some OAs and the Religious Leader expressed preferences for single-sex groups. It is interesting that only ladies' classes were mentioned as needing to be single-sex. Reasoning for preferring single-sex groups included modesty and potential judgement over physical appearance.

> "*I think it's nice to have a group of the men and women together because […] it's banter all the time, yeah, we've never had a problem with it, with a mixed group, actually*." 1HP

> "*There wasn't any men there, […] they were just on their own, women, and it was good. If you're going to have a multi exercise where, where both genders, and of course you have I as I said with the Caribbean, if they have to lift their legs or whatever, they probably wouldn't like men there*." 1RL

> "*I would prefer, I'm not being feminist, but I'd rather have ladies. Yeah, with my age and stuff, it's you know you feel embarrassed if something happened. You feel more comfortable being only ladies.*" 7OA

"*Well, I'm not too worried about mixed sex things like that. […] people are just people after a time, […] after a time in life, that chemistry is waning, you're just people*." 2OA

When groups are formed, either for PA or any other leisure activity, a sense of belonging is created. This sense of ownership is important for providing a feeling of welcome and acceptance among members, and they become empowered in making decisions within that group, thus taking some control over this part of their physical and emotional well-being.

"*What they have to get right is ownership though. Because if people feel that they are a club that belong to it. The trouble is lots of times things are done for you, not with you. And I mean that's one of the issues, I think in the acceptance."* 2CL

"They tried to have things going on at the various Community centres, but even then, it's a shared space, it's not your space, it's not friendly. You don't necessarily have a reason for being there." 2CL

"*People still met to go swimming (after take-over by a council-run organisation), but it was not the same. It was not their club. There is not that sense of ownership. There's not a cup of tea afterwards*." 2CL

6.4.4.3 PA as a tool for wellbeing

PA is not simply seen as a means to obtaining better physical health, but is viewed as contributing to wellbeing overall. This wellbeing intersects with aspects of independence, pain reduction, faith, music, and having "me-time".

As already stated, OAs often fear a loss of independence, and health problems are frequently seen as an inevitable part of the ageing process. There is great pride in remaining independent, both for the OA, and their family. This pride in their own abilities, and the desire not to lose face, may be an effective encouragement to maintain PA levels. PA can therefore be seen as a way of taking control of health and reducing this impending decline which can be quite empowering.

"*My mother is 80 and she's still very strong, very independent and living on her own*." 6OA

"*She doesn't want no stair lift or anything like that […] it's not pride, 'it's my exercise'*." 2FM

"(*Dad lived to) a hundred, and he was still, he was still going strong. Planting his seeds, his garden, keeping moving*." 5OA

"*The messages are clear that if the more active you are, the more independent you will be as you get older*." 1CL

"*It's more about what are the, the others going to think about me, so I need to make sure I cook my own food, I wash my house properly, I keep up pretty well."* 1HP

Others use PA as a means to manage existing health conditions and reduce pain.

"*They've come to the conclusion that if I get up and I do this, my back doesn't hurt so much, but if I sit down for too long everything is paining me*." 1FM

"*I've always done yoga funny enough when I was young because of the fibromyalgia […] It's good […] it does strengthen you 'cause you think without that like maybe I'd be just stuck in a chair or walk, walking with a Zimmer-frame or something because the pain can get so bad that nerves, the trapped nerves, sciatica, and so umm yeah so I just do these things just to keep myself, I don't, I don't feel my age*!" 4OA

In today's hectic and fast-paced world, some see PA as an important moment of "me-time". This can be beneficial both to an individual, or to couples as a time to catch up, talk, and reconnect after a busy day.

"'*cause it's also about forgetting about everyday life things, and just getting yourself in that door for an hour, you like me, me-time thing you know*." 4OA

"*We do support each other and encourage each other to go for those walks because for us the walks are good, in terms of physically you're, you're moving, but also it gives us the opportunity to talk as well as we're out and about*." 6OA

Caribbean people speak often of their faith, and their places of worship, religious leaders, and fellow believers are very important in their lives. Some churches play an important part in educating and accompanying their followers in different, relevant health matters. This reassures people as the visiting speakers, and the information has been approved by the church, and is therefore more likely to be accepted. It also fits in with Biblical teachings that individuals have a responsibility to look after the body that they have been given. A prayer before and after PA has also been a good experience for some, melding the physical and spiritual aspects of well-being.

"*I think it's just mainly encouraged from the leaders that it goes exercise, and I think our interpretation to exercise. You should look after your body. You should look after… we call it the temple*." RL

"*And at the end (of a PA session) we even had a prayer because most of the Caribbean's are believers in God. Yes, and we would finish before, pray, and everyone go to their different homes. It was lovely*." 1OA

"*I think more than anything that keeps her going. Your faith is really important, I think in your you know in your lifestyle as well*." 6OA

Music is an important influence on participation in PA, and many of the people interviewed spoke of Caribbean peoples' love of dancing and music. If the music is also specifically of their era, and reminded them of their youth, it could be particularly effective in motivating OAs to be more physically active.

"*I've found that doing a group, music is always a good thing in the background. I could get something that's a bit upbeat, get them going." 6HP*
"Music that reminds them of their youth." 1HP

"(*Caribbean) people love music, music goes on, dancing is, is something that we do […] if I'm doing any exercise, consider that the music is important, the colours, the attitude is all part of what would get them to umm to move their body a little bit*." 1CL

"*Yeah Caribbean people will dance to anything, anything!" 5OA. "They're very musical" 6OA. "As long as the music's going, they'll dance to anything*" 5OA.

A Community Leader with long experience of encouraging PA, also reported that giving exercise sessions a Caribbean-flavour in terms of music, colour, and attitude made them more successful and attractive to Caribbean people.

"*I still have quite a high following of black people who will follow me if I'm doing any exercise. I consider that the music is important, the colours, the attitude is all part of what would get them to umm to move their body a little* bit." 1CL

6.4.5 Obstacles to PA participation

6.4.5.1 Practical obstacles

6.4.5.1.1. Financial restrictions

Significant concerns have been expressed by those who work closely with OAs, that financial issues are one of the key barriers to OAs engaging with PA. These issues affect many OAs who are on limited incomes after retirement, and the lower the socioeconomic status, the greater the problems. The cost of transport to a PA group, and the cost of a gym class or entry fee, are too much for many OAs.

"*Of course they themselves are unable to fund, fund it. Taking a taxi, you're looking at probably £7.50 or whatever*." 1RL

"*I get mail in all the time from people asking, what can I do? […] I can't afford to go to a gym, what can I do?"* 1CL

For many OAs, these costs have a very low priority compared to heating and/or eating, or supporting family who are also in difficulty financially.

> "*Even if it's only £3.00 and you get a free bus pass, you get a free bus pass to get there on your two buses and it's only three quid to go in, that three quid is probably the difference in the roast chicken that's gonna last you all week, or having a heater on for a little bit of time*." 2CL

> "*One of the things we see repeatedly in in modern society is if grandma does have a bit of extra money, it's going to get shoes for the grandkids, or it's helping son keep his car on the road, or maybe paying the mortgage*." 2CL

Funding for community PA activities is also often vulnerable to the vagaries of purse-holders, meaning that popular and affordable groups often have to absorb costs if their funding source dries up. This places the burden of funding directly onto the group organisers who must find alternative sources for funding, either passing costs onto OA end-users, making the activity unaffordable for many, or causing the group activity to close. Local councils may also switch from community-run programmes, to larger professional bodies to provide services more cheaply. This professionalism of the activities is not only more standardised and thus less responsive to individual groups needs, it is also often more expensive for the users.

> "*So visualize a community group, where everybody is paying, I, whatever it was, you know for, for argument sakes, let's say two pounds, I can't remember. But they were paying the cost of admission to swimming, and then afterwards, you know we were transporting there with volunteers and cars, who again were older people who were half member half wherever, and a local sort of transport provider for disabled transport, 'cause a few people were, you know, unable to get in the car and needed to be transported by specialist transport. So, so, what happened was they, they had this like nominal charge which covered everything*." 2CL

> "*They (the council) put up the, the charges and so we couldn't like run this little swimming club you know economically anymore*." 2CL

> "*I was part of one that was in (place name) in the Community Centre, but lack of funding has dried all of this up, so I suppose all these people are in their homes, they not doing anything*." 1OA

Those who struggle financially, often have poor diets, leading to low energy levels, which make it even more difficult to engage with PA. This can lead to clinical frailty and associated muscle loss which in turn makes PA impossible, and the cycle continues.

> "*I think the other, one of the big factors be found […] is their nutrition. So, uh, yeah, when they have like poor nutrition then they just haven't got the energy to even be more active*." 7HP

> "*The thing is without improving the nutritional state because then they, you won't even be able to motivate them to do anything, because they're like exhausted or burnt out before they even start*." 7HP

> "*And give you the energy to actually do anything, because frail if you're not eating well, you've got no energy, you've got no muscle, you've got no ability to do anything*." 2CL

Concerns have even been raised about people pre-retirement (50-65) who are living through extended periods of austerity, have significant stresses on their mental health, don't exercise, and are poorly nourished. There are fears that this is going to become a major issue in the future when this group reaches older age.

> "*We're seeing a generation of people who are low income and badly nourished in their 50s. They're not really necessarily well exercised, and their mental health isn't good, and you know, I, I do actually think that we've been terribly short-sighted in looking at the impact of austerity. So the decade of austerity, which is really still continuing, it hasn't stopped, it has created a bunch of problems that we're doing absolutely zero to solve*." 2CL

6.4.5.1.2. The importance of class location

Location is another important consideration when offering PA options. Although OAs are eligible for a free bus pass when they reach the state pension age, the bus service is not always an easy option. If several buses have to be taken to reach a destination, with waits between each bus, OAs are exhausted before they even walk through the door, making PA an additional step too far. Taxis are a more direct and easier option, but cost too much, as already discussed.

> "*So we still have to change buses, go to off 2 buses […] a lot of people complain they can't do it. It's too much for them […] it's too much effort for half an hour or an hour. You put too much effort into getting there, and when you get there, you're more or less exhausted and then to get to make that journey back, it's a bit much*." 2OA

If, on the other hand, the location chosen is familiar and nearby, such as a church hall or community centre, then people often already have the habit of getting there making transport easier. It is familiar, and often in the centre of a community, which gives the sense of ownership already discussed.

> "*A Community Centre, or a church-hall If it's allowed. I think that would join a community I think that would maybe draw people more. When they said the gym., some people just… yeah*." 4OA

6.4.5.1.3. The effects of poor weather

The weather is another factor that strongly affects someone's desire to partake of PA. Even if the PA is not outdoors, the travel there is less appealing in poor weather. The poor weather often experienced in the UK is strongly juxtaposed against weather experienced by this community in the Caribbean. While people do enjoy getting out and being active when the weather is good, the short summer period means that much of the year is spent indoors.

> "*When the weather is not good, she doesn't wanna go nowhere*." 2FM, speaking about a family OA

> "*The fact that there is more, freedom to move about (in the Caribbean), because it's, it's warm. Yes, you know, it's warm, you're not locked into a*

house during the winter months […] we're all like couch potatoes, aren't we in the in the winter months, and then the sun comes out and we're all we're all going out." 6OA

OAs are also negatively affected by poor weather when it causes trip hazards, making them feel unsafe when out and about.

"*As you get older, and you're not easy on your foot, and it's sliding underfoot*." 2OA

6.4.5.1.4. Limitations caused by physical health issues

Pain is a significant barrier to PA, and is often a daily struggle for many in older age, whether just the aches and pains of ageing, or a specific condition. In extreme cases, painkillers are needed to even get up and start the day, making the additional efforts of PA impossible. For many, it prevents them from even beginning any form of PA. This may be due to low mood caused by pain, which creates a lack of desire for the individual to do anything, or because a new level of activity may initially bring discomfort, thus adding to a pain burden.

"*So I'm in a lot of pain, I start taking, I start with painkillers very early, so that I can even be able to be up*." 1OA

"*If they're going through illness that causes pain. That's definitely what will make you sad, that will make you don't want to do anything*." 2FM

"*The fear of its aching, and if I do anything, it's gonna hurt more*." 1FM

Weight is reported as being an issue for many Caribbeans, and managing it has often been a challenge for many years. This is also recognised as potentially exacerbating the aches and pains experienced in older age, making it a vicious circle of pain and inactivity.

"*And sometimes those aches and pain is basically because of a weight that they might incur*." 1RL

6.4.5.1.5. Deconditioning due to Covid

Covid has had wide-ranging effects on PA. OAs were afraid to venture out, for fear of contracting Covid-19, and even if they did, activities and facilities were closed. This long period of closure has now caused consequences due to the long period of inactivity, making it difficult for OAs to reintegrate into PA. In addition, lockdown has made OAs acquire habits that allowed them to compensate for social connection and diversion such as TV and the internet, but which have made it difficult to go back to more active pastimes.

> "*Especially the elderly. You know we were, we were almost ordered you know, to stay in if we could*!" 1OA

> "*We haven't had any interaction for nearly two years now*." 2OA

> "*TV can also be a hinderance to people exercising as well, especially during the lockdown. I think most people are more, just I don't know, just sit around, isn't it? Because you're frightened to go out, can't keep in contact with people, so you'll sit and watch more TV than you should, or look beyond your computer more than you should. And these things prevent you from taking physical exercise*." 6OA

6.4.5.1.6. Time constraints

Some find PA difficult to engage with as it takes time to adapt and see results. If the activity itself does not elicit pleasure, then some do not see the point.

> "*It's it for them, it's a bit, a bit boring, like they can lose interest. You're not going to see results straight away*." 4HP

Contrary to popular opinion, OAs are often extremely busy. There are many calls on their time, and it can be difficult to find time for PA in a busy schedule. Even if time could be found for the PA itself, the overall time investment (PA, travel, shower…) may be too large.

> "*That's another reason, too much going on*." 2FM

"*It takes you 25 minutes to get to the gym, and then you've got to be there for an hour exercising, and then you got to shower, and then you gotta get home, you have actually taken out of your day 2½hours*." 1CL

The preferred time of day for PA clearly depends on individual preferences, as different preferences were expressed. However difficult times for transport, such as after school were mentioned as something that should be avoided.

"*When is after three, school children are all on the road. I colour myself to traffic*." 2OA

6.4.5.1.7. The impact of low levels of digital literacy

Technology can be a significant barrier to PA as classes may need to be booked, opportunities for PA sought, or remote classes followed online. Many OAs do not have access to digital devices and cannot afford the hardware or connection costs. However, even if those devices are available, due to family passing on equipment when they update to newer models, neither the skills nor the desire to learn them are there. This creates significant barriers to accessing services or information that is provided in this way.

"*Now, so we've ended up with the digitally poor who are excluded […] again they are not looking at some of the reasons why. So one is the acceptance and seeing a clear benefit in it, yeah, but the other one is affordability. Having broadband isn't cheap*." 2CL

"*I've got all the gadgets because my daughter sees to it. I have it and, and now I must attest that I am extremely lazy. I don't learn*." 2OA

"*I've got two iPhones, I've got two computers. All the technology is there. Yet I am not interested*." 3OA

6.4.5.1 Psychological obstacles

6.4.5.1.1. Low levels of motivation

One of the hardest things for OAs appears to be the motivation for PA; some OAs just can't be bothered and find it difficult to motivate themselves to even start. As with all things, people are individuals, and this also applies to their attitudes towards PA.

> "It *also depends on what the actual person wants, to do. 'Cause you can't make someone do, you can take a horse to water, but you can't make him drink that water*." 2FM

> "*They find it hard to get going, especially if, if you, if you're elderly*." 1OA

> "*They're like every other group, some are active, and some are not*." 2OA

While this motivation needs come from the individual themselves, they can be motived by creating meaningful goals, and providing PA with purpose. It has been noted that while people may struggle to be motivated for themselves, accountability, or others relying on the individual's presence, can make it easier.

> "*So lots of people are very disconnected to things and that makes it very difficult to be motivated. 'Cause the biggest motivator in taking exercise is not letting somebody else down. Turning up because Marjorie is going to be missing you, or you know, Edith is gonna wonder why you're not there, and is gonna worry about you*." 2CL

> "*It's got to be something they want to do and something that can identify with*." 2OA

> "*It depends on how motivated they are in the first place. Those who feel motivated will be willing to probably, but those who umm, who need a bit more like umm positive encouragement by seeing other people do and things like that, it's, they're not going to join it, or that they make the effort to do it themselves*." 7HP

Some factors may not be specific to OAs, and can probably be generalised to the wider population. The lure of screens and sedentary lifestyles when tired out by hectic lives is something that most people can probably relate to, and it is no less prevalent among OAs.

> "*We're all trying to get fit. But I do I, I, even though I say this, is sometimes I become a potato […] some people just want to sit in front of the TV*." 2FM

Family members, health professionals, and community leaders have all noted difficulties they have experienced in trying to get OAs engaged in PA.

> "*It can be a struggle to engage in, like you know, gym activities and such*." 1FM

> "*In general is very difficult to actually get them to be active*." 1CL

> "*So yeah, very…not…very willing to participate, but just not engaging as much as they could be*." 1FM

> "(*Do I think that most Caribbean people are physically active?) I wouldn't say, I wouldn't use the word most*." 1RL

> "*I think now that we have become far more computer literate and then sitting more time in front of the box, I think the problems of the (Caribbean) community's probably not dissimilar to the deconditioned market in general in that you know people are less active. They spend more time in front of the television, more time in front of the computer and so therefore they pick up all the ailments that one is likely to get because of that kind of inactivity*." 1CL

6.4.5.1.2. Mental health obstacles

Mental health also plays a key role in PA. Loneliness and depression cause isolation and inactivity, and after a while an OA is less and less able to participate in PA as their body has become frail and stiff and the desire to engage with others, and with PA, wanes.

"*Well, when you're happy, you, you, you, you just have this, you just want to do things like you wanna join with others*?" 2FM

"*Yeah, yeah, because this lockdown has been almost deadly for some of us […] I mean you are so glad just to see someone*." 1OA

"*You know if you feel really lonely, you can become depressed, and you don't want to get up, and then you know you just find yourself falling into a rut, and then when you do want to get up, you can't because you been, your body seized up, because you sat down for so long*." 1FM

"*If they're quite depressed, lonely, I think it's very difficult to get them to get involved in activity even though activity will make their mood much better, but to get to that point…*" 7HP

In more extreme situations, cognitive issues can also make it difficult for an OA to understand the importance of being physically active.

"*It's (understanding) very variable according to their education or knowledge, umm, cognitive function*." 7HP

"*You have people who have dementia, Alzheimer's, and don't understand. Some people don't understand due to the cognitive issues that they may be going through*." 2FM

As already discussed, the difficulties in accepting physical changes due to age, can also affect expectations of PA. People may either expect to be able to return to the levels of fitness they had in their youth, others may begin to doubt ever being able to regain even a percentage of their lost physical capabilities.

"*He would always talk about like, what he was like before, not what he's like now […]. He thought the next day he was going to get better, and he thought that when he got home he, he would be better as well, 'cause he's in his own environment, he's back to where he was when he was active […] I think he, it*

kind of hit him once in a while, you know your activity and how healthy you are isn't forever. 4HP

6.4.5.1.3. Fears of negative consequences from PA

Fear is a significant psychological barrier to PA. Whether it be the fear of pain from pre-existing medical conditions, of making that pain worse, or of causing additional problems by increasing wear and tear on the bodies, some OAs can be distrustful of PA and sceptical of its benefits.

"*The fear of its aching, and if I do anything, it's gonna hurt more*." 1FM

"*They tell you to keep active, but keeping active also puts wears and tears*." 7OA

Having health conditions such as cardiac problems, or high blood pressure can make people afraid of the raised heart and breathing rates that PA often brings. OAs can be well and active one day, and then quickly brought down by a change in health status, even if it is temporary such as an infection.

"*Partly underlying medical conditions, because they can have cardiac problems, lung problems, arthritis all those things will limit their ability to be active, even if they want to, wanted to".* 7HP

6.4.5.1.4. Fatalism

These issues of ageing and health problems creating barriers to PA are seen by some OAs in a fatalistic light, although whether this is a more deliberate "head in the sand" type response, or more of a belief that there is nothing that can be done, seems more of an individual attitude. Often the latter arises as an individual may have seen friends and/or family members struggling with the same issues in the past, and thus believe that they will inevitably suffer in the same way.

"*It's, it's, you know that you hear the "I have been doing it for a long time. My mother had it. My father had it*." 1RL

"*There's a problem with being older and that is you go "well, I've lived this long doing what I've been doing all my life", it's fine, you know […] there's almost a don't care attitude as well*." 1CL

6.4.5.1.5. A retirement identity

Retirement can be a difficult point for many OAs. They no longer have their work identity, they may lose friends and/or loved ones, and finding their new identity can be difficult. This can cause a loss of confidence moving forward, making it particularly difficult to engage with new activities and groups. Learning to reinvent yourself is always problematic, but especially in older age.

"*You know not having identity, not, not being sure who you are. You know you don't work at the factory anymore [...] because you're constantly reinventing yourself through life*." 2CL

6.4.6 Understanding of PA and health

6.4.6.1 Varying definitions of PA

For some OAs, PA is inextricably linked with general health and well-being, and may also include elements of mental health within the definition. While this is a very holistic definition, it can lead to some people feeling that when they are keeping their minds active, this is sufficient for good health, and including PA is unnecessary.

"*Physical activity means to me, health, ultimate health*" 1FM

"*Sometimes it's not only physical for me but mental. I engage myself in, probably reading, that that's something big to exercise your mind*" 1RL

"*You are doing much more than exercising your body, you're exercising your mind, you're exercising your feelings*." 2OA

There does appear to be an overall awareness of the health benefits of PA, although the reported benefits seem more related to reducing pain and helping to stop OAs "seizing up". These "feel-good" benefits are often the side-effects of PA that once discovered, keep the OAs carrying on, while specific medical benefits such as a lower risk of high blood pressure,

diabetes, falls etc., seem less of a driving force to be active. People will be active, not because it's good for them, but because they enjoy it.

> "*When you actually have a opportunity to, engage in an activity, physical activity, whether knowingly or unknowingly, and you feel the positives of that impact, that impact, you know, that activity, it will encourage people to continue, even if it's twice a week they will, they will be encouraged to, you know, I felt much better after doing that, I'm going to try and do that again tomorrow. Or I'll try and do that again on Friday. You know. And, and that's how it starts, I think*." 1FM

> "*Because I've got the back problem, umm, I'm aware of that […] and it's by, by doing that, keep my back strong, that I know I'm getting the general overall benefits*." 4OA

> "*They do things because they like to do it, not because they feel it's going to benefit my health. So I gotta bring my blood pressure down low, you know, […] they don't look at activities like that, they look at the activities as pleasure*." 3OA

In addition, the very phrase "physical activity" may need modification, as responses as to what was understood by this phrase varied widely. Some OAs had no understanding of what this meant, even when prompted, while others feel it related more to specific, organised sports such as running, or jogging. Most were able to mention something involving moving about.

> "*I don't know what that means really. No*." 2OA

> "*You know walking or […] umm jogging and things like that*" 1OA

> "*Moving around, umm, doing things, keeping yourself active*" 2OA

> "*Just the umm, the things that you do, umm, like with me I like gardening, I like walking […] so I was doing everything I do, my housework, I did, you know, decorated my shed and I did my garage*." 3OA

6.4.6.2 Lack of understanding of guidelines and the link between PA and health

Caribbean OAs were very open to the idea of PA in later life and clearly did not feel that older age was a time to sit quietly and put your feet up. However, messaging regarding government guidelines for PA recommended specifically for OAs is clearly not getting through. This suggests that education may be required in order that people have a better understanding of the definition of PA, what should be done, how often, and how much. Health concerns can make the idea of PA worrying for some, and individualised advice on modifications to exercises to accommodate these health problems, or encouragement to build PA into everyday life may be needed. The message also needs to be repeated to remind people regularly. While this is understood by some, notably the health professionals, the message needs to be more widely disseminated.

> "*You ask them how much time per week should they exercise, and often they will say 30 or 60 minutes for the week! We know the minimum should be 150 minutes and they're quite shocked at that sometimes*." 6HP

> "*Not everybody likes sports and whatnot, but are quite physical by doing other things*" 3OA

> "*But with any message it needs continual reminder. You gotta keep on hitting them with it*." 1CL

> "*We explained, you know it's, it's something that you err might get a little bit out of breath with, an exertion extra to your just your daily routine. And they began to understand better […] Half an hour of, of hoovering and dusting and, and going up and down the stairs with your laundry and things like that that's counted as physical activity*." 6HP

Many participants reported a considerable lack of knowledge regarding matters of health. Whether this is due to poor messaging, a lack of desire to take health information on board by OAs, or a failure to do more than tackle the "active" problem by HPs due to a lack of time,

people are often unaware of the consequences of their daily lifestyle choices, and risk developing health problems as a consequence.

