An investigation of factors influencing physical activity levels in people living in the community after stroke

Sharon Margaret Jackson
Bachelor of Physiotherapy (Hons), The University of Melbourne
Graduate Diploma in Neurological Rehabilitation,
The University of Western Australia

This thesis is presented in partial fulfilment for the requirements of the Master of Neurological Rehabilitation

Centre for Musculoskeletal Studies
School of Surgery
Faculty of Medicine, Dentistry & Health Science
The University of Western Australia

July 2015
Abstract

Title: An investigation of factors influencing physical activity levels in people living in the community after stroke.

Aims: The main aims of this research were to explore the barriers to undertaking physical activity that are reported by a group of people living in the south of England who have had a stroke, and to understand the relationship between commonly reported barriers and self-reported physical activity levels.

Design: A mixed-method study incorporating a) a survey questionnaire (N=76) and b) three focus groups (N=12) to explore the levels of self-reported physical activity and beliefs and barriers to undertaking physical activity reported by the study cohort. The Theory of Planned Behaviour was used as a framework for development of the questionnaire, which was based on existing questionnaires identified in the literature exploring the barriers to exercise after stroke. A series of focus groups were held to complement the data obtained through the questionnaires. Focus group data were coded using the Theoretical Domains Framework.

Methods: A variety of methods were used to identify potential volunteers to complete questionnaires and convenience sampling was used to select focus group volunteers. From the questionnaires, quantitative responses such as reported duration, frequency and intensity of current physical activity participation and the type and frequency of reported barriers were tabulated, and are reported as percentages. Quantitative data were analysed using the statistical software SPSS version 19. Spearman's rank correlation coefficient (Spearman's Rho) and Chi-squared tests were used to explore associations between self-reported physical activity level and the following variables: age, gender, functional mobility, fear of falling, beliefs regarding physical activity, available supports and socioeconomic status. Qualitative data were extracted from the questionnaires regarding beliefs relating to physical activity and the type and frequency of reported barriers; these were used to inform subsequent focus group discussion topics. Audio recordings of focus groups were transcribed verbatim and the transcripts read in their entirety by the principal researcher and the co-ordinating supervisor. Qualitative analysis was performed by coding the interview transcripts to the Theoretical Domains Framework.

Results: Of the 322 questionnaires distributed, 76 were returned. The vast majority of participants identified as White British, the average age of participants was 75 and varied socioeconomic demographics were represented. Thirty-one respondents were
females and almost 60% were coded as community ambulators. Self-reported physical activity levels indicated that 54% of respondents do not undertake sufficient moderate-intensity physical activity to meet current guidelines from the American College of Sports Medicine, who recommend 30 minutes of moderate-intensity physical activity on five days per week. In addition, 63% of respondents reported that they often sit for prolonged periods. Participants reported a range of personal barriers to undertaking physical activity including fear of falling, stroke-related disability, pain and fatigue. Statistically significant relationships were found suggesting that participants who undertake less physical activity experience fear of falling and that functional mobility is linked to self-reported level of physical activity. Statistically significant relationships were also found between level of self-reported physical activity and prolonged sitting, and level of self-reported physical activity and negative beliefs relating to physical activity. Interpersonal and environmental barriers reported by participants included a lack of social support, difficulties with transport and the influence of inclement weather.

Three focus groups were held, with equal numbers of females and males represented. Ages ranged between 55 and 80, with a mean age of 70. Across the groups, equal numbers of participants were in their first, second and third year post-stroke. The majority of participants reported that their stroke resulted from an infarct; most lived with a spouse, with other socioeconomic variables varying across the groups. When focus group transcripts were coded using the Theoretical Domains Framework, discussion content was most frequently linked to the ‘Motivation and goals’ domain, followed by ‘Environmental context and resources’. When text was coded as either a barrier or enabler of physical activity, the domain most frequently represented for barriers to physical activity was ‘Environmental context and resources’, followed by ‘Skills’.