> "*What happens is that what you find is getting that knowledge, that knowledge about diabetes, cardiovascular diseases... there's not much of that wanting to know that knowledge […] it's kind of ignoring that part a little bit, wanting to ignore that part*." 1HP

> "*The lack of understanding education and literacy, health literacy, is failing us. We are failing ourselves as a result*." 1FM

> "*You have to find a way to get people to understand you're, you're living at a risk*." 1RL

6.4.6.3 Missed opportunities for messaging on PA

Some feel that an opportunity is being missed by doctors to improve this health knowledge. While most people visit the doctor in response to a particular problem, once dealt with, both patients and health professionals themselves would like the opportunity to go further. Advice from health professionals is well regarded and so discussing some preventative medicine options and improving the patient's health knowledge could potentially be quite effective. However, the difficulty of getting an appointment, and 10-minute time slots, make this possibility unlikely.

> "*But it's also been doctors. I don't think that doctors when they do an analysis of you should ever go, "everything is fine". They shouldn't do that, say, there should always be a but at the end of it, "so you have had your test, guess what? Everything is clear now, but I think you should be getting more active. I think you should actually be walking more. I think you should be going out with the dog more. I think you should be climbing as many stairs as you can. I think because if you do that, the mere fact that everything is OK right now, you will slow down the rate of deterioration of any condition you may have. […] And I think if I had my way, every doctor should be spreading that message continually. Don't tell people you're OK because the moment you*

just tell him "you're OK", you take away the warning they may have had. They put their hands up, and just go alright." 1CL

"*That's the biggest challenge for GPs now […] they end up treating the most active issue and leave it there because people haven't got the time*." 7HP

Other OAs may not even visit the doctor unless absolutely unavoidable, citing concerns about "being a bother", or feeling uncomfortable talking about private health concerns. As most of the OAs interviewed are not computer literate, they must make appointments by phone. This means facing the embarrassment of questions related to triage. Some OAs report not wanting to discuss private health matters with a receptionist, especially if they are considerably younger.

"*I don't want to be seen as a bother*." 7OA

"*So, you're going to the GP, and this time limit, like a GP has 10 minutes. […] if you book an appointment, and then to book the appointment you have to be triaged. And they don't like to talk with somebody on the phone about your, this is a barrier, to talk to somebody unknown to you, in a surrounding, yes they are saying it's private but in your mental, in your conscious state, is making OK, I'm relating to probably a 20-year-old on the phone now because my Internet problem, but that is a barrier when you want to go into the GP*." 7OA

Reasons why health messaging may not be reaching the target population are not clear but could be due to several factors. Health messaging is usually targeted to the general population, but this may mean that it does not reach certain groups (eg. non-English speakers, poor educational background, different cultural values…). Many OAs do not see the information given as relevant to themselves and so ignore it. Opportunities may be missed to pass on information due to time constraints or other priorities. Messaging may arrive too late, and certain messages would be better targeted at young people to promote the formation of good life habits rather than treating the results of bad habits later in life.

"*You always think it's someone else, you always think it's for someone else*." 1OA

"*You know, because values and beliefs are extremely strong, very strong, so it might start, might mean starting the programs in school, reception in primary*." 1HP

OAs often display a perceived lack of vulnerability to falls. Falls are also seen as only happening to other people, so OAs may continue with risky behaviours as they do not consider themselves to be in danger. There also appears to be a lack of knowledge about fall prevention. Some messaging about environmental risk factors was reported, but there was no knowledge of how PA could reduce fall risk, and in fact there seemed little belief in fall prevention at all, as falls tend to be seen in a fatalistic light.

"*There might be like a, like a, lack of risk, of risk awareness maybe, when you get to that age where you are more vulnerable to like fall down and have fractures […] They, they're more willing to put themselves at risk because they don't see themselves being vulnerable to falls and stuff like that*." 4HP

"*I'm not so sure if people know you can prevent, when you're going to fall, you're going to fall […] but then, I learnt about, you know, going to the, going, you know when I used to be, you listen to people who come to the lunch club with each concern and they come, they tell you what to do. You know, make sure you don't have rugs around and things like that*." 1OA

"*I don't know many Caribbean people that fall on a regular basis. I've never actually, I've never been faced with that*." 6OA

6.4.7 Need for trust in the Group Leader

The leader has emerged as a key element in the success of any group activities. Some referred to good instructors they had experienced in the past, others without a history of organized PA discussed what they would like from a group leader. It was apparent that a good

instructor/leader can be a “make-or-break” factor for participants, and that this component should not be overlooked in the planning of group PA.

6.4.7.1 Fun, knowledgeable, and caring group leader

It is important that the leader has a good knowledge-base and that participants can feel reassured and respect their advice. As mentioned previously, OAs may be lacking in confidence about their abilities, or concerned about exacerbating a medical condition or aches and pains. Trusting the leader to give good advice, and appropriately dosed or modified exercises is seen as very important by the OAs interviewed.

> “*So I think you have to have a good, a good knowledge*.” 1RL

In terms of enjoyment, people report enjoying classes more if they are having fun. A leader with lots of energy can encourage greater participation in the class and create more engagement by the OAs. An interviewee with experience of the fitness industry described how the use of humour can make exercises fun, less “scientific”, and easy to remember. This can distract participants who concentrate more on the fun they are having, and less on the exercise that they are doing.

> “*We had a very, very good, good instructor […], and you know she could just move and make us move […] yes you should very buoyant*.” 1OA

> “*I find I can get people to do the silliest of things. I mean, I, I'll always remember just creating some, some moves like whether it is pushing the shopping trolley, which is things that we all do, driving the car, just moving the steering wheel round and round, right, shooting a basket, spelling your name out with your hands doing big signs. So if your name begins with A, do a big A with your right hand, and if your name is Abigail, do a big B with the, the 2nd hand, and so I've always come up with things like that, which has always engaged people and make them not focus on exercise, but focus on the fact, Oh, that's a fun way of me doing things*.” 1CL

Ensuring that everyone is able to engage in PA, by offering options for all levels, and making it understood that PA is not only for young, fit people, makes it more accessible. PA is not only

high intensity exercise in a gym, but can be found in daily life, and is available to OAs of all levels of fitness and health.

> *"They're more willing to engage once they realize you haven't got to do really hard exercise for it to count." 6HP*

> "*I will have someone who has Parkinson's, someone in a wheelchair, someone who may want to do it from a chair, someone who is 80 years of age, and so that real mixture means that I've gotta make sure my exercises are tailored to be able to cope with anyone. They may have a condition, an underlying condition that needs addressing, and so […] it means that you haven't got an excuse. Now you can't go, "Oh, it's only for people who can stand up". No, no, no, sit down and do it. Alright, you can do arms, and so showing alternatives is important*." 1CL

Good leaders are also reported as treating the participants as people, not numbers. They will remember individual names, ask after injuries or illnesses, and check up on individuals who may have missed a class(es). They will also check on those with modified exercises and increase difficulty as the individual improves, thus increasing both trust and performance.

> "*I mean he's concerned about our welfare, so he wants to make sure. You know you want to always before, are you OK? How is your back? Like I hurt my shoulder the other day […] so he always says, you know he always tailors, you have options, it's tailored to suit the individual*." 4OA

6.4.7.2 Demographics of the Group Leader

6.4.7.2.1. Age

One result that evolved as a very important factor was the age of the leader. OAs often feel uncomfortable in a gym surrounded by young, perfect bodies. In the role of leader, there is a feeling that a young person cannot possibly understand the aches and pains, and limitations of older bodies. Leaders being of similar age to the participants has several benefits. Firstly, someone who is older but active and knowledgeable about PA, models a physically active lifestyle in older age that participants can then emulate. If in addition, they themselves are carrying the signs of ageing ranging from wrinkles to surgical scars, then this can empower

others to feel both more at home in their equally "lived-in" bodies. It clearly demonstrates that these factors are not barriers to living a healthy, active life.

> "*I haven't seen an instructor my age*." 7OA

> "*So he was a retired man and, umm, there was a woman, a female volunteer, umm, who had swum […] He'd been very active prior to all his health issues and, and I think he'd been an instructor in the Army or something at one stage you know, so very physically fitness minded. […] He had so much stitching 'cause he had had the entire breastbone opened up. and, you know. So there's all the sewing. He also had a colostomy bag, and he could wear shorts, and he would take people swimming. […] She had a mastectomy, and she'd also had a hysterectomy. You name it, she had it out. […] the next week (a new member) felt confident enough to put on a swimming pool and get in and get in there. […] just literally that acceptance of you know, we're all in this together. I mean it, it's just, it's just wonderful*." 2CL

6.4.7.2.2. Ethnicity

Although all OA interviewees were Caribbean, none of them felt that it was important for the leader to be of the same ethnicity. It was clear that the other factors mentioned such as knowledge, personality, and age ranked far more highly than ethnicity. Most Caribbean OAs have lived in the UK for a considerable period of time and are used to the multiculturalism commonly found here.

> "*I'm not really fussy. After living in England all this time, you get to be one, you are in England, it's multicultural. So you just get on with life*." 2OA

6.4.7.2.3. Gender

The gender of the leader was also not an important factor to most of those interviewed, with only one OA reporting a preference to have only ladies in a group class.

> "*It's more important that you have an instructor, they are good instructor, they, they're manageable towards you, they respect you, they accept you as a person*." 2OA

"*I would prefer, I'm not being feminist, but I'd rather have ladies. Yeah, with my age and stuff, it's you know you feel embarrassed if something happened. You feel more comfortable being only ladies*." 7OA

6.4.8 Preferred activities

When asked what PA would not be a welcome suggestion, the most common response was running, although it appears from one interviewee that bungee jumping would not be popular either! No other specific options were mentioned as unacceptable.

Dancing: as mentioned in the previous discussion on the importance of music, dancing is something deeply ingrained in the Caribbean culture.

"*I like dancing, I put the music on and I will dance to myself, so you can get some exercise on your own*." 2OA

Walking: this is the most commonly mentioned form of PA, and appears to be a popular activity, both in the UK, as well as in the Caribbean where it is often a social activity, or a form of transport.

"*We walk, we, we go out walking*." 6OA

"*Some of them you see walking, going wherever they're going, and like for my Mum they always call to her, or they come and have some tea*." 4OA speaking about her mother in the Caribbean.

Gardening: is another popular activity that is often discussed as being good for good PA.

"*I have a lot of friends who like to have allotments [...] My husband did that before he died. He used to have an allotment*." 1OA

Housework is also mentioned as a means of being physically active regularly within the home.

"*Put the music on, do the housework, have a dance, have a spin, so it involves a lot of sort of activity is not just like I'm gonna use the brush and sweep the floor, it's really active*." 1FM

Swimming has been difficult in recent times due to pandemic related closures of local pools, but it was mentioned as being a form of PA that is enjoyed by some.

> "*I do enjoy swimming and that's, you know, I was, I was sort of encouraged to do a bit more swimming because of my asthma*." 1FM

> "*So I used to swim a lot*." 4OA

Clubs were also brought up as an opportunity for both social and PA. However, it was conceded that often the social took priority via discussions, dominos, darts and bingo, while the physical was either neglected, or incidental, only being included in things like dancing, which are popular. Clubs are also a popular option among men, although the older 'Working Men's Clubs" no longer exist as they once did.

> "*I mean a lot of my friends, the male ones […] sometimes we playing dominoes […] years ago, usually when we have a little bit of time, at the club, you would have been like the West Indian clubs you would go and we have like a little dancing thing. So you've got exercise from dancing, you know interacting, socializing with everybody you know it could be playing darts, it could be playing…, but we don't have those Working Men's clubs anymore*." 5OA

> "*It tends to be that they do go along to these clubs, they do sit, and they do play games, and they do have quizzes and stuff like that, but the physical side is neglected*." 1CL

6.5. Discussion

This qualitative study was carried out in order to better understand the cultural characteristics and preconceptions of Caribbean OAs towards PA and ageing. As previously stated in the aims of this chapter, the previous literature review provided clear evidence that PA is the most effective fall prevention intervention. Therefore, this qualitative study focussed on the attitudes of Caribbean Oas to PA, in order to design a culturally tailored, PA-based, fall

prevention intervention programme. For this reason, attitudes to falls were not specifically targeted in this study.

Some of the evidence from this study confirms findings from previously published literature and could reasonably be generalised to OAs of all ethnicities, while other evidence gives insights into specific attitudes of the Caribbean community, thus adding to the knowledge regarding the promotion of PA as a fall prevention intervention to OAs.

While some of the barriers to PA noted here are specific to the individual, such as knowledge about PA, others are more external such as cost and availability. These different types of barriers need to be balanced in order to best help people to be more active, and such a wider systems-based approach is essential in order to increase the eventual success of such programmes.

6.5.1 Caribbean attitudes to ageing

The attitudes to ageing in this group confirmed evidence reported from other studies showing that OAs do not feel their age (Manor, 2017) and want to stay active and vital to enjoy these later years as much as possible, a description which embodies the idea of successful ageing (Calero and Navarro, 2018). The attitudes to and by Caribbean OAs were noted to have changed over the years, relegating the image of the older person seated in a comfortable chair in the corner, looking on, and dispensing wisdom, firmly to the past. A modern OA sees themselves as an active participant, both in their own lives, and those of the larger family, and there is no indication of any cultural barriers to the idea of OAs being physically active. Differences in activity levels between individuals is understood and accepted however. Some people are more active than others, but it was also thought that those who had been active in the past were more likely to be active in older age (Kosteli, Williams and Cumming, 2016), which led to some participants expressing concern for the future of their grandchildren. Modern children are seen as having far less active childhoods than those enjoyed by the OAs, thus causing concern for the future health of these youngsters. Another, perhaps more modern concern, relates to the reluctance to accept the physical changes that come with ageing, a phenomenon which Manor (2017) noted as being especially felt by women who are judged, often harshly, on their physical appearance. While modern media may have stoked

this aversion to the aesthetic of an ageing body, it is also the loss of function and the need to take more care which seems to be resented by OAs and undermines their attitudes to their own self-efficacy (Bodner, Shrira and Palgi, 2023).

As no previous studies have looked specifically at Caribbean attitudes to ageing, PA, general health, and falling, differences were sought as to how this may differ from other populations within the UK, and how this may affect messaging regarding health in general, and PA specifically. While all the participants in this study have been in the UK for a considerable period of time, and felt completely adapted to the British culture, most have also kept close contact with their Caribbean roots, causing their Caribbean-ness to be maintained within their personal cultural melting pot. While research has shown that immigrants tend to engage in healthier activities than the host-population (Abraído-Lanza, Chao and Flórez, 2005), a feature commonly referred to as the Healthy Immigrant Effect (HIE), this is not always evident as in the case of Canada's immigrant populations (Vang *et al.*, 2017). The HIE is typically found to be more common in adults than as children (Vang *et al.*, 2017), possibly as children may be faster to acculturate as their behaviour patterns have had less time to become fixed. This may account for the lack of health advantages seen across immigrant groups in this Canadian study, as their foreign-born population are mostly working adults with a median age of 47.4 in 2011. As the adults in this study mostly came to the UK as children or young adults, this may have allowed their rapid adaptation to British culture.

6.5.2 The greater levels of activity-based PA in the Caribbean

The more "Caribbean" factors that emerged related to the very active youth spent in the Caribbean, and a greater PA when visiting. The environment in the Caribbean lends itself to a more physically active lifestyle, through geographic factors such as the hilly terrain and warm climate, infrastructure such as the more limited public transport, and culture such as the early morning and evening walks that unite a community, both physically and socially. Moving to the UK often saw reduced levels of PA, which parallels the effects of a move from the Caribbean to the USA, resulting in reduced PA as described by Tookes (2019). This dual-sited study followed cohorts of Barbadian women both on the island of Barbados, and of a group of women who had migrated to Atlanta, Georgia. While this mixed method study was not carried out in the UK, a move from the Caribbean to an English-speaking, developed country,

such as the USA can reasonably be expected to be comparable. The effects of such a move on levels of PA may in part be due to the easy access to cars, public transport, lifts and escalators, and the evolution of technology such as TV, computers, and home appliances. The colder weather in the UK, and a less cohesive immediate community, with friends and family often living further away, all make outside PA less tempting.

In addition, although the OAs interviewed all spoke of very active lives in the Caribbean, this activity was all task-based. Exercise occurred through the necessity of getting from A to B, carrying shopping, gardening, housework, a practice confirmed by the qualitative study by Bramble, Cornelius, and Simpson (2009). Although this study was carried out in the US, participants were Afro-Caribbean and African-American women, making it extremely relevant to the target population in this thesis. The Afro-Caribbean women had begun life in the Caribbean before moving to a developed country, a situation comparable to Caribbeans who had moved to the UK. The participants in this study noted that their indigenous lifestyle involved a considerable amount of PA, including walking, washing, sweeping, and gardening. In this study, PA purely for recreational purposes was rarely reported, even when discussing participants' childhoods, meaning that similar activities were reported, including housework, walking, or gardening as a means of being physically active. Some people reported going to the gym, or swimming, but most preferred to have a reason beyond simple enjoyment for being active. This may suggest integrating PA into daily activities as much as possible in order to fulfil weekly recommended levels of PA may be more successful, rather than relying on only organised sessions in a gym. This approach has already been demonstrated in the literature as both effective and feasible (Weber *et al.*, 2018). This systematic review summarised the effectiveness of including PA into daily life via functional exercise, and found encouraging evidence for the benefits of such an approach, although there was limited evidence for younger OAs (60-70 years of age). Another more cultural factor reported by an interviewee with a long experience of getting people, including OAs, to be physically active, was the fun aspect. He reported that Caribbean people respond extremely well to Caribbean music, lots of colour, and some Caribbean "attitude". Using the analogy of tricking children to eat vegetables by mincing them up in their favourite foods, he finds that if people are distracted by the music and colour, and are laughing and having fun, they do not notice the effort they are putting into the PA. They will do more, and report having enjoyed it after. This

is in line with the literature, which shows that enjoyment is a strong facilitator in adherence to PA (Devereux-Fitzgerald *et al.*, 2016; Hardy and Grogan, 2009; Lindsay-Smith *et al.*, 2019; Maula *et al.*, 2019; Sandlund *et al.*, 2018; Yardley *et al.*, 2006). These studies include a systematic review, one mixed methods study from Australia, and four qualitative studies all across developed European countries. While there is currently a lack of research from both the Caribbean and other developing countries, the findings from these studies can be reasonably expected to be generalisable to the UK.

6.5.3 The importance of the social aspect of PA

The social aspect of PA also emerged as a key factor, which confirmed findings from other studies in Caribbean populations (Er *et al.*, 2017; Moore *et al.*, 2019). While these studies examined populations with prostate cancer and diabetes respectively, both looked at older Caribbean populations and found that social interaction and support were important factors in staying physically active. There appears to be little interest in working out alone, and a major attraction of group sessions is the opportunity to meet up and chat with friends. The systematic review by Devereux-Fitzgerald et al. (2016) found that this social enjoyment was even able to override a general dislike of PA. It seems that the cup of tea and the biscuit are just as important as the PA, and perhaps more so in increasing attendance and adherence. Many OAs live quite lonely lives as partners pass away, and children may not live close by. Moments to get out and socialise are reported as being even more precious after Covid lockdowns where many people were adversely affected by prolonged periods of social isolation. A study by Robb et al. (2020) showed significantly increased levels of loneliness, depression and anxiety among OAs during this period. Although this study was carried out via online surveys, which not all OAs may have been able to access, and the population studied only had 0.7% African/Caribbean respondents, it can be reasonably assumed that that the findings can be generalised to Caribbean OAs as the lack of IT access makes isolation and loneliness even more likely. Having said this, a new finding among some participants of this study, was that there was some appreciation of televised or online exercise classes which were discovered during Covid. For very busy OAs, this represents another option to fit exercise into a day that may be too busy to attend a group session, although the group sessions are still the preferred option. Granet et al. (2023) found that live or recorded exercise sessions were feasible, acceptable, and effective at improving physical function during Covid

lockdowns among Canadian OAs. Less dropouts occurred in the group assigned the live sessions, but there were similar levels of adherence and enjoyment between those who followed the live and recorded sessions. This suggests that outside pandemic situations, although in-person sessions remain the ideal, online options may be a solution for those unable to join groups physically, provided that they have the necessary technology, and the capacity to use it.

6.5.4 Faith and PA

Faith also emerges as a factor particularly important to Caribbean OAs, most of whom identify as Christian. The importance of faith in promoting PA has been described by Ige-Elegbede et al. (2019) in a systematic review of the facilitators and barriers to PA for OAs from ethnic minority groups in the UK. For many of these ethnic groups where faith is an important cultural factor, religion was found to potentially act as both a facilitator and a barrier to PA. While many see health as being a mixture of physical and mental health, people of faith also clearly incorporate a third dimension of spiritual health into the definition of overall health. Most of the studies included in the review examined the views of South Asian groups, while only one paper looked at Afro-Caribbean groups, however similarities can be found in the importance many of these ethnic minority groups attach to their religious convictions. This reliance on faith could be included into PA programmes in many ways, including working with religious leaders to get their support for the programme. Religious leaders can themselves be strong facilitators as they have such strong influence over their community, their teachings carry great credibility, and they have experience in motivating groups. Some older ladies interviewed in this study expressed concerns about maintaining their modesty and dignity during PA. Obtaining the sanction of religious leaders gives a stamp of approval to a programme, reassuring participants that it is acceptable, and encouraging them to participate. Anshel and Smith (2014), discussed how most religions endorse looking after the earthly body as much as possible, and refer to the body as the “temple”, the same word used by the religious leader interviewed in this current study. This support from religious leaders could counteract any ideas of religious fatalism, that health outcomes are merely God’s will and individuals are powerless to change this, a view considered a misinterpretation of teachings both by Muslim leaders (Ige-Elegbede *et al.*, 2019) and Christians (Anshel and Smith, 2014). In fact, members of a Seventh-Day Adventist Church in Barbados who followed

their church's health recommendations, showed lower levels of obesity, diabetes, and hypertension (Brathwaite *et al.*, 2003). This study was a cross-sectional survey however, and did not collect data on the experiences of the participants. It would have been interesting to know how the chosen delivery method via the church was experienced by participants, and whether it made the programme more acceptable to them. The interviews in this study included an experience where integrating prayer into a session was reported as adding to a sense of well-being felt following PA. In practical terms, sessions held within a familiar location such as a church hall or similar, increased familiarity and ease of travelling to and from sessions. The sense of ownership and belonging would also be increased by using a familiar location, and possibly even bringing together members of the same congregation into group PA sessions.

6.5.5 Financial barriers to PA

Out of the barriers that emerged as impediments to PA for OAs, one of the greatest was cost, a factor that can be reasonably be generalised to OAs of all ethnicities, and is especially relevant in light of the current economic climate. A systematic review by Franco et al. (2015) of 132 studies from all over the world, found that cost was a major barrier for OAs to participating in PA. This recurring factor across nationality and participant ethnicity, provides strong evidence for suggesting that removing this barrier would likely increase access to, and participation in, PA. Equally, Belza et al. (2004), studied the facilitators and barriers to PA in OAs from multiple cultures. While this paper did not specifically examine attitudes among Caribbean OAs, once again cost was identified as a major barrier. With a pension as the only income for most, the cost of travel, and the classes or membership themselves, are usually placed firmly in the "luxury" category. Much has been made in the media recently about the "heat or eat" crisis, and this dilemma only exacerbates the problem of PA. OAs who are unable to fund an adequate diet, find themselves becoming clinically frail, and simply lacking the energy to be physically active, furthermore increasing their risk of falling (Purdam, Esmail and Garratt, 2019). Even with the provision of a free bus pass, the time taken to wait for a bus, change to another, and then walk from the stop to the location of the PA session, especially in poor weather, makes such a trip unattractive at best, exhausting and impossible for many.

6.5.6 Health problems and PA

Older age often brings with it the onset of various health concerns. The wear and tear of even the healthiest lifetime begins to cause issues. Pain in particular makes PA difficult, and the fear that PA may make current pain levels worse can be a deterrent (Voss, Pope and Copeland, 2020). While this study examined sedentary behaviours of OAs in assisted living environments, pain as a barrier to being active was noted as being applicable to all OAs regardless of their living environment. While with experience, it can be viewed as a motivator by those who find it alleviates pain and stiffness, helping OAs to arrive at this personal understanding may be difficult. More serious health problems can make people worry about the consequences of PA such as increased breathing rate and heart rate. Symptoms such as dizziness, pain, or weak joints can be barriers to PA as people worry about "what may happen" to them (Horne *et al.*, 2013). While this qualitative study was carried out with older South Asians in the UK, findings can be reasonably expected to apply to British OAs of all ethnicities, as common age-related health conditions, and the painful results of a lifetime of wear and tear, can be worrying for all. These concerns could potentially be alleviated by health checks and advice from health professionals before beginning a programme, and well-trained group leaders who are able to tailor PA to an individual's needs. In fact, some people reported using PA to manage their pain, although most are too fearful to begin.

A problem particularly prevalent within the Caribbean community is weight. Many people reported having problems with weight themselves or knowing someone who does. Related health conditions such as Type II Diabetes are common (Moore *et al.*, 2019), and this can make PA difficult, although ironically it could in turn help with the diabetes. In fact, this issue demonstrated some of the fatalistic attitudes Caribbean OAs have towards health, PA, and falls, attitudes they have in common with other ethnic groups. Horne et al. (2009) conducted a qualitative study on Caucasian and South Asian adults in the UK, finding that OAs felt that there was a degree in inevitability about falls in older age. Horton and Dickenson (2011) interviewed Chinese OAs living in England, and found similarly fatalistic attitudes to falls and health. Whether this is viewed as being due to luck, or the desire of a higher being, depends on the individual and their religion, but it appears to be a commonly held attitude across different cultures and religions. Many expect to develop these kinds of problems, and either do not believe that there is any way to avoid it, or see so many others living with it, that

making the effort to avoid a particular health problem through PA is seen as unnecessary (Alvarado, Murphy and Guell, 2015).

6.5.7 Technology and PA

Modern life itself can bring some inherent barriers to PA. Technology, while useful in many ways, also sadly lends itself to the promotion of a sedentary lifestyle. Particularly during Covid, when outside activities were severely curtailed, some OAs reported having begun to rely more on indoor entertainment such as television and the internet in their interviews. This finding is supported in the literature by studies such as that by O'Connor and Smith (2021), a qualitative exploration of the coping mechanisms used by OAs in the US during the Covid-19 pandemic. They reported “increased television watching” as being the second most common coping behaviour, even though this was found to be linked to lower levels of well-being. While this study was conducted in the US, effects in the UK may have been even more marked as the lockdown regulations were more severe. Unfortunately, the Caribbean participants in this study reported this type of sedentary behaviour becoming a bad habit, and that once life opened back up again following lockdowns, the lure of these new distractions continued, and proved difficult to resist, especially during the winter months.

OA’s relationships with technology in a wider sense however, is not always positive. The older generations did not grow up in the digital age, and although the younger OAs seem to have adapted more, probably through their working days, many are not computer literate. This has led to the exclusion of a large proportion of the population, the digitally poor, many of whom are OAs. A study by Zambianchi, Rönnlund, and Carelli (2019) examined the attitudes of OAs based in Italy and Sweden, to Information and Communication Technologies (ICT). They found significant differences between the Italian and Swedish participants, with less use of ICT and a less positive attitude towards it found among the Italian participants, with age and educational levels also associated factors. This suggests that specific attitudes and reasons for a lack of digital proficiency need to be examined for each specific group, as cultural factors will differ widely. While one study by Tappen et al. (2022) does look at Afro-Caribbean attitudes, the participants all lived in the US, and the group was not uniquely Caribbean, although this group did show the lowest levels of device ownership and internet access. There

are currently no studies looking specifically at Caribbean populations, and none on Caribbeans living in the UK.

Among the participants of this study, it does not appear that hardware is an issue, as family typically seems to donate all older devices to the OAs in the family during their own upgrades. Broadband is expensive however, and yet another call on the purse of an OA who may already be under sever budgetary restraints. Kim and Gray (2016) found cost to be an important barrier to accessing IT among low-income OAs, and although the study was conducted in the US, this seems reasonably generalisable to the UK, and supports the finding of this present study. However, the greatest difficulty in accessing IT is the desire to learn. OAs unfamiliar with IT are often not interested in learning this new technology, with some taking lengths to explain that it was not that they lacked the ability, simply the desire to learn it. A study by Quan-Haase et al. (2018) found that many felt that learning was "not worth the effort", and that even digitally literate OAs prioritised and valued real-life interactions over virtual ones. Equally, Wang, Chen, and Chen (2018) similarly found that even those who are able to use IT, seldom use it unless absolutely necessary, and many only do it to assuage their family's concerns. Although this study was conducted in Taiwan, many of the observations expressed by their participants reflected similar comments found in this current study. This inability to use the internet means that they are unable to access many resources and essential tasks, since many local authorities have moved all of their interactions online. Ordinary tasks such as arranging a bin collection, making an appointment with the GP, or buying groceries online, are inaccessible. Hodge et al. (2017) found this to be a particular problem in rural communities in Australia, although their findings have impact to any community experiencing the withdrawal of physical services.

6.5.8 The difficulties of motivation for PA

This issue of motivation, or lack thereof, overlaps with PA also. As mentioned previously, some OAs are very physically active, and often have been throughout their lives. Others however, find it difficult to get started on any kind of PA programme. There are many factors that can make motivation an issue, and these are likely to be as varied as the individuals in question. Mental health may be a factor, as this is often an issue in later life. Repeated mental health stressors such as the death of a partner or friends, the challenges of physical ill health,

or even the changes due to retirement, can all accumulate (Murayama *et al.*, 2020). The more recent stressors due to isolation and fear during the Covid pandemic have been reported as significant motivational blockers. Initially OAs couldn't go out and be physically active, then once restrictions were eased, people remained too afraid to venture forth given the high mortality rate in OAs (McKinlay, Fancourt and Burton, 2021).

Other people, in their own words, just simply "can't be bothered". For some, it is a lack of energy. They are tired, have worked hard all their lives, and see older age as their reward, the time when they can rest. For these people, motivation may be encouraged through them finding an activity that they identify with, something that gives a purpose. One participant evoked Alexander Chalmers' famous ingredients for happiness "Something to do, someone to love, and something to hope for". Having a reason to get up in the morning, and an activity that one looks forward to as it is fun and enjoyable make prioritising the activity much easier. Maula et al. (2019) found enjoyment to be a key factor in increasing motivation and adherence of PA. While this study was conducted in the UK, and had a large number of participants, no mention was made of ethnicity in the demographic information given. It would be interesting to confirm whether this applied equally to all ethnicities in the UK.

Motivation may be difficult for oneself, but if you go with someone, who will not go if you don't, then not letting them down may be a strong motivator. Winzer et al. (2019) found that a buddy-style intervention achieved positive changes in PA for Austrian OAs. These results were mirrored in a PhD thesis study by Ellis (2019), who found that a buddy-style PA intervention was both acceptable to post-natal mothers, and also had a positive effect on self-efficacy. These studies both lend support to the importance of introducing a level of social cohesion to a group. When an individual is seen as a person, not a number; when their efforts are noted and appreciated; and when any absence is a loss to the group, then this is a promising avenue for increasing motivation, and eventually, adherence.

6.5.9 Low knowledge of PA among OAs

Many of these barriers have one factor in common, knowledge. It is difficult to motivate oneself, or prioritise PA if the reasons for doing so, or the potential benefits are not recognised. As already discussed, the messaging of what PA is, how much OAs should be

doing, and how one can reach these targets, is not reaching the target audience. Providing this information at the start of PA interventions may be a means of motivating OAs. Ensuring that people understand what components need to be covered to meet with the government's guidelines on amounts and types of PA is important. Gluchowski et al. (2022) conducted a qualitative evaluation of the awareness and knowledge of the UK government guidelines for PA among OAs. Although the participants were already active people, they had limited understanding of these guidelines, especially around the inclusion of a strength component. They also reported misconceptions about what strength training was, and concerns about how to engage with it. Greater explanations should lead to a better understanding that PA can be obtained in many forms without necessarily lifting weights in a gym, or jogging for an hour every day, which may make the targets more attainable. Knowing that not only will they not make their current aches and pains worse, but are likely to improve them, and recognising that they have control over many aspects of their health, and that they can prevent certain health conditions may encourage continued adherence. Doctors could play a key role in educating people, however both health professionals and OAs have noted the time constraints faced by GPs, making this unlikely. Alternative solutions should therefore be considered such as nurse practitioner-led group sessions, where a group of OAs could attend a lecture-style session with the incentive of tea, biscuits, and social interaction at the end. By conducting these in GP surgeries, the information carries the endorsement of the medical team and may be more valued in the eyes of the OAs.

7. Intervention Development

7.1. Introduction

The first two steps of the MRC guidelines have now been completed by exploring the existing literature, and appropriate theory. The next phase is to use the Behaviour Change Wheel as a tool to move from this stage through identifying the specific behavioural problem, and on to the design of an appropriate intervention.

The process of developing an intervention with the Behaviour Change Wheel includes eight steps which are divided into three stages as shown in Figure 21 (Michie, Atkins and West, 2014).

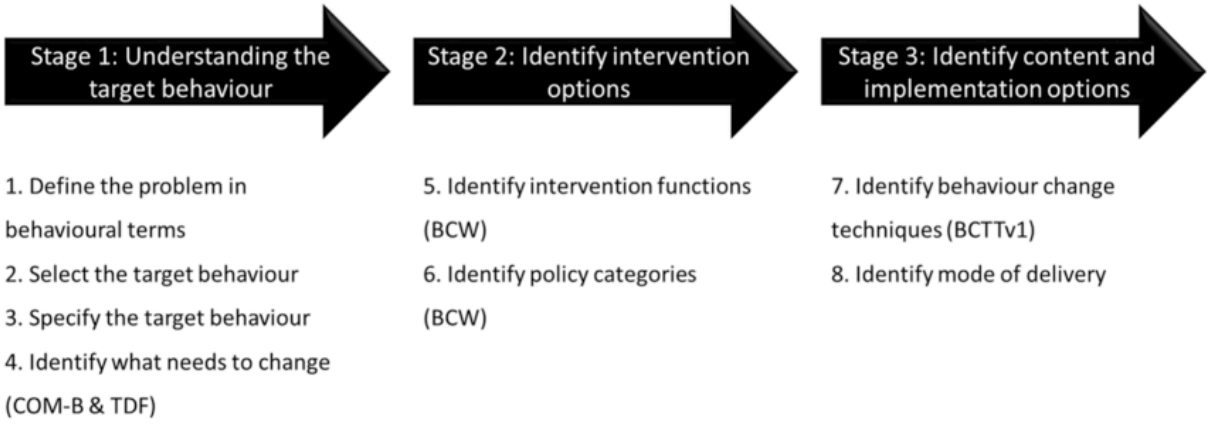


Figure 21: Steps of the Behaviour Change Wheel

(Michie, Atkins and West, 2014).

7.2. Applying the BCW

7.2.1 Step 1: Define the problem in behavioural terms

In order to define the problem in behavioural terms, it is essential to be specific regarding factors such as the target population and the behaviour that requires intervention. The two essential elements of this are: a) who needs to perform the behaviour, and; b) precisely what the behaviour is.

While there is robust evidence in the literature for PA reducing fall risk in OAs (Gillespie *et al.*, 2012; Sherrington *et al.*, 2017; Gawler *et al.*, 2016), there is much variation in studies

concerning the types of intervention, duration, and intensity of the PA programme used. PA is a general concept, and as discussed in the literature review, some PA is better for fall prevention than others. PA that allows OAs to increase their lower limb strength and balance, potentially reduces their risk of future falls (Myers, Young and Langlois, 1996; Hita-Contreras *et al.*, 2016; Liu-Ambrose *et al.*, 2013). Throughout this chapter, although PA will be referred to in a non-specific way, on each occasion it refers to PA that will increase lower limb strength and balance, in order to reduce fall risk.

The literature also clearly supports the premise that OAs do not carry out the recommended levels of PA (Clarke *et al.*, 2015). The qualitative study showed that a PA favoured by Caribbean OAs is walking, although the effectiveness of this for fall prevention was not able to be determined by the Cochrane report (Sherrington *et al.*, 2019). The intervention therefore must include PA that will increase lower limb strength and balance through PA, while maintaining acceptability for Caribbean OAs in order to maximise adherence.

Thus, the target group that need to perform the behaviour in this case are Caribbean OAs over 65 years of age. The behaviour that will be the target of the intervention is increasing PA in order to reduce the risk of falls, emphasising lower limb strength and balance.

7.2.2 Step 2: Select the target behaviour

This step considers all the behaviours that may be targeted by an individual. As described by Michie et al. (2014), behaviours are not isolated events, but instead are related to other behaviours, and those of other individuals, interacting as a system. It is important that all behaviours carried out by the target groups are considered, and if interdependent on other behaviours, then this needs to be taken into account in the intervention design process.

The qualitative interviews provided the data on the various physical-activity-based behaviours typically performed and/or preferred by the OAs. These behaviours were analysed to determine their appropriateness for the intervention. Behaviour change works best when introduced slowly, building incrementally towards desired levels. This was particularly relevant to PA as the government guidelines may initially seem daunting to inactive OAs. It is important that they are supported to increase their PA steadily towards these recommended

levels. This slow and steady approach will also have the added benefit of reducing potential negative side-effects of increasing PA too quickly, such as injury or discomfort (Maula *et al.*, 2019).

Factors considered also included how easily a target behaviour may be changed. The interviews clearly demonstrated the importance of building PA into their normal daily activities, so this factor was important in the behaviours that were selected.

7.2.3 Step 3: Specify the target behaviour

This step requires specific considerations of important behavioural factors. It is important to specify *who* will be performing the behaviour to be changed, *what* the individual needs to do differently in order to achieve the desired behaviour change, *when* the behaviour will be performed, *where* the behaviour will be performed, *how often* the behaviour will be performed, and, if appropriate, *with whom* will they perform the behaviour (Michie, Atkins and West, 2014). This degree of specificity is important as it allows a more focussed understanding of the target behaviour(s).

Based on the UK Physical Activity Guidelines (Department for Health, 2019), OAs should: i) be physically active on a daily basis; ii) perform activities that maintain or improve muscle strength, balance, and flexibility on at least two days per week; iii) perform at least 150 minutes of moderate intensity aerobic activity each week, and; iv) break up sedentary periods as much as possible. These recommendations are wide-reaching and their aim is to improve overall health, not specifically falls. As discussed in the literature review, strength, balance, and flexibility are important to reduce fall risk, and so the second recommendation is the most important vis-à-vis fall prevention. However, the other recommendations are also important in order to maintain overall physical condition which include strength and balance, as this cannot be maintained on a twice a week basis. The government recommendations will therefore form the basis of targeted behaviour changes, with barriers identified in the qualitative study directing choices such as location (potential difficulties with travel to group sessions) and time (potential difficulties with travel during peak-hours).

7.2.4 Step 4: Identify what needs to change

This step of the BCW requires a thorough investigation and understanding of the factors that influence an individual's behaviour, to diagnose why the target behaviour is not currently occurring. Some factors are non-modifiable, such as sex or ethnicity, and others are modifiable, such as knowledge or intention, making the latter a more appropriate target for behaviour change interventions. Accurate identification here, increases the likelihood that the intervention will be successful in changing the behaviours as desired (Michie, Atkins and West, 2014).

The BCW offers the COM-B model and the Theoretical Domains Framework (TDF) framework to help with determining which of the particular behaviours that have emerged from the previous qualitative study, need to change in order for behaviour change to occur. The COM-B model is used to identify facilitators and barriers to the target behaviour, and the TDFs give more depth to the exploration of these behaviours, offering more specific targets for the design of the intervention.

The qualitative study in Chapter 6 provided a plethora of information to explore this step in detail. For example, two of the major themes identified factors that promote PA, and obstacles to participation in PA. This mapped clearly to the COM-B of the BCW with examples such as Capability including domains such as Knowledge, which links to issues from the interviews around a lack of understanding of what PA is, how much is necessary, and what kinds of PA are recommended. This shows that education is required to improve understanding, and instructors need to demonstrate appropriate exercises to participants and ensure that they are being performed correctly. Another example is Opportunity, which is linked clearly to Social Influences, and the importance of social connection to the OAs interviewed. This may include finding instructors who genuinely care about their OAs, check up on them, and ensure that they are not "just a number". The group cohesion is important also, encouraging adherence behaviour through enjoyment and not wanting to "let down" the group. These details are more fully described in Table 19.

7.2.5 Step 5: Identify intervention functions

An intervention function is a broad category of means by which an intervention changes behaviour. Using results from the previous step identifying what needs to change, the BCW identifies the intervention functions that are likely to be effective for bringing about the changes. There are eight intervention functions that need to be appraised, in order to identify those likely to be effective. They are described in Table 16.

Table 16: BCW intervention definitions

Reproduced from (Michie, Atkins and West, 2014)

Intervention function	**Definition**
Education	Increasing the knowledge or understanding
Persuasion	Using communication to induce positive or negative feelings or stimulate action
Incentivisation	Creating an expectation of reward
Coercion	Creating an expectation of punishment or cost
Training	Imparting skills
Restriction	Using rules to reduce the opportunity to engage in the target behaviour, or to increase the target behaviour by reducing the opportunity to engage in competing behaviours
Environmental restructuring	Changing the physical or social context
Modelling	Providing an example for people to aspire to or emulate
Enablement	Increasing means / reducing barriers to increase capability (beyond education and training) or opportunity (beyond environmental restructuring)

Seven of these intervention functions were detected from the qualitative interviews (education, training, enablement, persuasion, environmental restructuring, modelling, and incentivisation).

The interviews indicated that while Caribbean OAs had a general view that PA was beneficial, they had very little concrete idea of what constituted PA, what types were most beneficial for them, or how much they should be doing every week. The intervention function of education is intended to bring about change in psychological capability, by increasing the knowledge and understanding of PA and how an OA should be integrating it into their lives. It also affects reflective motivation, hoping to generate better intentions of being physically active, and creating the belief that they are capable of performing PA and that it will bring benefits, both mental and physical.

Many OAs are inactive and have been so for a long time. The COM-B model hypothesises that Motivation is influenced by both Capability and Opportunity, making it an important mediator (Howlett *et al.*, 2019). Reflective motivation links into the 'beliefs about capability' domain, thus giving OAs confidence in their ability to successfully participate in PA, while also helping with planning and bringing about the change of including PA regularly into their daily schedule (Devereux-Fitzgerald *et al.*, 2016).

As highlighted in the interviews, the barriers for OAs to participating in PA are numerous and wide-ranging (Gluchowski *et al.*, 2022; Horne *et al.*, 2013; Ige-Elegbede *et al.*, 2019; Koshoedo *et al.*, 2015; Maula *et al.*, 2019). The intervention function of enablement aims to reduce those barriers unaffected by other intervention functions. This may influence both physical capability (making PA level-appropriate), and psychological capability (providing structure to plan for PA within the day). Opportunity is also influenced, both physical (resources such as financial, time, location…) and social (cultural requirements, supportive instructors…). Finally, automatic motivation influences social and emotional support (from social connections and a supportive and trusted instructor).

Learning to make PA a regular part of everyday life is a challenge and requires a change from normal behaviours. The intervention function of environmental restructuring targets psychological capability by impacting memory and decision-making processes. Actively creating new schedules with time for PA can help to shift behaviour in a positive direction (Arnautovska, O'Callaghan and Hamilton, 2018). In addition, environmental restructuring can also occur within the social context. We may not always want to do something for ourselves,

but we're more likely to do it if someone else, especially a friend, is depending on us. Here this intervention function creates change via social ties and through social opportunity. If a sense of belonging can be obtained in the group sessions, then it becomes much harder to skip a class. Your friends wonder where you were, they may phone to check on you. If you travel with a neighbour, they may not be able to go to class if you don't take them (Meredith *et al.*, 2023). This restructuring of the social environment can also help to bring about behaviour change.

If PA has not been an important factor in an OAs life previously, then the intervention function of persuasion becomes important. OAs must be convinced that they want to be active, and to see themselves as active people (Aloulou *et al.*, 2023). Both reflective and automatic motivation are all impacted to create the goal, intention, and belief that PA is an important and desirable part of life.

It can be difficult for OAs to see themselves as active beings. The intervention function of modelling is designed to provide visible examples of the desired behaviour change consistent with social cognitive theory and self-efficacy theory (Deneau *et al.*, 2023). This may be via physical opportunities, social opportunity, or reflective motivation, whereby instructors or other group members visibly demonstrate what an active OA looks like, thus helping to change previously held views of inactive identity, or what are culturally acceptable norms of older age.

Finally, no matter our age, we all need a reason to do something. The intervention function of incentivisation reinforces having chosen PA via automatic motivation. Whether this be the "tea and biscuit" opportunity for a social connection at the end of a group session, or the proof of progress through instructor praise or quantitative measures (heavier weights, faster times, weight loss…), it all helps to reinforce the change to a more active lifestyle (Haynes *et al.*, 2021).

7.2.6 Step 6: Identify policy categories

These intervention functions also interact closely with policy functions as they affect how the intervention functions can be delivered. There are seven policy functions, which are defined

in Table 17. As with many studies on the development of an intervention (Ojo *et al.*, 2019; Barker, Atkins and de Lusignan, 2016), potential recommendations on eventual policy changes have not been made here, as the data has not yet been obtained to support any such recommendations. Equally, the use of policies as part of an intervention is not appropriate because the nature of a small-scale intervention by definition doesn't have the wherewithal to include policy changes as part of its intervention. For example, a policy change such as a national ban on smoking in the workplace cannot be included as part of a single intervention.

Table 17: BCW policy definitions

(Michie, Atkins and West, 2014)

Policy function	**Definition**
Communication/marketing	Using print, electronic, telephonic, or broadcast media
Guidelines	Creating documents that recommend or mandate practice. This includes all changes to service provision
Fiscal measures	Using the tax system to reduce or increase the financial cost
Regulation	Establishing rules or principles of behaviour or practice
Legislation	Making or changing laws
Environmental/social planning	Designing and/or controlling the physical or social environment
Service provision	Delivering a service

7.2.7 Steps 7 & 8: Identify behaviour change techniques and mode of delivery

Once intervention functions that are most likely to be effective have been chosen, then the Behaviour Change Techniques (BCTs) that are the most likely to produce real change must be selected. BCTs can be described as the "active ingredients" of behaviour change, and comprise 93 BCTs collected in the Behaviour Change Technique Taxonomy (Michie *et al.*, 2013). Therefore, for each chosen intervention function in the behavioural analysis, appropriate BCTs were chosen from the taxonomy to identify those which were most likely to bring about the desired behaviour. These were mapped back to the TDF domains to ensure coherent alignment as recommended by Cane et al. (Cane *et al.*, 2015).

Out of a possible 93 BCTs, 35 were chosen as being applicable to this desired behaviour change, and are specified in Table 19. An example is that OAs have significant practical barriers to being physically active such as financial costs, both in the performing of PA and in traveling to its location. Enablement was identified as being the intervention function most relevant to this issue, which in turn allowed the identification of two BCTs most likely to generate change, problem solving and practical social support.

Lastly, the best mode of delivery for delivering an intervention needs to be determined, whether this be a face-to-face or distance intervention, something delivered individually or to a group, or via a website, mobile application, media etc. (Michie, Atkins and West, 2014). The APEASE criteria can again be helpful to determine the most appropriate delivery for the situation. As the BCW can be applied to a wide range of target behaviour change, not every intervention or policy function will be applicable in every given situation. The APEASE criteria can be used to help determine the applicability of each of the intervention functions and their criteria are described in Table 18 below. The application of the APEASE criteria is detailed in section 1.4.

7.3. Linking the COM-B model, TDF-domains, qualitative results, intervention functions, and identifying BCTs

The components of the COM-B model were linked systematically with the TDFs using evidence from the qualitative interviews and identification of what needs to change in order to improve the chances of the desired behaviour occurring. These factors were then linked to the most appropriate intervention functions, and finally the most relevant BCTs. This process is shown in Table 19 below.

Table 18: The APEASE criteria for evaluating interventions

(Michie, Atkins and West, 2014)

Criterion	**Description**
Affordability	All interventions have a budget. An intervention that is not affordable has failed, no matter how effective or cost-effective it is. An affordable intervention can be delivered to, and accessed by, all those who could benefit from it.
Practicability	An intervention is only practicable if it can be delivered as intended and designed, to the target population. If it can only be delivered by specialist staff, with specialist equipment, then these resources may not be available in all daily settings, making it unfeasible to use.
Effectiveness and cost-effectiveness	The effectiveness of an intervention refers to its effect size in relation to the desired objectives. Cost-effectiveness is the ratio of effect to cost. If two interventions are equally effective, then the most cost-effective should be chosen. If one is more effective, but not as cost-effective, then affordability needs to be taken into account when making choices.
Acceptability	This refers to the degree to which an intervention is viewed as acceptable by relevant parties (public, professional, political), and may be different for different stakeholders.
Side-effects/safety	Although an intervention may be practicable and effective, it may also have unwanted side-effects or unexpected consequences, which also need to be considered when deciding whether to select it.
Equity	Another consideration in choosing an intervention is whether it alters any inequalities in terms of health, wellbeing, or standards of living between different sectors of society,

Table 19: Combined links between the COM-B model, TDF domains, qualitative evidence, intervention functions, and BCTs

COM-B	TDFs	What needs to happen for the target behaviour to occur	Evidence from interviews	Intervention Functions	BCTs
Physical capability	Skills (be physically able to do it)	Have instructors demonstrate, teach, and guide OAs so that their techniques are correct when performing exercises	"*...describe an exercise to them… it can be so descriptive that it doesn't make sense, you know… they aren't really aware of like what it is you're asking them to do*" 4HP	Training	4.1 Instruction on how to perform a behaviour 6.1 Demonstration of the behaviour 8.1 Behavioural practice/rehearsal
		Have instructors provide level-appropriate exercises, easier options, and increase difficulty as required on an individual basis	*"We encourage them to start off small, 10 minutes at a time, even if it's once a day for a week, and then build it up to twice a day, until they do up to 30 minutes a day"* 6HP *"you should always work to the lowest common denominator…I will have someone who has Parkinson's, someone in a wheelchair, someone who may want to do it from a chair, someone who is 80 years of age, and so that real mixture means that I've gotta make sure my exercises are tailored to be able to cope with anyone"* 1CL	Enablement	1.5 Review behaviour goal(s) 8.7 Graded tasks 12.6 Body changes 15.1 Verbal persuasion about capability 8.3 Habit formation
Psychological capability	Knowledge (Importance of PA & the benefits it brings)	Provide information to promote PA in all its forms, explain what it is, and show its benefits	"*It's how you move around, yeah? The thing is, I'm, not everybody likes sports and whatnot, but are quite physical by doing other things*." 3OA "*The messages are clear that if the more active you are, the more independent you will be as you get older*" 1CL	Education	5.1 Information about health consequences 5.6 Information about emotional consequences
	Knowledge (what exercises to perform)	Provide information on what PA or exercises to perform	*"Physical activity ... I don't know what that means really*" 2OA	Education	

Knowledge (options available)	Provide information on different PA options and/or the different classes/groups available in the vicinity	"*We have an advice and information project and our local authority moved all advice … online… so we've ended up with the digitally poor who are excluded*" 2CL	Education
Knowledge (what constitutes PA, and how much they should be doing)	Provide information on how much/often PA should be carried out	"*You ask them how much time per week should they exercise, and often they will say 30 or 60 minutes for the week! We know the minimum should be 150 minutes and they're quite shocked at that sometimes*" 6HP	Education
Knowledge (is PA something that exists as its own end, or is it merely a by-product of task-based activities, eg. I run/walk to go to the shops, not just to run/walk for exercise)	Provide information to explain what PA is, giving examples of it in many different forms	"*If they were born back home in the country, they would have been running all the time, swimming in the sea, going up and down, climbing rocks, that was fun. So here now, the information OK exercises, this, this, this, it doesn't connect really at all. The connection between that and yes the idea exercise, here it's running, but why running if you're not running for something. Why do in the room and being closed up in a, in an environment where it's boring, to lift up weights and just look at other people lifting weights? So it's got to be activity based I think, really activity based. I'm doing this for that, because I have found with that population it's about purpose. Why am I doing that exercise for*" 1HP	Education

Knowledge	Teach about the benefits of PA and provide a safe environment where OAs can ask questions. Allow them to develop the knowledge that PA will be beneficial as an active team rather than "delivering" info and expecting it to be passively absorbed	"*Do (you and your peers)... know that it's important for health to be physically active? I'm not so sure about that, I don't think so*." 1OA	Education	5.1 Information about health consequences 5.6 Information about emotional consequences
Social influences	Have instructors provide lots of encouragement and positive feedback. Praise effort rather than outcome	"*I believe I've found the way to engage people...and make them not focus on exercise, but focus on the fact, Oh, that's a fun way of me doing things*" 1CL	Enablement	3.1 Social support (general) 3.3 Social support (emotional) 15.1 Verbal persuasion about capability
	Support from a buddy, partner to help OAs to remember to carry out PA	"*You still have to keep on hitting them with the...telling them you need to get up, you need to do something, you need to move your body*" 1CL "*It's always good to have someone there. Whether it's a buddy, a friend or family member, she'll push you to do things and that will help you to keep better health.*" 2FM	Enablement	3.1 Social support (general) 3.2 Social support (practical) 3.3 Social support (emotional)
Memory attention and decision processes	Practising new schedules that include PA	"*In this day and age, what I notice with family? Time. Do they have the time to do things?*" 2FM	Training	8.3 Habit formation 15.2 Mental rehearsal of successful performance

		Reminders for PA, eg phone calls from a buddy, text reminders on a phone, specific time of day…	"*You have to have a system of being able to check on them every, every so often. And that way it keeps them motivated, 'cause they know they're gonna have a call with you and you're gonna ask how they're doing…*" 6HP	Environmental restructuring	7.1 Prompts/cues 12.1 Restructuring the physical environment 12.2 Restructuring the social environment
	Behavioural regulation (are there systems in place to trigger the performance of PA, and to monitor if and how much has been done?)	Help to provide a structure to prioritise PA and plan for it within the day, suggest triggers (eg. moving about during ad breaks on TV), and record when PA has been achieved	"*Put the music on, do the housework, have a dance, have a spin, so it involves a lot of sort of activity is not just like I'm gonna use the brush and sweep the floor, it's really active*." 1FM	Enablement	1.4 Action planning 2.3 Self-monitoring of behaviour 11.3 Conserving mental resources
Physical opportunity	Environmental Context and Resources (how much time an OA has for PA)	Help to plan to make time for PA, and direct to resources if needed (eg to obtain care for a partner if the OA is a carer)	"*That's another reason (lack of time), too much going on*." 2FM	Enablement	3.2 Social support (practical) 12.2 Restructuring the social environment 12.3 Avoidance/changing exposure to cues for the behaviour

Environmental Context and Resources (cost of PA)	Provide financial assistance with the costs involved (eg cost of PA class, transport, care of partner…)	"*I get Mail in all the time from people asking…I can't afford to go to a gym, what can I do?*" 1CL "*So being income deprived is a huge, a huge barrier to participating in anything. Even if it's only £3.00 and you get a free bus pass, you get a free bus pass to get there on your two buses and it's only three quid to go in, that three quid is probably the difference in the roast chicken that's gonna last you all week, or having a heater on for a little bit of time.*" 2CL	Enablement	1.2 Problem solving 3.2 Social support (practical)
Environmental Context and Resources (location of PA, time to get there, difficulty of travel, cost of transport...)	Ensure proposed PA can be performed nearby, thus avoiding long, difficult, expensive trips. If unavoidable provide or subsidise transport	"*Yes, yeah you find a lot of the transport is not available. Of course they themselves are unable to fund, fund it. Taking a taxi, you're looking at probably £7.50 or whatever… to get from A to B.*" 1RL "*So we still have to change buses, go to off 2 buses. … a lot of people complain they can't do it. It's too much for them …It's too much effort for half an hour or an hour. You put too much effort into getting there, and when you get there, you're more or less exhausted and then to get to make that journey back, it's a bit much. 2OA* *"They used to have this umm, … vehicle that can go round and pick up people, but they pay a very small amount of money... I remember, they used to do that, pick up people, and drop them, there, and then that at certain time they will come back and pick all of them up.*" 2FM "*A Community Centre, or a church-hall If it's allowed. I think that would join a community I think that would maybe draw people more"* 4OA	Enablement	1.2 Problem solving 3.2 Social support (practical) 12.1 Restructuring the physical environment 12.5 Adding objects to the environment

	Environmental Context and Resources (poor weather makes outdoor PA difficult and perceived as unpleasant)	Propose PA options that can be performed indoors, and/or offer information on appropriate clothing etc if the preferred choice of PA is outdoors	"B*ut when the weather is not good, she doesn't wanna go nowhere*" 2FM	Enablement	1.2 Problem solving
Social opportunity	Social influences (acceptability of the PA, do they want to do this? Is it considered appropriate in their community/family?)	Provide examples of people within their culture/age group modelling behaviours to aspire to (eg instructors)	*"One of the old ladies who was sitting with me, was one of the people who's being you know, we're trying to say that would you like to have a go, said my God look at the state of him in the water. You know she said she, said he's like Frankenstein's monster. But the next week she felt confident enough to put on a swimming pool and get in and get in there*." 2CL	Modelling	6.1 Demonstration of the behaviour 13.1 Identification of self as role model
	Social influences (are there appropriate models of the desired behaviour, cultural or age similarity seen in the instructor or class members)	Aim to provide instructors of a similar age to participants, or from the same cultural group if possible	"*If you can see it, you can be it*" 1CL	Modelling	6.1 Demonstration of the behaviour

Social influences (interpersonal factors, do they have a buddy to do PA with?)	Have a buddy system, or class-mates who rely on the OA. This makes it harder to skip PA	"*But it is easier when you have a buddy when you're working in, you're meeting up to do things*." 2FM "*You know, with, with people around your own age, you know you can talk and laugh and can understand each other right?*" 1OA "*And kind of like the swimming club is a good example …you had your friends in the swimming club. You'd always be having events, maybe you're going to the pictures or something, which has nothing to do with the swimming pool. Yeah, so it's about it's about all that connectedness that makes exercise worth taking"* 2CL	Environmental restructuring	12.2 Restructuring the social environment
Social influences (interpersonal factors, do they like/trust the instructor…)	Having a supportive instructor, who cares about the OAs progress makes it more pleasant to attend, and more difficult to skip and "let them down"	"*It does help, yes and, and I mean he's concerned about our welfare, so he wants to make sure. You know you want to always before, are you OK? How is your back? Like I hurt my shoulder the other day. I don't know how, maybe a funny move, for, for a few months now I've been having problems with my shoulder so he always says, you know he always tailors, you have options, it's tailored to suit the individual*." 4OA	Enablement	3.1 Social support (unspecified) 3.3 Social support (emotional)
Social influences (cultural factors such as need for separate sex classes, no immodest exercises eg legs in the air, prayers before/after class……)	Fulfil non-negotiable cultural requirements such as single sex classes, and remain sensitive to other factors (eg what may or may not be considered immodest) depending on the OAs in a group	"*It's very rare that you have the mix, male and female… if they have to lift their legs or whatever, they probably wouldn't like men there*." 1RL "M*usic is important, the colours, the attitude is all part of what would get them to umm to move their body a little bit*." 1CL	Enablement	1.2 Problem solving 3.2 Social support (practical)

Reflective motivation	Goals (how much does an OA want be more active, filter, healthier…?)	Provide information to promote PA in all its forms, explain what it is, and show its benefits	*"I think over the last, umm, maybe 25 years, there's been a change … they are now more aware that exercise plays a big healthy part in their lives to keep them going*." 1RL "*You know, on the television and you talk about exercises and all that. … never really make, you know, impact in any way*." 1OA "*Because it's enjoyable, also as I said, because I've got the back problem, … and it's by, by doing that, keep my back strong, that I know I'm getting the general overall benefits. And I suppose that I don't want to be old (laughs)!*" 4OA	Education Persuasion	1.1 Goal setting behaviour 5.1 Information about health consequences 5.6 Information about emotional consequences 13.5 Identity associated with changed behaviour
	Intentions (has a firm intention been made to increase PA levels?)	Provide information on PA to allow for Oas to make an informed decision to increase their levels of PA	"*Do you think that all your friends… do they know that it's important for health to be physically active? I'm not so sure about that, I don't think so*." 1OA "*The messages are clear that if the more active you are, the more independent you will be as you get older*" 1CL	Education	1.9 Commitment 5.1 Information about health consequences 5.6 Information about emotional consequences
	Beliefs about consequences (has the OA come to believe that PA is important to improve their quality of life, reduce the risk of falling, and maintain their independence as they age?)	Provide information about the benefits of PA and exactly how it can improve these factors (eg maintain independence, reduce falls, improve mental wellbeing…)	"*Listen, every step you take, 250 muscles are gonna work. Muscles love work and every time you smile it's a facelift we can all do which costs no money. Yeah it is wonderful and, and a shower you have after you've been active is the best shower in the world you know. It's so invigorating, it makes you feel so good, and when you can get those happy hormones running around your body, guess what? You feel like telling the world about the fact that you did a walk, that you went up a hill. You will never find, anyone who does exercise regularly will always have a topic of conversation. They'll always tell you I did, I did, I did. Where as the one who's*	Education	5.1 Information about health consequences 5.6 Information about emotional consequences

		not doing anything, it doesn't even know what to talk about.“ 1CL		
Optimism (the confidence that making the effort for PA will bring about the desired outcomes)	Provide information to increase OAs confidence that PA will bring health benefits that will make them feel better	“*Well, it gets your blood flowing doesn’t it? It gets your blood flowing. It’s good for respiratory, cardiovascular, and things like that that, uh, you know, major, major health complications amongst my community in terms of umm you know weight, obesity, diabetes, hypertension and things like that*” 1FM “*If I get up and I do this, my back doesn't hurt so much, but if I sit down for too long everything is paining me*.” 1FM	Education Persuasion	5.1 Information about health consequences 5.6 Information about emotional consequences

Beliefs about capabilities (does the OA believe that they are capable of performing PA, and increasing their levels as they improve?)	Provide information to persuade OAs that they are capable of performing PA and how it can be tailored to their abilities	*"I believe that exercise should be all inclusive… someone who has Parkinson's, someone in a wheelchair, someone who may want to do it from a chair, someone who is 80 years of age, … that real mixture means that I've gotta make sure my exercises are tailored to be able to cope with anyone. They may have a condition, an underlying condition that needs addressing*." 1CL "*You reassure people in order to give them the confidence to actually stand and commence. … to encourage others, to say "I used to be like that*"." 1RL	Persuasion	2.7 Feedback on outcome(s) of behaviour 2.2 Feedback on behaviour 15.1 Verbal persuasion about capability
Professional role and identity (is PA something that an OA believes is appropriate for OAs? Should it be an important part of life in older age?)	Provide information about guidelines of PA for OAs to show that they can and should be physically active	"*Elderly people do things, they have sex, they think, they do, so if they do those things, why can't they do yoga? I like to*." 4OA "*Being 60 is not old, being 70 is not old*" 2OA	Education Persuasion	
	Provide instructors that model an active lifestyle in older age	*"He (the instructor) looked like Frankenstein's monster. He had so much stitching 'cause he had had the entire breastbone opened up, and, …he also had a colostomy bag, and he could wear shorts, and he would take people swimming. He'd been very active prior to all his health issues …umm, there was a woman, a female volunteer, umm, who had swum. …she had a mastectomy, and she'd also had a hysterectomy. …So what happened was (the Council took over), and they had this, you know "Ken and Barbie". I mean they were just like perfect bodies. … and a few of the*	Modelling	6.1 Demonstration of the behaviour

		people who attended our session did go to it, and they stopped going very quickly." 2CL		
	Use communication and reassurance to help OAs see themselves as active older people	"*When you get old you lose your power and you lose your identity."* 2CL	Persuasion	5.1 Information about health consequences 6.3 Information about others' approval 13.5 Identity associated with changed behaviour
Professional role and identity (am I a "sporty" person who does PA?)	Include group sessions where OAs can see other people of a similar age who are all active in different ways	"*If you did go to a gym that you didn't know, would you rather that there was people sort of your own age in the class? Yeah, yeah, I would prefer that*." 4OA	Modelling	6.1 Demonstration of the behaviour
	Use communication and reassurance to help OAs see themselves as active older people, that you do not have to be "sporty" to be active	*"The thing is, I'm, not everybody likes sports and whatnot, but are quite physical by doing other things*." 3OA	Persuasion	2.2 Feedback on behaviour 13.2 Framing/reframing 13.5 Identity associated with changed behaviour
	Provide information on all the different forms of PA. It does not need to be a "sport" to be a PA	"*We explained, you know it's, it's something that you err might get a little bit out of breath with, an exertion extra to your just your daily routine. And they began to understand better […] Half an hour of, of hoovering and dusting and, and going up and down the stairs with your laundry and things like*	Education	

			that that's counted as physical activity." 6HP		
Automatic motivation	Emotion (is the OA fearful of injury, or shy about joining an unknown group?...)	Provide social support, both practical and emotional, to help the OA feel confident and secure	*"That's huge. Yeah, … confidence. So, so actually having communities of interest for some, some reason why you getting involved… You know you have, you have to have a reason for linking into things sometimes and, and so actually not belonging, not being connected to things is difficult…They don't have an identity necessarily outside being a care recipient or … a widow, maybe you live alone, but that's not an identity, that's not a Club, that's not a sense of ownership, in the way that you know you do things as the as (a member of a club) or whatever.*" 2CL "*Somewhere they feel safe, somewhere they feel like they're not gonna be ridiculed you know? Maybe, maybe that's why a lot of them them, you find the younger people are all gym-y 'cause they have nice flat stomach and and thing. But the older generation I think are conscious that they're older, are conscious that the body is not how it used to be*." 4OA	Enablement	3.1 Social support (unspecified) 3.2 Social support (practical) 3.3 Social support (emotional)
	Reinforcement (are there incentives for performing PA? Tea and biscuits with the group after?)	Provide tea and biscuits with the group afterwards to provide social contact and support	"*There was a lovely camaraderie. There was a cup of tea and coffee afterwards*." 2CL	Incentivisation	10.4 Social reward 10.5 Social incentive

Reinforcement (trust in a likeable instructor, who provides trustworthy information, support, and encouragement)	Provide a supportive instructor, who cares about the progress of their class, and makes it more pleasant to attend	*"I think if you find the right kind of teacher and I say to everybody, you need to experiment. Do not make do. If you find the right kind of teacher, you'll be empowered to to do things*." 1CL	Enablement	10.5 Social incentive
	Provide an instructor who will demonstrate, teach, and guide OAs so that their techniques are correct when performing exercises, provide level-appropriate exercises, easier options, and increase difficulty as required on an individual basis	"*We had a very, very good, good instructor, Natalie, and you know she could just move and make us move*." 1OA	Training	2.2 Feedback on the behaviour 3.1 Social support (unspecified) 3.2 Social support (practical) 4.1 Instruction on how to perform a behaviour 6.1 Demonstration of the behaviour 8.1 Behavioural practice/rehearsal
	Ensure that both effort and progress are noticed and praised by the instructor	*"I really think generally, umm, whether it be… we do, we do need more encouragement. We do need more encouragement."* 4OA *"Those who … who need a bit more like … positive encouragement by seeing other people do"* 7HP *"Encouragement is good. And one thing I say, is that is having encouragement from other people, it's a great help as well."* 1RL	Incentivisation	10.4 Social reward

	Reinforcement (seeing improvement in concrete terms)	Ensure that the OA receives feedback on their efforts and their improvements, so they can see their effort pay off eg. number of times PA achieved, improvement in measures…	"*don't expect everyone to do it all, but if ...can get most people to do most of it, they'll improve*" 2OA	Incentivisation	2.2 Feedback on behaviour 2.3 Self-monitoring of behaviour 2.7 Feedback on outcome(s) of behaviour 10.4 Social reward

7.4. Applying the APEASE criteria to develop an intervention

As previously described, the APEASE criteria can be applied to all identified intervention functions and BCTs in order to determine their affordability, practicability, effectiveness and cost-effectiveness, acceptability, side-effects/safety, and equity. Only those which can be reasonably expected to work in a real-world intervention will be selected. This practical approach increases the chances of success as both end-users and other interested parties such as funding providers may be less willing to accept proposed solutions that difficult to implement or costly (West, 2020; Waddell *et al.*, 2023).

Contrary to the normal procedure when following the BCW, in this instance, the mode of delivery was chosen first. This was because the qualitative study had indicated that a face-to-face intervention was more likely to fulfil the preferences of the OAs interviewed as it also provided opportunities for the important social element. The caveat was that in order to achieve the desired outcome of being physically active on a daily basis, it would not be possible to attend a session outside the home every day. In order to reduce the travel, cost, and time constraints this would imply, “homework” would be given for the OA to complete on the days when there was no organised session. This would allow the instructor to monitor the progress of an individual, respond to queries, and increase the PA as and when indicated for each individual, but would also allow for the individual to integrate daily PA into their routine in the most appropriate way for them. Details of the intervention functions are shown in Table 20.

Table 20: Intervention functions selected as being most likely to bring about a change in the PA levels of Caribbean OAs

A= Affordability, **P**=Practicality, **E**=Effectiveness/Cost-effectiveness, **A**=Acceptability, **S**=Side-effect/safety, **E**=Equity

Intervention function	**A**	**P**	**E**	**A**	**S**	**E**	**Comments**
Education	✓	✓	✓	✓	✓	✓	
Persuasion	✓	✓	✓	✓	✓	✓	
Incentivisation		✓		✓		✓	While there may not be a budget for a payment scheme, a "tea and biscuit" incentive might be feasible among participants with everyone taking a turn to provide it.
Training	✓	✓	✓	✓	✓	✓	
Restriction							This is not applicable to this type of behaviour change intervention.
Environmental restructuring				✓		✓	There is unlikely to be a budget for sports equipment, so options that do not require any specific equipment will be prioritised.
Modelling	✓	✓	✓	✓	✓	✓	
Enablement	✓	✓	✓	✓	✓	✓	

7.5. Developing an intervention strategy

As previously discussed, not every intervention function is applicable to every different intervention. By applying the APEASE criteria to each BCT identified, each BCT's applicability to this particular situation can be evaluated, allowing only the most suitable to be used in developing the intervention.

The 39 BCTs identified in the Behaviour Change Technique taxonomy were all evaluated against the APEASE criteria (Table 21). Only the 28 deemed most likely to be effective were selected to form the basis of the intervention to be delivered, in an attempt to change OAs behaviours around PA. These selected BCTs are used as the foundation of the intervention, which is detailed in the feasibility study proposed in chapter 8. The feasibility study also allows for adaptation when responding to feedback from the participants following the initial round. This makes the process less subjective, by including the responses and preferences of the participants to inform further versions.

One issue elicited from the qualitative study is that OAs report being unsure of what PA actually is (eg. *"Physical activity ... I don't know what that means really*" 2OA). This evolved into the selection of two BCTs, 5.1 Information about health consequence, and 5.6 Information about emotional consequences, being chosen to educate and provide information on the health and emotional consequences of performing PA. This may involve explanations from trusted sources such as medical professionals (Keyworth *et al.*, 2020) about how following guidelines for PA reduces the risks of developing certain health conditions (Bean, Vora and Frontera, 2004; Ekelund *et al.*, 2015; Sun, Norman and While, 2013), and the expectation of greater feelings of wellbeing following PA (Lindsay-Smith *et al.*, 2019).

In some instances, BCTs such as 12.1 Restructuring the physical environment, are unlikely to be successful in this particular situation. While effective for certain situations such as encouraging weight loss by removing unhealthy food choices from the home, it does not seem that similar changes would be possible in this situation. Participants mentioned problems related to transport or locations that were not easily accessible. There is unlikely to be a generous enough budget to arrange for transport for each participant (eg. taxi vouchers,

picking everyone up with a minivan etc.), and removing structures linked to more sedentary behaviours at home, such as a sofa or TV, are simply unfeasible options.

Table 21: Screening of the selected behaviour change techniques with APEASE criteria mapped to intervention content

	Affordability	Practicability	Effectiveness or cost-effectiveness	Acceptability	Side-effects/safety	Equity	Comment	Intervention content and mode of delivery
1.1 Goal setting behaviour	✓	✓	✓	✓	✓	✓	Identifying goals for each person at the initial session.	At an initial information session, participants will be helped to make programme goals with measurable and attainable elements such as attending the supervised sessions once a week, and adhering to home sessions three times per week. At the initial supervised session, the trainer will assist with selecting individual-appropriate goals in terms of cardiovascular (eg. walking duration), strength (eg. exercises and repetitions), and balance (eg. appropriate exercises) training. This will be evaluated and modified as per each individuals progress throughout the programme.
1.2 Problem solving	✓	✓	✓	✓	✓	✓	Identifying specific triggers eg. fear of pain (get checked by GP and given green light as to safety of being physically active), lack of motivation (eg. being active with a friend or partner) etc. Is there time for this? Who does this, psychologist? Cost?	Prior to the initial information session, participants will be evaluated by a GP (if budget allows, if not they will be asked to be checked by their own GP) to increase confidence in their ability to safely perform PA. At the initial information session, participants will be helped to identify any barriers unique to them, and helped to find solutions to these.
1.4 Action planning	✓	✓	✓	✓	✓	✓	Making detailed plans of how and when to include PA into their day rather than relying on when they "feel like it"	At the initial information session, participants will be helped to make timetables for their week, detailing when they will exercise (eg. every Tues I will go to the group session at 11:00 am, 11:00-12:00 on Mon Wed and Fri, I will do my home exercise before lunch, I will walk to do my shopping on Thursday afternoons, I will practice my balance exercises

								every time I brush my teeth and wait for the kettle to boil). These times are then protected for PA, and other activities cannot be made at these times.
1.5 Review behaviour goal(s)	✓	✓	✓	✓	✓	✓	Working with the trainer that goals are reasonable. If not, modifying the goals to be more achievable.	The trainer will review the exercise programme with each individual every 2 weeks and modify (eg. longer duration, more repetitions, different or more advanced exercise…) as per their progress so that the programme remains challenging and acceptable.
1.9 Commitment	✓	✓			✓	✓	Also infantilising. Language use and affirmations unlikely to be well received.	/
2.2 Feedback on behaviour	✓		✓				Not practical or acceptable in this context. Side-effects may be to reduce attendance if participants feel spied upon.	/
2.3 Self-monitoring of behaviour	✓	✓	✓	✓	✓	✓	Diaries of attendance and instances of PA being incorporated in their day	PA diaries will be provided for participants to record their performance of PA (eg. walked for 30 min, completed exercises, practised balance exercises 3 times…)
2.7 Feedback on outcome(s) of behaviour	✓		✓				No practical or acceptable in this context. Side-effects may be to reduce attendance if participants feel spied upon.	/
3.1 Social support (unspecified)	✓	✓	✓	✓	✓	✓	Include family members in the initial session to be informed and reassured about the programme. If unable to attend, letters sent to encourage support of OA in their goal to be more physically active.	Family and/or friends will be included at the initial information session. They will be included in the education regarding the benefits of PA, reassured as to the capability of their OA to perform these activities by a trusted source such as a medical professional. Their own importance in supporting the OA will be emphasised, and examples given on how they could encourage them in their PA and celebrate their successes in adhering to the programme. Examples about the kinds of practical assistance that. can be given will also be discussed. The importance of not doing things *for* their OA, even with the very best of intentions,
3.2 Social support (practical)	✓	✓	✓	✓	✓	✓	Provide examples of how they can help with their friend or family member eg.	

							go to the shops *with* them, not *for* them.	will be explained. The preferred option of doing things *with* their OA will be encouraged.
3.3 Social support (emotional)	✓	✓	✓	✓	✓	✓	Provide examples of emotional support such as reassuring the OA they are capable of being more active, and applaud adherence to the programme.	
4.1 Instruction on how to perform a behaviour	✓	✓	✓	✓	✓	✓	Trainer will give clear instruction on how to perform exercises.	The trainer will give each individual very clear instructions on how each exercise should be performed. Written information will be provided to take away that reminds each OA about the exercises required, and the duration or number of repetitions prescribed for each.
5.1 Information about health consequences	✓	✓	✓	✓	✓	✓	Give information about the numerous health benefits of PA, including fall reduction.	At the initial information session, a trusted source such as a medical professional and researcher will provide information about the benefits of PA. This will include both physical benefits such as lowering the risk of falls and various health conditions, and maintaining independence, as well as greater feelings of well-being.
5.6 Information about emotional consequences	✓	✓	✓	✓	✓	✓	Give information about the benefits of PA such as having better mood, remaining more independent…	
6.1 Demonstration of the behaviour	✓	✓	✓	✓	✓	✓	If possible, use older adults as trainers to model the desired active lifestyle.	As for 4.1 the trainer will clearly explain and demonstrated each exercise to the OA. However, in addition, trainers who are OAs themselves will be selected if possible, in order to demonstrate the results of changing behaviour to a more active lifestyle.
6.3 Information about others' approval	✓	✓	✓	✓	✓	✓	Approval from family members and setting a good example for younger generations would be motivating.	At an initial information session, family/friends will be asked to express their approval of their OA being more physically active.
7.1 Prompts/cues	✓	✓	✓	✓	✓	✓	Depends on the home programme (eg sticker on the bathroom mirror and	Prompts of stickers, devices such as reminders on phones etc will be discussed at the initial information session, and appropriate solutions will be selected for each OA.

							kitchen kettle to remind OA to do balance exercises	
8.1 Behavioural practice/rehearsal	✓	✓	✓	✓	✓	✓	Improve skill at performing exercises safely by doing them under the supervision of the trainer until correct form is achieved.	As for 4.1 and 6.1, the trainer will explain and demonstrate each exercise, but also observe and correct the OA until they are confident in performing each exercise correctly.
8.2 Behaviour substitution	✓	✓	✓	✓	✓	✓	Include plans for replacing a drive to the shops with walking if not too far, replace sitting on the couch watching TV, with doing exercises in front of the TV first before sitting down etc.	At the initial information sessions, the group will work in teams to brainstorm ideas for planning alternative actions when undesirable behaviour is an option. Replacement behaviours can be thought out to reduce the mental load of making decisions in the moment.
8.3 Habit formation	✓	✓	✓	✓	✓	✓	Timetable PA into OAs day and link exercises with other tasks such as balancing while waiting for the kettle to boil, or brushing teeth…	At the initial information sessions, the group will work in teams to work out individual timetables which make concrete plans to schedule activity into their days. Where possible, this will be linked to other activities (eg. if going to the library, walk instead of driving, as long as the weather is good; do home-based exercise every day after lunch…)
8.7 Graded tasks	✓	✓	✓	✓	✓	✓	The trainer will monitor each OA and "prescribe" the activities to be carried out at home weekly.	Each week, the type of exercises, number of repetitions, and intensity etc will be reviewed and increased as the OA improves in fitness.
10.4 Social reward	✓	✓	✓	✓	✓	✓	Include a social "tea and biscuit" time after each supervised session.	OAs will all be encouraged to stay for a social session after each in-person session. This is intended to build camaraderie and social cohesion within the group, and reward attendance.
10.5 Social incentive	✓	✓	✓	✓	✓	✓	Inform OAs ahead of time that the "tea and biscuit" social session will occur at the end of each in-person supervised session. Individuals will be congratulated for their	This will provide motivation to attend the group sessions.

							attendance and effort in class.	
11.3 Conserving mental resources	✓	✓	✓	✓	✓	✓	Homework will be given in the supervised sessions, and diaries with exercises and repetitions clearly listed so OAs don't have to remember or choose exercises to do. PA will be timetabled into their day so that they do not have to choose a time to exercise.	Rather than having to decide every day how to organise your time, and how to fit PA into the day, this will all be planned out ahead of time.
12.1 Restructuring the physical environment							? While it is possible to facilitate desired behaviour (eg. put out exercise clothing the night before), it is more difficult to remove barriers to desired behaviour (eg. cannot remove the sofa and TV from the house)	/
12.2 Restructuring the social environment	✓	✓	✓	✓	✓	✓	Not appropriate to remove exposure to unwanted social contacts (eg. inactive or unsupportive family members), however the creation of a cohesive and supportive social group within the programme reconstructs a new and beneficial social environment.	While changing the social contacts outside this study is neither practical nor ethical, attempts will be made to offset any potentially negative social environment by building a cohesive and supportive social environment within the group.
12.5 Adding objects to the environment		✓	✓	✓	✓	✓	No budget to offer options such as respite care for OAs who are carers of family members	/

12.6 Body changes	✓	✓	✓			✓	This may occur naturally as OAs find themselves becoming stronger or slimer, but this should not be the focus of the programme.	/
13.1 Identification of self as role model	✓	✓	✓	✓	✓	✓	Being a good example to others in the group, the church, or their family.	Regularly reinforce the good example that the OA is setting to their family, children, grandchildren, and wider community such as fellow church-goers.
13.2 Framing/reframing	✓	✓	✓	✓	✓	✓	Framing the inclusion of PA into each day should be seen as reducing sedentary behaviour rather than increasing PA.	Encourage a change in the use of language. Instead of telling OAs to be more active, encourage them to be less sedentary.
13.5 Identity associated with changed behaviour	✓	✓	✓	✓	✓	✓	Encouraging OAs to see themselves as active people.	Encourage a change in the use of language. Encourage OAs to refer to themselves as an active person, or describe themselves as a “walker”, or “energetic”.
15.1 Verbal persuasion about capability	✓		✓	✓	✓	✓	While a GP evaluation ahead of the programme beginning is preferable, this may not be practical, and it also falls outside the remit of this intervention, as it would occur before the intervention begins.	/
15.2 Mental rehearsal of successful performance	✓	✓			✓	✓	Imagine themselves being more physically active eg. walking to the shops, gardening, playing with grandchildren… This type of activity could be seen as infantilising and unacceptable.	/

7.6. Discussion

The purpose of this Objective was to apply the data gathered from the qualitative interviews to a systematic process allowing the design of a culturally tailored intervention, underpinned by theory. This intervention is intended to increase the levels of PA among Caribbean OAs in order to reduce risk factors for falls. The BCW was used to identify the origins of current behaviours reported during the interviews, and to analyse these with the COM-B/TDF model. While the BCW is a model developed from 19 behaviour change frameworks, it is not a theory in itself. Despite this, when people group BCTs together, they are often linked to underlying theory, whether the authors of the interventions explicitly use theory to develop their interventions, or not (Bohlen *et al.*, 2020). The behaviours identified from the interviews were then linked to the five most appropriate intervention functions: education, persuasion, training, modelling, and enablement. Finally, the 28 best behaviour change techniques to use in order to design a truly tailored intervention were selected.

The main strength of using the BCW framework is that it offers a user-friendly methodology for designing an intervention by obliging designers to consider all mechanisms of behaviour change. By combining evidence with best judgement, the final intervention is more likely to be effective, by responding to the unique needs and preferences of end-users. The attention paid to the underlying need to change the behaviours of individuals for whom the intervention is designed can also be linked to the MRC guidelines (Skivington *et al.*, 2021) for developing complex interventions.

Another strength of using the BCW is the systematic and rigorous nature of the process, ensuring that each and every potential component is considered in the design of an intervention. However, this attention to detail takes considerable time to complete thoroughly, and necessitated a thorough understanding of the different stages of the BCW (Murtagh *et al.*, 2018). This requirement for a high number of person-hours to complete the process effectively was noted by Webb et al. (2016) in their design of a PA programme for cancer patients. This could equate to considerable cost when designing an intervention in a professional setting, potentially having a deleterious effect on budgeting.

However, although systematic, this process does include a degree of subjectivity in determining how the COM-B components, intervention functions, TDFs, and BCTs are linked (Ekberg *et al.*, 2021). Although when using the BCT taxonomy, intercoder reliability has been shown across coders with different levels of expertise and experience (Wood *et al.*, 2015), it is possible that different researchers would link elements differently, resulting in different final BCTs. Normally this work would be carried out as a team, with collaboration increasing the reliability of results, however the work in this thesis is necessarily that of the author, so such collaborative methods were not used here.

The task of effectively combining 9 intervention functions, and 93+ BCTs can be overwhelming. The desire is to include everything, so as not to miss any potentially important factors, however Michie et al. (2014) recommend refining the choices as much as possible so that the intervention is highly targeted and specific. This refinement meant that the judgements made, although based on evidence, were also pragmatic and practicality oriented (feasibility, resources…). However, this does introduce a degree of subjectivity to the process, and offers a possibility of introducing bias.

Although the choice of 93 different BCTs appears comprehensive, the most reported intervention function was *Education*. However, there are limited options among the BCTs offered which can account for factors required in the final intervention to respond to the aspects of education evoked by the qualitative data. For example, no BCTs appear to respond adequately to issues such as: what is PA and how to get it, how much PA is necessary and how often should it be performed, what are some examples of PA, and how do all these issues relate to OAs? Many OAs are clearly unsure as to what PA consists of, and only consider PA to be things like competitive sports, running, or lifting weights in a gym. Educating them on all the forms that PA may take, could make it much more achievable in their eyes. For instance, presenting guidelines of PA for OAs could help them realise that PA is not only for the young, and help them be more realistic in terms of how much they need to build into their daily lives to achieve these levels.

Moving forward into the next chapter, the protocol for a PA-intervention designed to reduce risk-factors for falls in Caribbean OAs will be presented. The BCW does not offer specific guidance on

translating BCTs into practical components of the intervention, and therefore these have been chosen based on both evidence from the literature, as well as this author's experience of working in the health sector. Nevertheless, the BCW is widely considered to be the most comprehensive framework for intervention design currently available, with a rapidly growing evidence-base of its efficacity.

8. Protocol for a feasibility study of a fall prevention intervention tailored for Caribbean Older Adults

8.1. Introduction

The aim of this thesis was to develop a PA programme, based on the findings of the literature review showing that PA is the most effective fall prevention intervention, specifically tailored to Caribbean OAs, that is designed to reduce the risk of falling. Chapter 6 discussed the qualitative study, which generated evidence of Caribbean OAs attitudes to ageing and PA. The barriers and facilitators they experience with regards to PA were also explored. The results of this study were used in Chapter 7 in conjunction with behaviour change techniques to develop elements important to tailor a PA intervention to the specific preferences of this population. This chapter describes the protocol that has been designed to test the feasibility of this multi-component intervention to its target population.

A feasibility study is intended to assess the processes involved in the research, or as described by the NIHR, "can this study be done?" It is a useful tool therefore for deciding whether or not an intervention is appropriate for further larger-scale testing, thus also preserving resources for the most promising interventions (National Institute for Health and Care Research, 2019). Even potentially useful interventions rarely spring forth fully formed at the first draft, and feasibility studies may also indicate where in the methods or protocols adaptation or modification may be required before moving onto large-scale studies (Bowen *et al.*, 2009). In addition to the NIHR, the use of a feasibility study is also recommended by the MRC as one of the stages in the development of complex interventions (Skivington *et al.*, 2021).

The primary aim of this study is therefore to determine the feasibility and acceptability of conducting a randomised-controlled trial evaluating a PA intervention tailored to the OA Caribbean community, intended to reduce falls.

In order to determine these factors, differing methodologies will be required in order to evaluate all the different and essential aspects of the proposed study. A process evaluation, as recommended by the MRC (Craig *et al.*, 2008), can help to identify areas of strength and/or weakness within a study, and allow for appropriate improvements if necessary. Mixed methods allow for all the differing aspects of this study to be appropriately evaluated. Quantitative methodologies will be used to evaluate recruitment, retention, data completion, adherence, and sample size calculations. Qualitative methodologies will be used to determine the acceptability of the intervention and the randomisation procedures.

The main objectives will be:

- To evaluate the proposed recruitment strategy
- To assess rates of participant retention and data completion
- To assess the acceptability of proposed randomisation procedures
- To evaluate the acceptability of, and fidelity and adherence to the intervention
- To obtain the standard deviation of the primary outcome measure in order to calculate the sample size needed for a larger-scale trial.

Secondary objectives will be:

- To collect initial estimates of the intervention's efficacy in reducing falls, improving physical function, fall self-efficacy, and quality of life.

8.2. Methods

8.2.1 Design

This feasibility study will be a three-month, multi-component, randomised-controlled trial of a PA intervention tailored to the OA Caribbean community, intended to reduce falls. The study will be registered on ClinicalTrials.gov, and ethical approval will be applied for from the University of East London Ethics Committee. The study will be conducted in accordance with all requirements of the Declaration of Helsinki, and all participants will give their informed written consent prior to any and all study activities. Approval from NHS ethics is not required for this project, as participants will not be recruited via any NHS services. This has been verified through the use of the HRA decision tool (NHS Health Research Authority, n.d.).

Should any eventual recruitment occur via NHS services, either for this feasibility study if recruitment proves inadequate, or for a subsequent efficacy study, this may be necessary. Baseline measures will be carried out prior to randomisation to the intervention or wait-list groups, and measurements will also be repeated following the 12-week intervention. An overview of the study design can be seen in Figure 22.

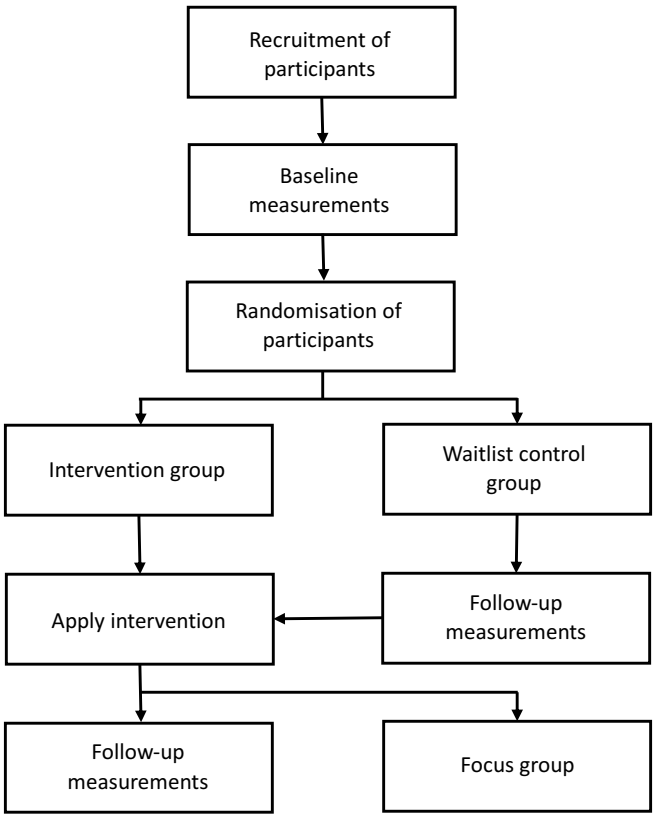


Figure 22: Overview of protocol study design

The three phases of the intervention programme include:

1. An initial educational session for OAs and their close support networks (ie. family and/or friends).
2. Weekly group sessions of PA run by a trainer and followed by a group "tea and cake" social session.
3. Regular, individualised PA homework set by the trainer.

8.2.2 Study setting

The group sessions will take place in a community or church hall local to the participant group. The choice will prioritise a convenient, familiar, and accessible location for the OAs, which also provides parking to facilitate those who may arrive by car, including any professional participants, trainers, etc. This responds to the issues over travel elicited during the qualitative study whereby long travel to a more distant location was identified as time consuming, fatiguing, and often expensive. By remaining local, these particular barriers are removed, and participants are more likely to feel relaxed and comfortable in a familiar setting.

8.2.3 Participant recruitment

Recruitment to the study will be via local branches of age-related charities such as Age Concern, local churches, and Caribbean social clubs in the area. The researchers will work closely with these agencies to identify any of their members who meet the eligibility criteria. Any Caribbean OAs who meet the criteria will be given information about the study and encouraged to discuss it with family. This will be followed up, and interested individuals will be given the opportunity to meet with researchers and discuss any questions they may have about the study. Any family members with concerns will also have the opportunity to telephone or email researchers with any concerns or questions they may have. Once they have agreed to participate, they will be asked to give their written consent.

8.2.4 Participants

8.2.4.1 Eligibility criteria of OAs

The inclusion criteria will be adult participants ≥65 years of age, living independently in the community, and self-identifying as Caribbean. They must be able to understand English and have full capacity to understand the purpose of this study and give informed consent. Exclusion criteria will be anyone with any comorbidities that could pose a medical threat to their safety by participating or impair their ability to fully participate in the study. This could include, but is not restricted to: severe hypertension, any coronary artery or peripheral vascular disease, previous stroke, heart disease, insulin-dependent diabetes, renal disease, liver disease, active cancer, severe osteoporosis, previous acute moderate-severe knee injury, anaemia, neuromuscular disease that precludes PA, significant visual or hearing problems,

cognitive impairment, or unwillingness to make any changes to PA levels, or to travel to in-person sessions.

8.2.4.2 Trainers

Ideally trainers will be OAs themselves (Table 21 BCT 6.1), thus modelling behaviours to aspire to, and demonstrating an example of an active life in older age. The feasibility of recruiting trainers who are OAs will be a key element of this feasibility study, and training of potential trainers may have to be considered.

While it would be ideal from a modelling perspective if the trainer could also be Caribbean themselves, this is not essential. None of the Caribbean OAs interviewed in the qualitative study felt that it was important for their trainer to be of the same ethnicity. It was considered far more important that the trainer be knowledgeable in order to reassure OAs who may be concerned about their abilities or pre-existing health conditions. Personality was far more important to motivate participants, encourage and engage them, and to provide accountability. Building a relationship with the trainer increases trust and ensures the OA feels valued as an individual, not just a number (Devereux-Fitzgerald, Powell and French, 2021).

8.2.4.3 Professionals

Support will be sought from medical professionals for the initial educational session and for the pre-intervention health checks. It is important that the health professionals selected are supportive of the study and encouraging of increasing PA for OAs, as evidence shows that this is not always the case (Hirvensalo *et al.*, 2005; Cunningham and O'Sullivan, 2021).

8.2.5 Sample size

Although it is common in feasibility studies to see the authors claim that no sample size calculation is necessary due to the pilot nature of the proposed trial, these studies should not be considered exempt from providing a clear justification of the number of participants chosen (Billingham, Whitehead and Julious, 2013). While there is currently no accepted gold-standard for choosing a sample size for feasibility studies, one must consider the role of the sample. The main quantitative objective is to be able to estimate the standard deviation in

order to determine the expected sample size for a full trial, in other words to find the minimum number of participants a full trial will need to be able to effectively answer the research question (Whitehead *et al.*, 2016). Although Willett et al. (2023) recommends a sample size of 30 as being adequate for ensuring a normal distribution of the participants, a more formal calculation was also carried out.

There are different methods that are recommended for the estimation of sample sizes in feasibility studies use an estimate of what constitutes the smallest worthwhile effect, otherwise known as the minimal clinically important difference (MCID). The method used in this thesis was that proposed by Walters et al. (2019) and is also recommended by the NIHR (Julious, 2004). This method estimates the sample size for a study with a normally distributed outcome and two study groups, where the sample sizes of the groups and the standard deviations are equal. This method requires that the primary outcome variable be normally distributed. In this case, the primary outcome measure is the SPPB, which is an ordinal variable that is measured on a 12-point scale from 0-12. However, population-based studies using the SPPB typically report values that are normally distributed (Ramírez-Vélez *et al.*, 2021). In addition, parametric statistics are robust enough to deal with violations of normality (Norman, 2010). The formula for the number of the subjects in each group is:

$$n = \frac{2\sigma^2\left[Z_{1-\alpha/2} + Z_{1-\beta}\right]^2}{\delta^2}$$

In this case, δ is the minimal clinically important difference (MCID) expected between the mean outcomes for the two groups, and σ is the standard deviation of the population for the primary outcome measure. The MCID (as described in more detail in the literature review, section 2.5.4.3.1) is the amount of change that would be considered important or meaningful by an individual or clinician. $Z_{1-\alpha/2}$ and $Z_{1-\beta}$ are the acceptable error rates (Type 1 and Type 2).

$Z_{1-\alpha/2}$= Z score for Type 1 error. If the error = 5% (0.05), then Z=1.96

$Z_{1-\beta}$ = Z score for 80% power = 0.84

$$\Rightarrow n = \frac{2\ x\ population\ SD^2[1.96 + 0.84]^2}{MCID^2}$$

In this case MCID = 1.0 (for the SSPB), and population SD = 1.5

$$\Rightarrow n = \frac{2\ x\ 1.5^2[2.8]^2}{1^2}$$

$$\Rightarrow n = 4.5\ x\ 7.84$$

$$\Rightarrow n = 35.3 \quad \Rightarrow 36 \text{ people needed}$$

Although the recommended sample size is 36 people for statistical reasons, it is important to account for dropouts, as failure to do so could leave a study underpowered (Adhikari, 2021). Accordingly, to allow for a dropout rate of 25%, an additional 12 participants will be required, bringing the total sample size to 48. This will be split into 24 participants in each group and provide data for the standard deviation estimation. This also meets with guidelines from the Research Design Service of the NIHR (Hooper, no date).

8.2.6 Randomisation

Participants will be randomised between the intervention and wait-list arms of the study. The randomisation will be done by an independent third-party researcher (Kennedy *et al.*, 2017) who will use online computer software (https://www.randomlists.com/team-generator).

8.3. Intervention

The intervention described here was developed by using the Behaviour Change Wheel as described in Chapter 6. Initially, analysis of the data from the qualitative study described in Chapter 5, identified 7 themes. These data were then systematically applied to the BCW, from which 9 interventions, and 39 BCTs were elicited. To decide which of these were most likely to be effective in delivering the desired change in behaviour, or in this case adherence to a PA intervention that is likely to reduce falls, each BCT was evaluated via the APEASE criteria, to determine their Acceptability Practicability, Effectiveness/cost-effectiveness, Affordability, Safety/side-effects, and Equity. This allowed the final selection of 28 BCTs to be included in the final intervention.

8.3.1 Pre-intervention checks

One important barrier to PA for OAs is their pre-existing health concerns. If a person is unwell, or in pain, then it is a common myth that no matter the cause, they should rest and not exert themselves. In fact, many conditions common to older age can benefit from PA, such as osteoarthritis, cardiovascular disease, diabetes, and respiratory disease (Bean, Vora and Frontera, 2004). For safety, it will be recommended to all participants that they be evaluated by their GP before starting the intervention, and they will be asked in their consent form whether their GP has confirmed that they are safely able to participate in the PA of this intervention. In addition, it has been shown that this reassurance from a trusted health professional makes OAs more likely to initiate and engage with a PA intervention (Hurst *et al.*, 2023).

8.3.2 Educational session

An important Intervention Function from the BCW was related to education. The participants in the qualitative study reported a clear lack of understanding around the meaning of PA, how much PA should be done to maintain health and reduce falls, what kinds of PA are recommended, and how they can do this safely. Therefore, the intervention will begin with a group educational session where trusted health professionals such as a GP or gerontologist, and a lead researcher will present the benefits of PA for health, both physical and emotional (Table 21 BCTs 5.1 and 5.6). Although it was noted that no BCTs were appropriate for some of the issues related to education, these educational requirements will be fulfilled by providing information on the types of activity that "count" as PA, and those that are the best for reducing the risk of falls. Government and NHS guidelines on how much PA should be incorporated into every week will also be presented and explained. This will help to reinforce the idea that PA doesn't need to be formalised sports activity, but can be integrated into daily life, eg. walking to the shops and carrying the shopping back home, gardening etc. This approach also fulfils the need for Caribbean OAs to integrate PA into their daily life and have purpose for it, as discovered in the qualitative study.

Family and friends will be encouraged to attend along with the OA. By being equally educated on the same information, they are more likely to understand the reasons behind the intervention and support their OA in participating. The importance of their encouragement

and support will be emphasised (Table 21, BCT 3.1, 3.3, and 6.3), and examples of the kinds of practical support that could help (Table 21, BCT 3.2) will be discussed. This aspect of the intervention is supported by research that shows that family may otherwise discourage OAs from PA due to concerns about their health or safety (Resnick *et al.*, 2002; Kolt, Paterson and Cheung, 2006).

After this short lecture session, participants will be assisted in a short workshop. The first tasks will be to complete a goal sheet (Table 21, BCT 1.1) (see Appendix 4). This sheet will list measurable and attainable goals for each individual, such as attending the supervised group session each week, and completing three homework sessions each week. Participants will be encouraged to take the sheet home and display it somewhere openly such as on the fridge, as such environmental cues have been shown to help the early stage of habit development (Jenkins *et al.*, 2024). These cues can be developed further by the provision of stickers to be placed around the home (eg. on the bathroom mirror, on the kettle etc.) to provide situational cues, or by helping OAs to set reminders on their phones (Table 21 BCT 7.1). These cues will be adapted to each individual and their preferences to find the most appropriate solutions.

Next, participants will develop individual timetables for their week (Table 21, BCT 1.4, 8.3, and 11.3) (see Appendix 5). Time will be blocked off for the supervised session for example, someone who lives very close may decide that 10:45-12:15 every Tuesday will be blocked off for the supervised session (15 min to get there, one hour of the session, 15 min to get home again), others may need longer and include getting ready. Home sessions will also be timetabled, such as taking half an hour Monday, Wednesday and Friday at 11:00 to do the homework exercises. PA will also be planned to link with other activities where possible, such as choosing to walk on the weekly trip to the library if the weather is good. Not only does this activity allow for PA to be organised into daily life, it also conserves mental resources by removing the effort of decision making every day about PA. It also helps prioritise PA in busy lives where it may easily get pushed aside for other activities until it becomes a habit. By timetabling it clearly and visibly, other activities can be made around the planned PA “Oh, I can’t come then I’m busy, how about the afternoon instead?”

By working together in a workshop scenario, ideas can be exchanged, and solutions found together. The groups will be asked to brainstorm ideas for replacing unwanted behaviours with more active solutions (Table 21, BCT 8.2). For example, doing some exercises before sitting down on the sofa to watch TV, walking to the shops instead of driving if the weather is clear and it's not too far. This can also reduce the mental load of making choices in the moment and provide a social cohesion within the group where everyone is facing the same kind of problems.

8.3.3 Group supervised sessions

The in-person sessions will be run weekly in a community or church hall local to the participant group, as described earlier. The trainer will introduce activities to the group that are designed to train gait, and balance, while incorporating functional training to improve an individual's function during familiar daily activities (as discussed in section 2.5.2.1). Strength and resistance exercises will also be included (as discussed in section 2.5.2.2). All exercises will be prescribed individually, modifying difficulty, repetitions etc to the ability of each individual. These levels will be reviewed at least every 2 weeks and adapted to the improvements of each person as appropriate (Table 21 BCTs 1.5, 8.7).

Each exercise will be fully explained and demonstrated by the trainer (Table 21 BCT 6.1), and the OAs will practise each one under supervision until they are confident that they are able to perform it with correct technique (Table 21 BCT 8.1). Written/diagrammatic instructions will be provided as a reminder on how to perform these exercises at home, with the required exercises and repetitions clearly marked for each individual (Table 21 BCTs 4.1, 8.6).

The priority of all in-person sessions will be having fun, with upbeat, age-appropriate music, and engaging activities used to deliver the exercises.

Following each in-person activity session, there will be a "tea, coffee, and cake" session for the group to socialise. This will not only serve as an incentive to attend the in-person activity sessions (Table 21 BCT 10.5) but will also build the social cohesion of the group (Table 21 BCT 10.4) and develop a supportive environment (Table 21 BCT 12.2) for the OAs.

These social sessions will additionally allow the OAs to begin to modify their own self-views. The trainers can praise the attendance and efforts of the OAs and reinforce how they are role models to their family and community (Table 21 BCT 13.1). Language will also be reframed in a positive manner such as "reducing sedentary habits" (Table 21 BCT 13.2), rather than "being more active" which reinforces the positive change they are making rather than dwelling on the fact that they may currently be inactive. They will also be encouraged to see themselves as active OAs by describing themselves as "energetic" or "a walker" (Table 21 BCT 13.5).

8.3.4 Individual home sessions

"Homework" for participants will be based on the Lifestyle integrated Functional Exercise (LiFE) programme (Clemson *et al.*, 2012). This programme combines both structured exercises as well as incorporating exercises designed to improve balance and lower limb strength into daily activities and routines. This responds well to the findings from the qualitative study showing that Caribbean OAs see PA more as something incorporated into daily life rather than as an entity in and of itself. As well as carrying out prescribed exercises three times per week, exercises also occur whenever the opportunity arises with the linked daily activity. The aim of this programme is to create new habits related to specific situations, where these situations become cues to perform the PA behaviour.

Balance is improved according to the following principles: reducing the base of support, shifting weight to the limits of stability, stepping over objects, and turning and changing direction (Clemson *et al.*, 2012). An example of a way this could be integrated into daily life would be "reducing the base of support" by standing with feet together while working at the kitchen bench for example. Over time, this exercise should increase in difficulty such as standing on one leg instead of feet together.

Strength is improved according to the following principles: bending the knees, raising onto the toes, rocking back onto the heels, sit to stand, walking sideways, and tightening muscles. An example of a way this could be integrated into daily life would be "bending the knees" by placing commonly used products such as dishwashing liquid into lower cupboards and squatting to retrieve them, rather than bending over.

The structured exercises performed three times per week include seven balance exercises and six strength exercises. Balance exercises involve tasks such as walking heel to toe, standing with the feet together, balancing on one leg, leaning forwards, backwards, and side-to-side, and stepping over an object (imaginary to begin with) both in front, behind, and to the side. Over time, the challenge of these exercises should be increased, by standing on one leg instead of feet together, closing eyes, walking heel to toe backwards etc. Strength exercises involve bending the knees to a partial or full squat, sitting and standing from a chair without the use of hands, standing and walking on "tippy-toes" and heels, walking sideways, and climbing stairs, and tightening muscles whenever seated. Again, difficulty should be increased over time.

Ideas for linking these activities with daily tasks can be brainstormed as a group in the initial educational session, and new ideas shared in the weekly social sessions. Stickers will be provided to help serve as reminders to participants. These can be placed wherever an activity could be linked to PA, eg. a sticker on the kettle to remember to walk heel-to-toe alongside the kitchen bench while waiting for it to boil, a sticker on the bathroom mirror as a reminder to stand on one leg while brushing the upper teeth, and the other leg while brushing the lower teeth etc. As much as possible, these activities should be personalised to each participant and their lifestyle.

Participants will be provided with the LiFE manual which provides detailed explanations of the exercises, and ideas for integrated these strategies into daily life. Participants will also be given diaries to record their PA (Table 21 BCT 2.3, 2.4), and this will be reviewed every two weeks by the trainer, and exercises revised as necessary.

8.3.5 Cost

Many OAs cite cost as a major barrier to PA. Therefore, it is essential that funding be obtained to ensure that there is no cost to the OAs participating in this feasibility study. In addition, any subsequent efficacy testing, and any eventual implementation of this programme need to address the issue of cost as an essential element. Ideally there would be no cost for OAs in order to maximise uptake, and to address potential inequalities of health that may arise by only offering services to those who can afford it.

8.3.6 Control group

The control group will be asked to maintain their usual levels of PA throughout the initial 12-week intervention period, before being offered the intervention after completion of the first group's intervention trial. This wait-list control group design was selected both in order to reduce drop-out rates from a group not receiving the more desirable intervention, but also as it could be considered unethical to deny these participants access to the potentially fall preventing intervention.

8.4. Outcomes

Outcome measures will be taken at baseline and at the end of the 12-week programme, for both the intervention and control groups. In addition, a range of demographic data will be collected as covariates at the start of the programme (age, sex, socio-economic characteristics, medical history, and any previous falls).

8.4.1 Function

The Short Physical Performance Battery (SPPB) (Guralnik *et al.*, 1994) tool will be used to assess physical performance, particularly the function of lower extremities. The SPPB has been highly recommended for performance-based tests of physical function in OA (Freiberger *et al.*, 2012). Poor lower limb performance is often manifested in weakness, gait and/or balance disorders (Masud and Morris, 2001), all of which are also associated with increased fall risk. As this is a composite test, it provides a good assessment of three important categories in physical function that are required to function well together in order to protect an individual from falls: strength (chair stands), balance, and walking speed. One of the drawbacks of the SPPB is its ceiling effect whereby high performing participants who score the maximum of 4 points on one of the three tests cannot score any higher than this, so any improvements cannot be measured. By also looking at the individual component results, such as the time for the five repeated Sit-to-Stands, individual scores for lower limb strength can be evaluated, and improved function may be able to be seen more clearly.

8.4.2 Balance

Balance will be assessed by the Berg Balance Scale (Berg *et al.*, 1992) which tests balance in three domains: sitting, standing, and changing posture; and includes tasks such as reaching, turning, looking over each shoulder, and transferring from one seat to another. It has good validity and sensitivity for this population, along with its use in fall prediction making this the most useful tool for measuring the balance of participants in this study.

8.4.3 Strength

Grip strength will be used to test strength in this study. Grip strength is a good predictor of declines in mobility and physical function, and falls in older people (Rijk *et al.*, 2016). Although a measure from an upper limb, it has been shown to correlate highly with lower limb muscle strength (Lauretani *et al.*, 2003). In addition, the Five times Sit to Stand (5STS) test from the SPPB will be used to evaluate individual scores for lower limb strength. The 5STS is a good predictor of lower limb strength (Park and Shin, 2024) and is part of the diagnostic criteria for sarcopenia (Cruz-Jentoft *et al.*, 2019).

8.4.4 Falls

Although the aim of this programme is to reduce falls in Caribbean OAs, this is not a good choice for the major outcome measure for this feasibility study. Firstly, as previously discussed, the reporting of falls is often inaccurate due to varying factors such as memory problems or a desire to hide signs of frailty. In addition, the participants of this study are required to be living independently in the community, meaning that they may be fit and well, and less likely than frailer counterparts to fall. In addition, if the commonly cited statistic that one-third of OAs fall every year (Tinetti, Speechley and Ginter, 1988) is used as an estimate, this would amount to 8 of our expected 24 participants in the intervention arm falling in a 12-month period. Since the programme lasts only 12-weeks, this would further reduce the expected figure to 2. Therefore, a change in fall prevalence during this period is unlikely to present itself with any degree of statistical significance. In addition, as the primary outcome measure is also intended to allow for the calculation of a sample size for any future larger-scale trial, falls are not a helpful measure. As falls are a binary issue, essentially a yes/no answer, it is not possible to calculate the necessary standard deviation that would allow for this sample size estimation.

8.4.5 Adherence

The benefits of PA programmes for OAs are only conferred when the PA is actually carried out and maintained long-term. This makes adherence an essential element in any PA programme. There are however, many definitions of adherence, and its reporting in the literature varies considerably (Hawley-Hague *et al.*, 2016). It is important that careful thought is given to the purpose of the study, and the different definitions and measurements that may best apply.

Adherence to PA for fall prevention may best be served by basing adherence on several definitions, including: completion, attendance, duration, and intensity. *Completion* of the programme, or its alternative, drop-out, looks at the retention of participants. Alone this may not be a realistic measure, as someone may miss several classes, but still be adherent. *Attendance* may be defined as the percentage of classes attended, but can equally cause problems if a participant's attendance is affected by normal, practical reasons such as ill health, caring responsibilities, or holidays. It could cause them to be labelled as non-attending, even though they are committed enough to return to class when able. By combining these measures, a better understanding of participants' attitudes may be gained, by identifying whether there is in fact a reason for any gaps in participation. *Duration* looks at the time spent in PA and is usually self-reported. This brings about some questions about the reliability of the data, as self-reporting of PA by OAs may be overestimated, and sedentary time underestimated, due to social desirability bias (VandeBunte *et al.*, 2022). *Intensity*, or the degree of physical exertion, may be defined in different ways such as the time spent at 55-70% of maximum heart rate, or at "moderate intensity" (Hawley-Hague *et al.*, 2016). This is a measure that is not often used in the literature but is important as participants may attend sessions for the social aspect, doing very little actual PA, and thus not making the physical improvements in strength, balance etc. that will have a real effect on their fall risk. While sensor technology may be helpful in providing more objective measures to measure adherence via duration and/or intensity, the cost and potential for a Hawthorne effect mean that this may only add extraneous variables to the measures (Hawley-Hague *et al.*, 2016). A better method for group led sessions may be to include a measure reported by the session leader estimating each participant's adherence to the programme, ie. scoring whether they participated as asked, just gave a semblance of participation, or sat out for most of the

session. While this version of measurement does not currently appear in the literature, it may provide an additional viewpoint to self-reported or objective measures, and thus is an additional measure worth trialling.

Therefore, adherence will be measured using:

1. Completion: the number of participants still attending supervised sessions at the end of the study for follow-up. Non-completers will be contacted to ascertain the reason(s) for their drop-out.
2. Attendance: percentage of sessions attended out of the full number of sessions offered.
3. Duration: self-reported completion of the "homework" assigned by the instructor.
4. Intensity: both self-reported and instructor-estimated level of effort and degree of participation in sessions.

8.4.6 Feasibility

The recruitment response rate, eligibility rate, and retention rate will all be calculated to evaluate feasibility. The recruitment response rate will be calculated as (percentage of people who volunteer for inclusion in the study / number of people approached or invited to participate x 100). The eligibility rate will be calculated as (percentage of volunteers screened / number of people eligible to participate / 100). The retention rate will be calculated as (the number of participants who complete the 3-month programme / the number of participants who begin the study x 100). Data completion rates will be calculated as the number of complete datasets at the end of the study.

8.4.7 Healthy ageing outcome measures

Participants will be evaluated on measures of self-efficacy via the FES-I (discussed in section 2.5.4.4.1). It is hypothesised that a more active lifestyle, and increasing strength and balance, will result in a greater confidence by the OA in their ability to engage in ADLs safely, without the risk of falling.

As more and more of our populations move into older adulthood, it is important that we do not only concentrate on the ability to extend life, but that we also ensure that that longer life

is worth living. Therefore, assessing the quality of life (QOL) becomes an important factor when assessing interventions designed for OAs. Participants in this study will have their QOL evaluated with the EuroQoL EQ-5D-5L, a means of measuring health-related quality of life for adults. This is the preferred measure of the National Institute for Health Care Excellence (NICE) (National Institute for Health Care Excellence, 2019). This measure comprises two sections, a descriptive and a visual. The descriptive section asks participants to evaluate their perceived state in each of five dimensions: mobility, self-care, usual activities, pain/discomfort, and anxiety/depression. They rate their state as one of five levels: no problems, slight problems, moderate problems, severe problems, and extreme problems. The visual section asks participants to evaluate their health on a visual vertical analogue scale where the endpoints are 'the best health you can imagine' and 'the worst health you can imagine'. The EuroQoL EQ-5D-5L is short and quick, comprising only six questions, and is easy for participants to complete. It is validated and shows high reliability and validity with a lower ceiling effect than other measures (Feng *et al.*, 2021).

8.4.8 Process evaluation

A process evaluation will be conducted to better understand any factors and/or mechanisms that may have affected how the intervention impacted participants, or how the intervention was implemented. As per the objectives, quantitative measures of participant recruitment, retention, and adherence; and qualitative measures of the acceptability of randomisation measures, and the PA programme will be measured.

Another, related factor that is important in evaluating intervention outcomes is fidelity. This assesses the degree to which the intervention is designed, carried out, and received as planned. Fidelity measurements assist in delivering an intervention as designed, without deviation, and are essential for accurate evaluation of the effectiveness of the intervention (An *et al.*, 2020). Currently, measures of fidelity for PA interventions are either highly heterogeneous or omitted completely, and clearer guidelines are needed to direct researchers so that measures become more consistent, and bias is reduced overall (Lambert *et al.*, 2017).

Focus groups/interviews will be completed by all participants, to explore their experiences of participating in the study, any barriers or facilitators they identified for increasing their PA, and any other changes to their behaviour during the study. Both intervention and control groups will be asked about the measurements carried out during the study, and how this affected their behaviour during this period. In addition, any participants who withdrew during the study will also be invited to be interviewed in order to better understand the reasons for their withdrawal.

Semi-structured interviews will be carried out with three groups of six participants, from each of the intervention and control group, and with the trainers of the supervised sessions. Participants will be interviewed in order to gain a better understanding of their reasons for participating in the study, the acceptability of the intervention and its measurements, and whether any changes in their behaviour have been elicited by this study. The trainers will be interviewed in order to evaluate their experiences of delivering the intervention, and the responses and motivation of the participants to the PA. Interviews are expected to take no longer than 30-40 minutes and will continue until data saturation has been reached and no new information is being identified.

8.4.9 Participant incentives

Each participant will receive a £10 gift voucher at both the initial and final data collection point. The weekly "tea, coffee and cake" sessions are also provided free of charge and will be designed as a positive incentive for OAs to attend the supervised sessions.

8.5. Data analysis plan

8.5.1 Data management

All personal data collected during this study will be managed in accordance with the UK Data Protection Act (2018). All electronic data will be stored on devices that are encrypted and password protected, and online on a cloud-based service, the UEL OneDrive for Business. All participants will be allocated a participant ID code at the point of enrolment, which will be used on all data collection formats to anonymise them. All interview recordings will be destroyed immediately following transcription. The master copy of participant name, code,

and contact details will be kept, with physical separation from all data, in a locked cabinet to which only the research team will have access. This personal data will be retained for 12 months following the end of the study to allow for dissemination of the results to the participants, after which it will be destroyed.

8.5.2 Data analysis

The main outcome measures (SPPB, BBS, SSTS) are measured using scales, so will result in continuous variables (post-intervention scores, adjusted for baseline scores). To analyse these continuous outcomes, standard statistical methods such as an Analysis of Covariance (ANCOVA) can be used compare the mean changes from baseline to follow-up between the intervention and control groups and adjust for baseline values of each outcome to control for any initial differences between groups.

Mixed-effects models could also be applied to account for repeated measurements over time and to handle any potential clustering within groups or sites. These models provide a flexible approach for handling missing data and accommodating different time points of follow-up.

8.5.3 Procedure to account for missing or spurious data

All data will be checked regularly during the two data collection phases, and any missing or unexpected data will be highlighted and queried. All such data will be reviewed by the research team.

8.6. Progression criteria to a large-scale trial

The decision on whether to advance this study into a large-scale RCT, will be based on the following criteria:

- The desired number of participants are able to be recruited in the timeframe allocated.
- ≥70% of participants successfully complete the 12-week programme and provide valid outcome data at both collection points.
- Participants deem the programme to be acceptable.
- The intervention is able to be delivered as planned.

If any one of these criteria is not met, then an exploration of the reason for the failure will be explored by the research team. Modification of the programme may be required, and potential adaptations may be tested before moving to the large-scale trial.

8.7. Discussion

This RCT protocol is designed to evaluate the feasibility of a 12-week PA intervention, specifically tailored to Caribbean OAs, that is predicted to reduce the risk of falling. This protocol was developed from a qualitative study of the target population, which then informed the use of the BCW to identify intervention functions and BCTs. These in turn were evaluated using the APEASE criteria in order to maximise the final intervention's effectiveness via a systematic and evidence-based approach.

The greatest strength of the study is the use of the BCW to design the protocol. This design is based on the experiences of the target population and has been created to fit the preferences and needs of this specific group. Other strengths of this study include the randomisation of intervention groups to reduce bias and allow for a direct comparison between groups. The inclusion of home-based PA also maintains ecological validity, as it more accurately reflects real-world application. Potential limitations include sample representativeness, as participants will come from a geographically limited area, and PA levels prior to the study cannot be standardised, making some participants potentially fitter and more open to increasing PA than others. However, there is greater room for impact in people with the poorest PA levels ahead of the study.

This study will provide important evidence regarding the potential success of tailoring a PA programme to specific cultural groups. While the importance of PA for OAs is widely accepted, one-size-fits-all policies may contribute to the low adherence of more generic interventions. If interventions can be tailored to be more acceptable to the target populations, then the adherence should improve, and subsequently results such as improved strength and balance, and reduced fall prevalence would follow. The findings of this study would inform a larger-

scale RCT to fully determine the effectiveness of this complex PA intervention to reduce falls in the Caribbean OA community.

9. Summary and contribution of this thesis

9.1. Thesis Overview

This chapter summarises the thesis by reviewing the findings of each of the five main objectives presented in Figure 3, and considering their significance and implications. The strengths and limitations of each objective will be assessed, as well as recommendations for future research in this field.

This thesis contributes to the knowledge of fall prevention in OAs, in particular the use of PA and how an intervention may be tailored to a particular ethnic group in order to increase acceptability and thus adherence. The review of literature was presented in Chapter Two, and presented the oft cited statistic of a third of adults aged over 65 having a fall every year (Gale, Cooper and Sayer, 2015), increasing to 40% for those over 80 years of age (Tinetti, Speechley and Ginter, 1988). The effect of these falls on OAs was shown to be considerable, ranging from injury (Masud and Morris, 2001; Nevitt, Cummings and Hudes, 1991), fear of falling (Vellas *et al.*, 1997), institutionalisation (Scuffham, Chaplin and Legood, 2003), and even death (Guzon-Illescas *et al.*, 2019; Salkeld *et al.*, 2000). Fall risk factors, including intrinsic and extrinsic risk factors were explored and found to be cumulative, with the greater the number of risk factors present, the greater the risk of falling (Tinetti, Speechley and Ginter, 1988). The most commonly used intervention to reduce risk factors for falls, is exercise, which has been shown to significantly reduce falls (Gillespie *et al.*, 2012). PA helps to maintain balance, strength, flexibility, and reflexes, all of which are important for postural stability, especially in the face of a perturbation (Myers, Young and Langlois, 1996).

Ethnicity was explored as a concept, particularly in relation to the UK as a multicultural society. There is an increasing proportion of the ethnic minority population, with considerable inequalities in health (Nazroo, 2015; Williams *et al.*, 2010; Bidulescu *et al.*, 2015; Office of National Statistics, 2021), particularly in older age (Nielsen and Krasnik, 2010). Attitudes towards ageing are culturally-based and may range from an appreciation of OAs by a society, or alternatively a rejection of ageing and a desire for youth (Löckenhoff *et al.*, 2015). Most of the data leading to the previously stated statistic on average fall prevalence, came from studies carried out in Western countries, and there was a notable lack of data on fall rates in

different ethnic groups. The literature also demonstrated that although many OAs do not attain the recommended levels of PA, that those from ethnic minorities were even less likely to do so (He and Baker, 2005), although the reasons for this were unclear (Mathews *et al.*, 2010). There are many cultural factors that may hinder participation in PA from socioeconomic barriers, lack of cultural traditions of PA, different aesthetic preferences, and cultural expectations, particularly for women (Mathews *et al.*, 2010; Patel *et al.*, 2017; Wilcox *et al.*, 2009; Patel *et al.*, 2001).

The different forms of PA intervention were described according to the ProFaNE taxonomy (Lamb *et al.*, 2011) and evaluated for their success in reducing falls. Adherence was noted as a key element as no matter how successful the intervention, it will only be effective if it is carried out or adhered to. In addition, it will only be carried out by an individual if it is acceptable to them. Acceptability is an individual response, but one that is likely to be highly affected by cultural factors, thus tailoring an intervention to a particular ethnic group may be an effective means of increasing acceptability, thus increasing adherence, and therefore increasing the likelihood of an intervention being successful in reducing falls.

9.1.1 Objective One: Prevalence of falls in different ethnic groups: A systematic review and meta-analysis

In accordance with MRC guidelines (Skivington *et al.*, 2021), the recommendation that all complex interventions should begin with a systematic review of current literature, was followed. Complex interventions are defined as interventions that include several interacting components. As discussed, health inequalities between ethnic groups are a recognised concern, particularly in OAs, and as such, the possibility of there being a difference in fall prevalence based on ethnicity was considered.

While fall prevalence is usually described as one-third of OAs falling every year (Gale, Cooper and Sayer, 2015), rising to 40% over the age of eighty (Tinetti, Speechley and Ginter, 1988), several papers from around the world reported different levels of fall prevalence. Therefore, the aim of the systematic review was to determine whether differences in reported fall rates exist between different ethnic groups worldwide.

Searches of the academic literature were carried out in four databases, and papers were sought that compared fall prevalence between two or more ethnic groups. This comparison within each study was chosen in order to counteract the high levels of heterogeneity found between papers from many different countries, and with different methods used. Twenty-three articles were included for review, and meta-analyses were carried out on the 16 retrospective studies that reported falls in the previous 12 months.

Differences were found in the prevalence of reported falls in different ethnic groups. The lowest fall prevalence was seen in the Asian group, followed by the Hispanic and Black group with similar levels, and finally the White group with the highest fall prevalence. Interestingly, differences between ethnic groups remained in studies that adjusted estimates of effect statistics for the odds/risk of falls. The adjusted effect statistics included factors such as co-morbidities, depression, mobility limitations, functional tests and sociodemographic characteristics

Therefore, differences in fall prevalence between ethnic groups do appear to exist, however the reasons for these differences are likely to be complex and require further investigation. Reasons may include, but are not confined to, differences in attitudes to fall risk and risk-taking behaviours between different ethnicities (Kwan *et al.*, 2013), including the acceptability of assistive devices. Fatalistic attitudes towards falling (Horne *et al.*, 2009; Horton and Dickinson, 2011), poor health (Huang, Tsai and Subeq, 2020), BMI (Lockhart *et al.*, 2019), and a desire not to lose face, or appear old (Huang, Tsai and Subeq, 2020), may all have impacts on the results found.

Overall, this study showed a worldwide difference in fall prevalence between ethnic groups even after adjusting for multiple covariates. This suggests that the ethnic groups at highest risk of falls should be identified so that fall prevention interventions can be targeted towards them.

None of the studies included in the systematic review came from the UK. While fall rates have been measured within studies carried out in the UK, (Gale, Cooper and Sayer, 2016; Lamb *et al.*, 2020), they do not specify ethnicity of non-White participants. Ethnic minority groups

have been shown to have poorer health outcomes than their White counterparts in the UK (Marmot M, 2020), and with the population of ethnic minorities increasing in the UK, and the population ageing, it is essential that more effort is made to identify risk factors for these at-risk groups. More data is needed on fall prevalence in the UK's different ethnic groups, so that interventions can be better targeted to these populations.

9.1.2 Objective Two: Analysis of data to decide which ethnic group to study

The choice of ethnic group to select for the study was made by analysing data from electronic health records (EHR) and the census. The EHR data, involved comparing falls from GP health records for different ethnic groups.

The fall prevalence reported across the data was 24.0% which is slightly lower than reported in some literature. For instance, in other studies measuring fall prevalence in the UK, such as the English Longitudinal Study of Ageing, fall prevalence was reported as 28.4% (Gale, Cooper and Sayer, 2016). However, falls are frequently underreported in EHR data, as patients may not mention falls to their doctor, especially if their visit was for a different health concern. Equally, doctors may not record falls in the health record for reasons such as the fall being minor and only mentioned in passing, or due to lack of time (Jung, Park and Hwang, 2020). However, EHR data is currently the best method available to identify the number of falls reported in a specific area, although it cannot be adjusted for socio-economic factors due to the inaccurate and/or missing data. In this data set, when compared to the White group, the highest fall risk was seen in Bangladeshi and Caribbean OAs, RR 1.26 (1.05, 1.51) and 1.21 (1.04, 1.41) respectively, and the lowest in Black African OAs at 0.79 (0.68, 0.93).

These results are somewhat surprising, as the systematic review and meta-analysis from the previous objective found that Asian groups fell the least, and Black groups had moderately high fall rates. Part of this difference may come down to the definition of the ethnic groups, as the vast area of Asia contains very different populations. From Japanese and Chinese in the far-East to people from the Indian subcontinent, the cultural differences make this an umbrella term for extremely diverse groups of people. "Asian" in the systematic review referred to papers that were all carried out in East and South-East Asia (Japan, China, and the Philippines). None of the papers included participants from South Asia (India, Pakistan, Sri

Lanka). Within the UK, 75% of people who identify as “Asian” have ancestry from the Indian subcontinent (Office of National Statistics, 2022), and this difference may explain the disparity in fall rates in the UK. The systematic review also used the term Black to combine African and Caribbean people. Although Caribbean people are often categorised as “Afro-Caribbean”, there appear to be differences between the two populations in respect to fall prevalence. This suggests that different countries need to ascertain the specific fall prevalence of the ethnic minority groups within their population, in order to determine the groups with the highest prevalences, irrespective of origin and local confounding factors.

The 2011 census data showed that the population of Caribbean OAs in East London was larger (6,586) than the population of Bangladeshi OAs (4,933). As the aim was to select a group with a population of large enough size to make recruitment and testing practical, while also demonstrating high fall prevalence, the Caribbean group was selected.

The 2011 census results were used when writing this chapter of the thesis, as at the time the 2021 census had not occurred. The results of the 2021 census were not released until the end of June 2022, and the data on ethnicity was not available until January 2023. Once these data were released it became evident that there have been changes since the 2011 census. While the population of Caribbean over 65s in the four East London boroughs of Newham, Hackney, Tower Hamlets, and Barking & Dagenham has not changed very much (6,586 in 2011, 6,365 in 2021), the population of Bangladeshi over 65s has increased (4,933 in 2011, 6,957 in 2021). As stated in Chapter 5, the adults of the Windrush generation who came to the UK between 1948 and 1970, are now old-OAs, and their children are now retired and make up the younger OAs, with 15.07% of the population in these boroughs aged over 65. Conversely, the Bangladeshi population is young, with only 3.62% of the population in these boroughs over the age of 65. Almost half of their total population live in London, mostly in East London. With almost 1% of the UK population now Bangladeshi, we can expect the numbers of Bangladeshi OAs to increase rapidly, suggesting that future research needs to explore ways of keeping this population as healthy as possible.

9.1.3 Objective Three: A qualitative analysis of Caribbean attitudes to ageing, falling, and fall prevention interventions

A qualitative study was carried out to determine the cultural attitudes towards fall risk factors for Caribbean OAs. Semi-structured virtual interviews with participants from the Caribbean community were held, as well as with their family members, community leaders, and medical professionals, in order to identify some of the facilitators and barriers this community have towards a fall intervention programme. Seven main themes were identified from analysis of the interviews: attitudes to ageing, the impact of Caribbean life and culture on OAs attitudes, facilitators of PA, barriers of PA, understanding of PA and health, group leader, and preferred activities.

This study found that Caribbean OAs do not feel their age and hope to live an active life into their older age. They report having had a very active childhood in the Caribbean, but that their activity levels decreased upon immigration to the UK, possibly due to factors such as more access to transportation, television, computers, and home appliances, as well as the colder weather making PA less appealing (Tookes, 2019). The activity reported in the Caribbean was therefore more task-based, and recreational PA was rare, suggesting that PA built into ADLs may have a greater chance of success than formalised PA in gym-based sessions (Clemson *et al.*, 2012).

The social aspect of PA evolved as a key factor in the enjoyment and adherence to PA (Er *et al.*, 2017; Moore *et al.*, 2019). The opportunity for social connection is a valuable one for OAs as motivation and mental health can be a challenge in older age. A lack of confidence in physical abilities, or the cumulation of stressors later in life such as ill health and/or the death of loved ones (Murayama *et al.*, 2020), can result in depression and apathy, or even avolition, towards PA (Harrison *et al.*, 2023). Coupled with enjoyment via the inclusion of Caribbean colour and music to PA sessions, this is fundamental in increasing acceptance and thus adherence (Devereux-Fitzgerald *et al.*, 2016; Hardy and Grogan, 2009; Lindsay-Smith *et al.*, 2019; Maula *et al.*, 2019; Sandlund *et al.*, 2018; Yardley *et al.*, 2006).

Notable barriers to PA for this population were cost and health. Older age is a time of life with limited income and PA is often of less importance than higher priority expenses such as food,

power bills, and helping family (Franco *et al.*, 2015). Age also brings a myriad of health complaints, causing fear over issues such as pain (Voss, Pope and Copeland, 2020), or raised heart and breathing rates (Horne *et al.*, 2013). Weight is a concern for many Caribbean OAs and can make participation in PA difficult (Bramble, Cornelius and Simpson, 2009).

Possibly the largest barrier to PA for OAs is a lack of knowledge about PA. OAs interviewed had little or no knowledge of what was meant by PA, how much, and what types should be done, or what the benefits were of achieving recommended levels of PA. Medical and Public Health professionals face considerable challenges in increasing awareness of PA among this community.

This is the first study of Caribbean OAs and their attitudes to PA. Other studies have been carried out with a range of other ethnic groups, often referred to as Black, Asian, and Minority Ethnic (Haith-Cooper *et al.*, 2018; Ige-Elegbede *et al.*, 2019; Koshoedo *et al.*, 2015) or specific groups such as South Asians (Johnson, 2000). The results of this PhD have some cross-over with results of studies looking at the facilitators and barriers of engaging with PA for different ethnic groups within the UK. Factors such as differences in attitudes towards and perceptions of PA (Koshoedo *et al.*, 2015; Haith-Cooper *et al.*, 2018), a lack of knowledge about the benefits of PA (Horne *et al.*, 2013) and a sense of fatalism towards their own health (Ige-Elegbede *et al.*, 2019) are themes frequently found in similar studies. Some results may reasonably be expected to have parallels across OAs of any ethnicity, with barriers such as cost, transport, and physical problems (Johnson, 2000; Koshoedo *et al.*, 2015) potentially being more related to difficulties related to age, rather than ethnicity. In addition, differences in other ethnic groups may be greater than those found for Caribbean OAs. While this study has shown specific cultural differences exist in attitudes to ageing, falling, and PA in Caribbean OAs, there are also many similarities to British culture. Other groups with different languages, religions, and stricter cultural expectations regarding societal roles, especially for women, may show greater differences than those seen here. This strengthens the argument for identifying these underlying cultural requirements and preferences, in order to tailor health responses to specific ethnic groups.

9.1.4 Objective Four: Intervention development

This is the first study using the specific attitudes and preferences of Caribbeans to develop an intervention to reduce fall risk by increasing PA. There have been some studies of PA interventions in the UK for other ethnic populations, such as South Asian (Cross-Bardell *et al.*, 2015), and African populations (Kyei and Howie, 2024), but no previous work specifically with Caribbean populations.

The Behaviour Change Wheel (Michie, van Stralen and West, 2011) was used as a tool to develop an intervention to reduce fall risk by increasing PA in Caribbean OAs. This process allows a meshing of the findings from the literature, with the preferences of the target population. In this case, the literature shows that PA that targets lower limb strength and balance needs to be prioritised in order to maximise the effectiveness of the PA in reducing fall risk (Myers, Young and Langlois, 1996; Hita-Contreras *et al.*, 2016; Liu-Ambrose *et al.*, 2013).

The BCW is becoming a widely used tool to approach complex behavioural situations. It has been used successfully in interventions ranging from audiology (Ekberg *et al.*, 2021), sexual counselling (McSharry, Murphy and Byrne, 2016), medication management (Sinnott *et al.*, 2015), and counteracting sedentary behaviour in the workplace (Ojo *et al.*, 2019). It offers a systematic method of designing an intervention, ensuring that no detail is left unconsidered in the design process. By evaluating every detail in such a precise fashion, an intervention is more likely to address all aspects of an intervention, covering these areas more systematically than the traditional approach, described as the ISLAGIATT approach by the original authors ("It seemed like a good idea at the time") (Michie, van Stralen and West, 2011). This more off-the-cuff and cursory approach may miss out small but essential elements that tip the balance of an eventual intervention into the unacceptable category, requiring repeated redesigns and wasting resources.

The themes elicited from the qualitative study were mapped to the components of the COM-B model and the TDFs, and then subsequently linked to the most appropriate intervention functions and BCTs. The APEASE criteria were then applied to the BCTs to determine those that would realistically be most useful in the final intervention. These steps highlight the

subjective element introduced when a researcher must make pragmatic but often subjective decisions of areas to focus on. This issue has been highlighted in other research studies (Ekberg *et al.*, 2021; Sinnott *et al.*, 2015) and is usually mediated somewhat by working on these decisions as a team. As this study is part of a PhD thesis, the work must necessarily remain that of the author, and therefore this teamwork was not possible, with the potential of greater subjectivity in the decisions made. The use of the APEASE criteria however, has been noted as a means to guide decision making (Bennett *et al.*, 2023) and was used here in an attempt to reduce subjectivity as much as possible.

While there have been other studies that use the BCW to produce a PA intervention for OAs, none have targeted a specific ethnic group. Power et al. (2024) used a very similar process to this study, beginning by understanding the behaviour via qualitative interviews and mapping the themes and codes onto the COM-B model. They then selected the intervention functions most likely to initiate behaviour change, further checking the appropriateness of each via the APEASE criteria. The intervention content was decided by selecting the most appropriate BCTs from the BCT-taxonomy, mapped against the intervention functions. Some of their results mirrored those found in this study, such as Education, as it was found that OAs may not know the type of exercises to do, or the techniques needed. Enablement was used to provide a social support network, Modelling allowed instructors to demonstrate correct techniques for exercises, and Training provided exercises of an appropriate level, progressing as required. Others differed from the needs of the participants in this study and methods to encourage habit formation to maintain PA long-term, notably the fact that they chose a purely home-based programme. The study described in this thesis combined a home-based programme with a weekly group-activity session. It is interesting that their study noted the importance of social support to increase PA ,as did this study, although this author felt that the need for social support and cohesion identified in the qualitative study, would be difficult to implement without a social, face-to-face element of the intervention. The Modelling in their study also did not include elements of peer-instructors modelling an active lifestyle in older age. The similarities between the methodologies of these two studies support the approach used in this study, while the differences also support the need for interventions tailored to the target group as clearly differences occur in the preferences of different groups, and one size does not fit all.

9.1.5 Objective Five: The protocol for a feasibility and acceptability study of a Caribbean-specific fall prevention intervention

Finally, a protocol for a feasibility study of the intervention was detailed as recommended by the MRC guidelines in the development of complex interventions (Skivington *et al.*, 2021). Ideally, this would have been carried out, followed by a pilot study, in order to evaluate the intervention, and determine its suitability for further large-scale testing. However, all of these phases necessitate a larger timescale than a PhD programme, and therefore these phases will be carried out post-PhD study. In addition, the advent of the Covid-19 pandemic also caused difficulties and delays, notably with the recruitment of OAs for the qualitative study, that slowed progress. The impact of Covid-19 on this research is detailed further in section 9.4 of this chapter.

This feasibility study will allow for the testing of the intervention in order to determine whether it is appropriate to advance to larger-scale testing of a randomised-controlled trial (National Institute for Health and Care Research, 2019). This RCT will evaluate a PA intervention tailored to the OA Caribbean community, intended to reduce falls.

This three-month, multi-component randomised-controlled trial, will include three phases, an educational and workshop session, weekly group sessions including a social element, and individualised “homework” PA. The sample size of this RCT was chosen with the intention of determining the expected effect size, so that the number of participants required for a full trial can be calculated.

The outcomes of this feasibility trial will be measured at baseline and at the end of the 12-week programme. Outcomes will include measures of function, balance, strength, falls adherence, feasibility, and healthy ageing outcomes such as self-efficacy and quality of life. In addition, a process evaluation will be carried out to determine the impact of the programme on participants, its acceptability, and any changes that may have occurred to their behaviour.

Finally, the decision on whether this study should be advanced to a large-scale RCT will be determined by the success of recruitment, percentage of participants completing the programme, its acceptability by participants, and its successful delivery.

9.2. General discussion and implication of the findings

The results of the five objectives within this thesis make a novel contribution to the knowledge base in respect of a specific ethnic approach to falls, and fall prevention through PA. The first objective looks beyond the traditional gold standard quoted on fall prevalence as being a third for adults aged over sixty-five (Gale, Cooper and Sayer, 2015), increasing to 40% for those over eighty years of age (Tinetti, Speechley and Ginter, 1988), and asks whether this is indeed true for all ethnicities. Inequalities in health for different ethnic groups is well documented, therefore it is also important to know whether there are also differences in fall prevalence between these groups. The differences demonstrated by this systematic review, even after adjusting for multiple covariates, may be used in future to target specific ethnic groups, allowing for resources to be used more effectively, and for interventions to be better targeted to the needs of each of these groups. In addition, the low number of papers including ethnic differences in fall rates, and the high levels of heterogeneity between the studies, strongly suggest the need for a more standardised approach to fall monitoring and measurement worldwide.

While this study gives the first indication that differences in reported fall prevalence exist between different ethnic groups worldwide, there were limitations in the studies used for the systematic review. The countries in which the research was carried out were heavily skewed towards the USA, with 13 studies included; and Asia, with 8 studies. Two studies came from Australia, but only a single study came from Europe (The Netherlands), Africa (South Africa), and South America (Brazil). In addition, the term Asia represented only East Asian countries (Japan, Malaysia, Singapore, Taiwan, and Hong Kong), and no studies were from South Asia even though these ethnic groups are strongly represented in the UK population. Therefore, while this does give an indication that differences between ethnic groups occur, differences should be determined between the ethnic groups found within different locations, as each country will have a unique ethnic profile in their population.

The differences in fall prevalence between different ethnic groups found in the systematic review was reflected by the findings in objective two, where Electronic Health Records across 16 London CCG areas were examined for falls in OAs. This data confirmed the literature

showing a higher fall prevalence for women than men (Chang and Do, 2015; Alex *et al.*, 2018), fall prevalence increasing with age (Geng *et al.*, 2017; Karlsson *et al.*, 2014; Perracini *et al.*, 2012), and higher levels in lower socioeconomic areas (Chang and Do, 2015). It also confirmed the findings from objective one, by demonstrating differences in fall prevalence between different ethnic groups in London. These differences in fall prevalence however, did not reflect the findings of the systematic review in the previous chapter, suggesting that the four ethnic categories used there are an indication only, and equally do not represent the ethnic diversity of the UK. Categories such as "Black" combine many different groups, and the UK category of "Afro-Caribbean" may be too blunt a tool to describe each group accurately. In this case it appears that Black-African OAs in London do not have a very high fall rate, as opposed to Caribbean OAs who do. Although, as stated previously, there is little information on ethnic differences in fall prevalence in the UK, there is a recent and similar study on ethnic differences in frailty (Pradhananga *et al.*, 2019). Frailty is a condition in OAs described as a progressive age-related decrease in several physiological systems, leading to a reduction in energy levels, physical function, cognitive abilities, and health. It is also linked to an increase in the risk of falls (Xue, 2011), although this is not exclusively the cause as it has already been demonstrated here that falls are multifactorial. Pradhananga et al. found differences in levels of frailty between different UK ethnic groups, with the highest levels of frailty found in Bangladeshi people at 32.9% (95% CI, 29.2-36.7), and the lowest levels found in the Black, Afro-Caribbean population at 14.0% (95% CI, 12.6-15.5). This is interesting, as the same two populations are elicited in this study as in the Census/EHR analysis here, although while this PhD found them to be competing for the highest fall rates, they also appear to show the highest and lowest levels of frailty. This suggests that while Caribbean people are falling more, they are not frail, suggesting that other factors are involved in increasing their fall rates. This intriguing difference further strengthens the argument for greater attention to ethnicity in health, as while the fall prevalence results suggest that Bangladeshi and Caribbean people have similar fall prevalences, it would clearly be a mistake to group them together in a response to this fall risk, as they have considerable differences in other related areas such as frailty. Each ethnic group needs individual investigations and responses to such complex health conditions. This objective also demonstrated the availability of this data via the use of electronic health records. This data is currently underutilised and should be used more

systematically for national monitoring of ethnic differences in fall rates, and other health conditions potentially affected by ethnic differences.

Future research needs to become more tailored to ethnicity, and also to the ethnic groups predominant in the area of study in order to more accurately target areas of greatest need. In addition, large UK studies need to increase their percentage of ethnic minorities included. The English Longitudinal Study of Ageing (The English Longitudinal Study of Ageing, 2024), in the 10th Wave, still only contained just over 561 non-White ethnic minority participants. These numbers do not allow for any further breakdown analysis as each individual ethnic group size is too small, and even raises ethical concerns about potential identification of individuals due to the small sample sizes. It is important that the UK obtain a clear view of the fall prevalences for the specific multicultural population found. This would need to be a large-scale, prospective cohort study of ethnic minority groups in the UK, not simply White British.

The Caribbean group was chosen as the target population for this thesis, as it was shown to have one of the highest fall rates, as well as the larger population, according to the 2011 Census.

The qualitative study looked at the cultural influences, preferences, attitudes, facilitators, and barriers with respect to fall risk factors, and PA among Caribbean OAs. The exploration of these issues has not been previously studied, and the results have important relevance for the understanding of the acceptability of fall intervention programmes, and why they may, or may not, be successful. The insights gained by this study are invaluable and showed clear differences in preferences of one ethnic group towards issues of ageing, falling, and PA. This allowed the tailoring of a fall prevention intervention to this population and may also be of use in offering similar insights into other tailored health interventions for them. The insights offered also have valuable implications for health professionals (eg, physiotherapists) and PA practitioners, as current interventions are mostly designed for White populations, and would benefit from adaptation to different ethnic groups within clinical practice.

The use of the BCW in designing the intervention allows the detail from the qualitative objective to provide an informed starting point in the development of an intervention. Even

the best of interventions can succeed or fail due to one small factor. For example, a mixed gender PA intervention is likely to be unacceptable to a Muslim target group. The systematic nature of the BCW tool ensures that thorough attention is paid to every component, and by basing each decision on evidence from the qualitative results, those decisions are more likely to reflect the preferences of the target population. The resulting intervention is therefore more likely to be deemed acceptable making it in turn more likely to be adhered to, and thus maximising the possibility of the desired outcome, in this case fall prevention.

There are multiple factors that affect falls, and influence attitudes to PA in Caribbean OAs, and therefore multi-component interventions are the most appropriate to target all these different factors. Opportunities for PA already exist for OAs, but their uptake is limited by various barriers cited by the OAs interviewed. Barriers such as cost and accessibility need to be addressed in future, and these existing services may need to be adapted to remove or reduce these barriers. Knowledge of PA, how much should be done, and what kind of PA should be performed has also shown to be lacking among Caribbean OAs. This suggests that improvements in education and better signposting of existing PA services may be an effective strategy to increase PA.

Due to the novelty of the proposed intervention, a feasibility study will determine the acceptability and feasibility of conducting an RCT to evaluate the PA intervention tailored to the OA Caribbean community, with the intention of reducing falls.

9.3. Implications of Covid-19 on this research

The five objectives proposed at the start of the PhD were an ambitious task for such a short timeframe. This thesis began in October 2019, and like many other theses, began with reading material on the topic, and preparing the literature review. At the same time, some lunchtime social clubs for OAs were visited while assisting on a project with Age Concern in order to determine the recruitment possibilities for the future qualitative study. Most of these clubs were of mixed ethnicity as the target group had not yet been chosen, but by chance some were Caribbean clubs. These clubs were found to be a rich source of participants, and the ability to make social connections and build trust with the members, suggested that this

would be a highly successful means of recruitment. Unfortunately, shortly after these initial contacts, the Covid-19 pandemic began.

Initially, the impact of Covid-19 was thought to be minor with the government claiming in March 2020, that they could "turn the tide of coronavirus in 12 weeks". Unfortunately, this proved incorrect, and the first national lockdown was called on the 23rd March 2020. The UK went on to experience several major waves of infection, resulting in three separate official "lockdowns" in the UK, finally easing in March 2021. Covid-19 disproportionally affected OAs, resulting in most OAs shielding-at-home, an unforeseeable factor that proved to be an extremely challenging barrier to recruitment. All social clubs, the chosen route to recruitment, were closed. Gatekeepers/managers of these Caribbean social clubs, were also very reticent to pass on information about the project to their members, often incorrectly claiming data protection issues, and this proved a nearly insurmountable barrier to making contact with OAs. Naturally there was a strong desire to protect vulnerable OAs during this difficult time. However, the inability to build up social connections and trust with OAs due to a lack of face-to-face contact, meant that it was not possible to present the project to OAs and answer any questions they may have had in a personal one-to-one way. Personal and professional contacts were followed up in order to recruit participants, but this was also challenging. Even when their referee had prepared them for contact, the OAs did not know this person telephoning them, and therefore had no trust of the researcher or the research. Several expressed concerns about their data, effects on their families after they die, and the nature of the interview. It took a significant amount of time to try to build the familiarity and trust that had come so easily and naturally in a face-to-face situation, in a familiar location. Frustratingly, many of these recruitment leads did not result in interviews. Overall, this meant that no participants were able to be recruited via what were expected to be "normal" pathways.

Technology also proved to be a barrier in trying to reach OAs, as many do not use, or have access to email or the internet, making it impossible for clubs or societies to pass on details via these methods. Telephone contact was the preferred means of communication for the OAs, but this too was hindered by other issues such as hearing loss. Many other people included in the interview groups such as community and religious leaders, and medical

professionals, naturally had other priorities in those difficult times, and even contacts passed on by known intermediaries were often not followed up.

This telephone contact also meant that the interviews were almost all done separately, and only one group of six Health Professionals could be interviewed together as a focus group, as they remained working together during the pandemic. This necessitated separate transcription and coding of each individual interview, another time-consuming process.

The delays on this third qualitative objective had knock-on effects, causing delays in subsequent objectives. In normal circumstances, the application of the Behaviour Change Wheel is a time-consuming process in itself, so the delays in beginning this process, caused delays to the end result and the design of the intervention.

Finally, the long, slow lifting of lockdown measures, the time it took for many OAs to become less fearful of public interaction, and the delays experienced in working through objectives 1-4, meant that it was not possible to carry out the feasibility study, and a protocol for this was included instead. This PhD is not alone in these challenges. Tyson (2023), developing an intervention to promote PA among adults diagnosed with asthma, was likewise obliged to adapt their planned in-person focus groups to online virtual focus groups. Fortunately for them, this was possible due to the ages of the participants, and therefore they did not have to manage the technological challenges faced by OAs. They were also unable to include stakeholders such as healthcare providers due to the demands on these professionals during the pandemic. While this thesis similarly included a systematic review, qualitative study, and use of the BCW to develop an intervention, it did not include either any statistical analysis of EHR or Census data, and did not test their developed intervention or provide a protocol to do so.

9.4. Future directions for this research

The objectives presented in this thesis are based on the first two steps of the MRC guidelines for the development of complex health interventions. The intention is to complete this step following this PhD. Two locations have already been identified as potentially being suitable

for this feasibility testing, and potential individuals are also being identified who could take the role of our older Caribbean instructor. Funding will be sought, but this would not need to be high as simple community-based locations such as village or church halls are not costly to rent, and the instructor fees would also not be high for a morning per week over 24 weeks (two arms of 12-weeks).

If the feasibility testing proves successful, then the next two steps of the MRC guidelines, evaluation and implementation, can then complete the cycle. The cyclical approach of these guidelines allows for adaptation following any issues that may be revealed during these stages. If this efficacy testing is also successful, this kind of tailored intervention could be repeated and carried out with other ethnic groups in the future, notably with Bangladeshi OAs who were also shown to have a high rate of falls.

Beyond this thesis, this work demonstrates the need for more ethnically tailored interventions in healthcare. Interventions are only successful if carried out, and therefore adapting interventions to be more acceptable to different ethnic groups will potentially increase the adherence of participants, thus increasing the chances of successful outcomes. For this to occur, more research is needed on the cultural attitudes of different ethnic groups within the UK, so that interventions can be adapted appropriately.

While ethnic differences in fall rates have been found both worldwide and within the UK, the reasons for these differences need further research. Are there specific causative factors involved, or are the differences, as suggested by Marmot, the result of inequalities in health, social, and economic factors (Marmot M, 2020)? More research is needed to determine the reasons for these differences in reported fall rates.

9.5. Strengths and limitations of this research

The strengths and limitations of each objective in this thesis have already been discussed in detail in each chapter, and therefore these will not be presented again here. Overall, the greatest strength of this thesis is that it followed a systematic method of intervention development.

Prior to this thesis, Gale et al. (2015) and Tinetti et al. (1988) provided the statistic that was considered to be the gold standard for fall prevalence among OAs. Therefore, another strength of this thesis is that it has qualified this gold standard, demonstrating that differences exist depending on ethnicity. As the UK population continues to diversify, this may allow for better responses to different groups within the population, both for a better targeting of resources and future research.

No previous study has sought to understand the cultural influences, preferences, attitudes, facilitators, and barriers with respect to fall risk factors, and PA on Caribbean adults aged 65 years or older. It is essential to gather contextual evidence from experts in order to both confirm hypotheses developed from the literature, and to provide context to the findings. This rich source of data from the Caribbean participants, can then be applied to behaviour change models and thus to develop interventions more likely to correspond to their preferences and thus be acceptable to them. If an intervention is acceptable, it is more likely to be adhered to, and if adhered to, is more likely to produce the intended effects. Therefore, this is the first intervention specifically tailored to increase PA in Caribbean OAs.

Interview participants were largely recruited from less-affluent areas, which also allows targeting of populations most likely to benefit from the intervention. Feasibility testing of the intervention in a wider area would be ensure that the findings can be generalised to the Caribbean OA population regardless of socioeconomic status.

This thesis does have some limitations that may affect the findings reported and the generalisability of the results to other Caribbean OAs. The question of whether researchers should be members of the population they are studying is frequently debated (Dwyer and Buckle, 2009). Attributes that are shared between the researcher and their participants make them an “insider”, but they are an “outsider” when they do not belong to the same group (Bukamal, 2022). This is not always a dichotomous position as one may share certain characteristics and not others, making them insider and outsider at the same time (Wray and Bartholomew, 2010). For example, one may not share the same ethnicity, making them an “outsider, but the researcher may share the same gender, or socioeconomic, maternal, or immigrant status as the participant. There are benefits from each position, and self-reflection

is important to acknowledge the potential biases and perspectives of the researcher (Dwyer and Buckle, 2009).

It seems that being an inside researcher certainly allows better access for recruitment, and membership of the community also confers a level of trust and an awareness of cultural "rules" such as how to approach certain topics. However, this very closeness may make the insider researcher too close to the population they are observing, and they themselves may be too similar to be truly objective. Participants may also have doubts about anonymity and confidentiality within their community if things are discussed with a fellow member, and other things may even go unsaid if they believe that the researcher is already aware of certain cultural issues (Wray and Bartholomew, 2010).

Alternatively, outsider researchers may be able to create certain levels of trust simply by their status as a university researcher. Equally the trust may not be with the researcher themselves, but via a trust of the gatekeeper who recommended the research/researcher to the participant. The outsider researcher also benefits from a certain freedom to ask the "silly" question, as there is no expectation of knowledge or understanding of the culture of the participant. This may cause participants to elaborate on historical or traditional factors to explain them better.

During this research, the researcher is clearly an outsider as they are not Caribbean themselves. However, a degree of trust was clearly created through certain gatekeepers who were held in high regard in their communities, increasing the chance of the person agreeing to participate in the research. Although face-to-face meetings were not possible, a friendly relationship was created through small talk before the interview, and the researcher's early childhood on a Pacific Island allowed a discussion and comparison of island life. This appreciation for the culture, that although different in many ways, had enough similarity to suggest a desire to learn more about the Caribbean attitudes to the subject matter of the interviews. A previous career in healthcare also provided excellent training for extracting information via friendly conversation rather than rapid-fire questioning.

The difficulties discussed above regarding the recruitment of the Caribbean OAs interviewed during the Covid-19 pandemic, may have affected the sample. The necessary reliance on snowballing via gatekeeper acquaintances of the researcher, has the potential to have skewed the sample by including participants who share similar characteristics such as a knowledge of research, or the importance of health in older age (Sadler *et al.*, 2010).

9.6. Conclusion

This study provides new evidence that differences exist in fall prevalence among OAs, both worldwide and within the UK. It is the first study evaluating the cultural influences, preferences, attitudes, facilitators, and barriers with respect to fall risk factors, and PA on Caribbean adults aged 65 years or older. The findings from this novel study were applied to a systematic process for developing an intervention that tailors a PA intervention to reduce falls in Caribbean OAs. This process is designed to maximise acceptability, hypothesizing that this will increase adherence to the intervention, thus increasing the possibility of successfully reducing falls in the target population. The feasibility protocol designed, will be carried out, and if shown to be feasible it will subsequently be tested for efficacy in a large-scale trial. If successful, similar interventions should be developed for other ethnic groups at high risk of falls and with low levels of PA.

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Appendices

Appendix 1: Interview schedule

Interview schedule:

Theme	Health professionals	Community leaders	Religious leaders	Family members	Older people	References
Definitions	/	What does physical activity mean to you?	What does physical activity mean to you?	What does physical activity mean to you?	What does physical activity mean to you?	"The meaning and importance of exercise can vary between and within cultures" (Jang 2016)
Types and levels of PA	How active do you think members of the Caribbean community are?	How active do you think members of the Caribbean community are?	How active do you think members of the Caribbean community are?	How active do you think members of the Caribbean community are?	How active do you think members of the Caribbean community are?	"Women across the Caribbean region were more likely to have diabetes, be obese and less physically active than men" (Alvarado 2015) "Almost half the population (49.9%) (Barbados) did not meet the minimum activity recommendations of the WHO" (Unwin 2015) "60 % of women and men were classified as PA overestimators, i.e. they considered their activity to be sufficient though they were objectively classified as inactive" (Howitt 2016)
	What sort of physical activity do you think older members of the Caribbean community commonly participate in?	What sort of physical activity do you think older members of the Caribbean community commonly participate in?	What sort of physical activity do you think older members of the Caribbean community commonly participate in?	What sort of physical activity do you think older members of the Caribbean community commonly participate in?	What sort of physical activity do older members of the Caribbean community commonly participate in?	"In order to motivate at-risk elderly persons to exercise, programs must take these varying preferences into account" (Cohen-Mansfield 2004)
Benefits of PA	Do you think there is much knowledge in the Caribbean community about the benefits of being physically active?	Do you think there is much knowledge in the Caribbean community about the benefits of being physically active?	Do you think there is much knowledge in the Caribbean community about the benefits of being physically active?	Do you think there is much knowledge in the Caribbean community about the benefits of being physically active?	Do you think there is much knowledge in the Caribbean community about the benefits of being physically active?	"Health is not a major motivation for physical activity" (Alvarado 2015)
Benefits and downsides of PA	/	What do you see as the benefits of being physically active?	What do you see as the benefits of being physically active?	What do you see as the benefits of being physically active?	What do you see as the benefits of being physically active?	
	/	What do you see as the downside of being physically active?	What do you see as the downside of being physically active?	What do you see as the downside of being physically active?	What do you see as the downside of being physically active?	
Age and PA	/	Do you think older people should be physically active?	Do you think older people should be physically active?	Do you think older people should be physically active?	Do you think older people should be physically active?	"In many studies, the value of exercising in older age was questioned with participation considered by some as inappropriate, incompatible or useless" (Jang 2016)

Facilitators and barriers	What do you think would help older Caribbean people to be physically active?	What do you think would help older Caribbean people to be physically active?	What do you think would help older Caribbean people to be physically active?	What do you think would help older Caribbean people to be physically active?	What do you think would help older Caribbean people to be physically active?	
	What do you think makes it hard for older Caribbean people to be physically active?	What do you think makes it hard for older Caribbean people to be physically active?	What do you think makes it hard for older Caribbean people to be physically active?	What do you think makes it hard for older Caribbean people to be physically active?	What do you think makes it hard for older Caribbean people to be physically active?	
				Do you have any concerns about your family member participating in physical activity?		"Last week I asked my son to buy me a bike for my exercise, but my son was very scared that I might have an accident. Our children sometimes prevent us from doing exercise or physical activity." (Kolt 2006) "many family members continue to refrain from encouraging older family members to exercise because they are concerned that they will fall, get hurt, or exacerbate underlying chronic illnesses" (Resnick 2002)
Support role	Do you think there is anything that you could do in your capacity as (*add role*) to help/support/encourage older Caribbean people to be more active?	Do you think there is anything that you could do in your capacity as (*add role*) to help/support/encourage older Caribbean people to be more active?	Do you think there is anything that you could do in your capacity as a religious leader to help/support/encourage older Caribbean people to be more active?	Do you think there is anything that you could do to help/support/encourage your (*add relationship*) to be more active?		"faithbased organizations are important partners for sharing health promotion programs and preventive health services" *a Latino study* (Harmon 2020). "Families were also an important influence on participation in exercise" (Jang 2016). "Physicians or health professionals played an important role in supporting, encouraging and recommending exercise" (Jang 2016)
Practical details					What time of day is most suitable for you to exercise?	"Times of prayer can be a constraint, as all activity must stop" (Caperchione 2009)
					How long would be the maximum time you could give to exercise?	"Perceived constraints that most restrict elderly people from exercise were lack of time…" (Baceviciene 2013)
					Where would be some locations that would be suitable for you to exercise in?	"close location… were the most important aspects of an exercise class in this older population (Cohen-Mansfield 2004)
					Would you prefer mixed-gender, or single-sex groups?	"Most women reported only exercising with other women" (Alvarado 2015)

					Would you prefer exercises to do by yourself at home, or go to a group outside your home?	“A growing body of research suggests that older exercisers prefer to exercise alone rather than in group-based settings”, ”However, the results revealed that older and younger adults alike express a positive preference for exercising in standard exercise classes comprised of similarly aged participants” (Beauchamp 2007)
					What are some things you wouldn't want to do?	
					Are there any things that would make an exercise programme specifically appealing to Caribbean people?	“Program participation is influenced by cultural values and motivational, social and environmental factors” (Jang 2016)
					Are there any things that would make an exercise programme specifically off-putting to Caribbean people?	

Appendix 2: Participant Information Sheet

University of East London
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University of East London

Stratford Campus, London E16 2RD

Research Integrity

The University adheres to its responsibility to promote and support the highest standard of rigour and integrity in all aspects of research; observing the appropriate ethical, legal and professional frameworks.

The University is committed to preserving your dignity, rights, safety and wellbeing and as such it is a mandatory requirement of the University that formal ethical approval, from the appropriate Research Ethics Committee, has been granted (reference: ETH2021-0020).

Director of Studies

Dr Paul Watts

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Student Researcher

Natasha Wehner-Hewson

University of East London, Stratford Campus, London E16 2RD

n.wehner-hewson@uel.ac.uk

Consent to Participate in a Research Study

The purpose of this letter is to provide you with the information that you need to consider in deciding whether to participate in this study.

Project Title

The Development and Feasibility of an Ethnically Tailored Intervention to Prevent Physical Risk Factors for Falls in Older Adults:
a Mixed Methods Exploratory Design

University of East London
Pioneering Futures Since 1898

Project Description

This project is part of Natasha Wehner-Hewson's ongoing doctoral research, funded by the Graduate School at The University of East London. The aim of this project is to gain a better understanding of the cultural factors affecting falls among older members of the Caribbean community. This will assist us in designing a more appropriate intervention to reduce fall risk factors in this group.

You have been chosen for your knowledge and expertise, because you are either:

- part of the Caribbean community and are over 65 years of age yourself.
- part of the Caribbean community and have a family member who is over 65 years of age.
- a medical professional who works closely with members of the Caribbean community, and has insight into many areas of interest to us.
- a religious or community leader who works regularly with, and is interested in the well-being of older members of the Caribbean community.

You will be contacted, and if you are willing, you will be invited via email to a meeting on a video platform called Microsoft Teams. If you do not have access to a computer, or to this particular platform, you can be contacted by phone. Your views and opinions will be sought via an interview, which will last no longer than an hour. With your permission, the interview will be recorded and subsequently transcribed. We will be discussing what kinds of physical activity people take part in, and what things help or hinder them from being active. We are particularly interested in these things from the point of view of the Caribbean community. Our PhD student, Natasha Wehner-Hewson, will guide you through the various issues we want to explore. There are no right or wrong answers in a discussion of this kind – we are simply interested in your opinions.

The benefits of taking part in this research is that you will be part of a larger project that is aiming to design a fall prevention intervention particularly tailored to the preferences of the Caribbean community. We are hoping that this will make more people want to participate in this intervention, which will hopefully reduce the number of falls experienced by older people each year. Your contributions will help us create innovative solutions by allowing us to better understand the needs and preferences of the Caribbean community. The only disadvantage of participating in this research study is that it will take up a little of your personal time (no more than an hour).

Disclaimer

Participation is entirely voluntary, and you can withdraw at any point without giving a reason. If you withdraw within 2 weeks of participating in the research, then all data collected from you will be deleted and not used within the study. You may withdraw after this date, but it may not be possible to exclude your data from the study, as it will already have been anonymised and/or analysed.

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Confidentiality of the Data

All information you provide will be kept confidential unless something you say indicates that you, or someone else is at serious risk of harm. Such disclosures may be reported to the relevant authority.
All information you provide will be securely kept on a password protected computer. No names or organisations will be identified within the research process. Data from all interviews will be kept securely and fully anonymised. All data generated in the course of the research will be retained in accordance with the University's Data Protection Policy.
No names or other identifying features will be used in any reports. Any demographic information collected will be used purely to provide context to any quotations in the report, however no quotations that could identify you will be used.

Remuneration

In order to compensate you for the time given to this study, we will send you a £10.00 gift voucher with our grateful thanks.

University Research Ethics Sub-Committee

If you have any concerns regarding the conduct of the research in which you are being asked to participate, please contact:
Catherine Hitchens, Research Integrity and Ethics Manager, Graduate School, EB 1.43
University of East London, Docklands Campus, London E16 2RD
(Telephone: 020 8223 6683, Email: researchethics@uel.ac.uk)

For general enquiries about the research please contact the Principal Investigator on the contact details at the top of this sheet.

Appendix 3: Participant Consent Form

University of East London
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UNIVERSITY OF EAST LONDON

The Development and Feasibility of an Ethnically Tailored Intervention to Prevent Physical Risk Factors for Falls in Older Adults:
a Mixed Methods Exploratory Design

Director of Studies
Dr Paul Watts
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Student Researcher
Natasha Wehner-Hewson
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Please tick as appropriate:

	YES	NO
I have read the information leaflet relating to the above programme of research in which I have been asked to participate and have been given a copy to keep. The nature and purposes of the research have been explained to me, and I have had the opportunity to discuss the details and ask questions about this information. I understand what is being proposed and the procedures in which I will be involved have been explained to me.		
I understand that participation involves being interviewed for no more than an hour about the Caribbean community, what kinds of physical activity older people take part in, and what things help or hinder older people from being active.		
I understand that this interview is to be video and/or audio recorded (delete as appropriate) and I give my consent to this.		
I understand that my involvement in this study, and particular data from this research, will remain strictly confidential unless a disclosure is made that indicates that I or someone else is at serious risk of harm. Such disclosures may be reported to the relevant authority. Only the researchers involved in the study will have access to the data.		
I understand that anonymized quotes of things I say may be used in publications		
I understand that the results of this research will be published in a doctoral thesis and scientific literature. It may also be presented in internal reports/presentations, conference presentations, presentations to participants or relevant community groups, or in books or chapters.		
I agree to be contacted by the researcher following my interview to follow up on my comments, if necessary.		

I agree to be contacted by the researcher following my interview regarding future research opportunities.		
It has been explained to me what will happen once the programme has been completed.		
I understand that my participation in this study is entirely voluntary, and I am free to withdraw at any time during the research without disadvantage to myself and without being obliged to give any reason. I understand that my data can be withdrawn up to the point of data analysis and that after this point it may not be possible.		
I hereby freely and fully consent to participate in the study which has been fully explained to me and for the information obtained to be used in relevant research publications.		

Participant's Name (BLOCK CAPITALS)

…….

Participant's Signature

…….

Investigator's Name (BLOCK CAPITALS)

…….

Investigator's Signature

…….

Date: …….

Appendix 4: Workshop PA Goal Sheet

Goal sheet

	Health	**Fitness**	**Function**	**Mental health**	**Health conditions**	**Life choices**
Maintenance	*eg. Stay in good health*	*eg. Maintain current fitness level*	*eg. Maintain strength, balance, flexibility*	*eg. Feel positive and enjoy life*	*eg. Maintain mental function and prevent disease*	*eg. Continue enjoying my current activities*
Improvement	*eg. Improve my health*	*eg. Increase my fitness level*	*eg. Improve my balance, strength, flexibility, sleep, weight…*	*eg. Feel better, reduce stress, avoid cognitive decline*	*eg. Recover from disease, prevent falls*	*eg. Get fit/well for a desired trip, sporting, or social activity*

Modified from Lynch *et al.* (2023)

Appendix 5: Workshop Individual Timetable for PA

Activity Timetable

Physical activity timetable for:_____

My goal is to perform _____ minutes of aerobic activities this week

Activity	Mon		Tues		Wed		Thurs		Fri		Sat		Sun	
	Time/day	Duration	Time/day	Duration	Time/day	Duration	Time/day	Duration	Time/day	Duration	Time/day	Duration	Time/day	Duration

Modified from American Family Physician (2010)

Appendix 6: Ethical Approval Decision Letter

University of East London

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Dear Natasha

Application ID: ETH2021-0020

Project title: The Development and Feasibility of an Ethnically Tailored Intervention to Prevent Physical Risk Factors for Falls in Older Adults: a Mixed Methods Exploratory Design

Lead researcher: Mrs Natasha Wehner-Hewson

Your application to University Research Ethics Sub-Committee was considered on the 20th of October 2020.

The decision is: **Approved**

In view of the COVID-19 pandemic, the University Research Ethics Sub-Committee (URES) has taken the decision that all postgraduate research student and staff research projects that include face-to-face participant interactions, should cease to use this method of data collection, for example, in person participant interviews or focus groups. Researchers must consider if they can adapt their research project to conduct participant interactions remotely. The University supports Microsoft Teams for remote work. New research projects and continuing research projects must not recruit participants using face-to-face interactions and all data collection should occur remotely. These regulations should be followed on your research until national restrictions regarding Covid-19 are lifted. For further information please visit the Public Health website page https://www.gov.uk/government/organisations/public-health-england

The Committee's response is based on the protocol described in the application form and supporting documentation.

Your project has received ethical approval for 2 years from the approval date.

If you have any questions regarding this application please contact your supervisor or the secretary for the University Research Ethics Sub-Committee.

Approval has been given for the submitted application only and the research must be conducted accordingly.

Should you wish to make any changes in connection with this research project you must complete 'An application for approval of an amendment to an existing application'.

The approval of the proposed research applies to the following research site.

Research site: Online via Teams

Principal Investigator / Local Collaborator: Mrs Natasha Wehner-Hewson

Approval is given on the understanding that the UEL Code of Practice for Research and the Code of Practice for Research Ethics is adhered to.□□

Any adverse events or reactions that occur in connection with this research project should be reported using the University's form for Reporting an Adverse/Serious Adverse Event/Reaction.

The University will periodically audit a random sample of approved applications for ethical approval, to ensure that the research projects are conducted in compliance with the consent given by the Research Ethics Committee and to the highest standards of rigour and integrity.

Please note, it is your responsibility to retain this letter for your records.

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With the Committee's best wishes for the success of the project

Yours sincerely

Fernanda Silva

Administrative Officer for Research Governance

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