**Conclusion:** Participants reported a number of interlinking and overlapping personal, interpersonal and environmental barriers to undertaking physical activity, and many reported levels of physical activity which are insufficient to meet current guidelines as well as prolonged periods of being sedentary. These findings are similar to those reported in other studies, both within the United Kingdom and Ireland and in the United States of America. Larger studies, which include greater ethnic diversity, would be useful to inform clinical practice and policy to increase engagement with physical activity in people living in the community following a stroke.
## Contents

Abstract ........................................................................................................................... 1  

Contents ...................................................................................................................... 3  

List of Tables .................................................................................................................. 4  

List of Figures ................................................................................................................. 4  

Glossary of abbreviations ............................................................................................... 5  

Acknowledgements .......................................................................................................... 5  

Declaration ...................................................................................................................... 6  

Chapter 1 - Introduction ................................................................................................. 7  

Chapter 2 – Literature review ......................................................................................... 9  

2.1 Benefits of physical activity in non-stroke populations ......................................... 9  

2.2 Benefits of physical activity in people who have had a stroke. ........................... 14  

2.3 Measuring physical activity in stroke populations ............................................... 17  

2.4 Physical activity levels and fitness in stroke populations .................................... 19  

2.5 Barriers to physical activity in stroke populations ................................................ 23  

Chapter 3 – Methods .................................................................................................... 32  

3.1 Study design ....................................................................................................... 32  

3.2 Phase 1 - Questionnaire ..................................................................................... 32  

3.2.1 Survey development ..................................................................................... 33  

3.2.2 Survey Procedures ....................................................................................... 34  

3.2.3 Participants ................................................................................................... 35  

3.2.4 Sample size estimation ................................................................................. 35  

3.2.5 Data management and analysis ................................................................... 35  

3.3 Phase 2 - Focus groups ...................................................................................... 36  

3.3.1 Procedures ................................................................................................... 37  

3.3.2 Participants ................................................................................................... 38  

3.3.3 Sample size estimation ................................................................................. 39  

3.3.4 Data management and analysis ................................................................... 39  

Chapter 4 – Results ...................................................................................................... 40  

4.1 Questionnaires .................................................................................................... 40  

4.1.1 Sample characteristics ................................................................................. 40  

4.1.2 Self-reported physical activity levels ............................................................. 40  

4.1.3 Barriers to physical activity ........................................................................... 42  

4.2 Focus groups ...................................................................................................... 47  

4.2.1 Focus group sample characteristics ............................................................. 48  

4.2.2 Thematic coding - Theoretical Domains Framework .................................... 49  

4.3 Summary ............................................................................................................. 59
Chapter 5 – Discussion ................................................................................................ . 59

5.1 Benefits of physical activity in chronic stroke survivors ........................................... 60
5.2 Physical activity levels amongst study participants .................................................. 62
5.3 Barriers to physical activity in stroke populations .................................................... 63
   5.3.1 Personal barriers ..........................................................................................  63
   5.3.2 Interpersonal barriers .................................................................................. 69
   5.3.3 Environmental barriers ................................................................................ 70
5.4 Summary ............................................................................................................. 73
5.5 Implications .......................................................................................................... 74
5.6 Strengths and limitations ..................................................................................... 76
5.6 Future directions .................................................................................................. 78

Chapter 6 – Conclusions ............................................................................................... 79

References .................................................................................................................... 80

Appendices .................................................................................................................... 90

List of Tables

Table 1. Exercise recommendations for older adults* .................................................. 10
Table 2. Exercise recommendations for people who have had a stroke ...................... 17
Table 3. MET values for variety of activity levels ....................................................... 18
Table 4. Psychological and social factors influencing physical activity after stroke .... 27
Table 5. Theoretical domains framework (37) .............................................................. 29
Table 6. Demographic characteristics of the survey cohort .......................................... 41
Table 8. Self-reported physical activity and sedentary behaviours ............................. 41
Table 7. Stroke characteristics of the survey cohort ................................................... 41
Table 9. Focus group 1 cohort characteristics .............................................................. 48
Table 10. Focus group 2 cohort characteristics ............................................................ 48
Table 11. Focus group 3 cohort characteristics ............................................................ 48

List of Figures

Figure 1. Cycle associated with inactivity ................................................................. 24
Figure 2. Focus group participants for each study location ........................................ 38
Figure 3. Physical activity preferences ................................................................. 42
Figure 4a. Personal barriers to physical activity .................................................. 43
Figure 4b. Personal barriers to physical activity .................................................. 44
Figure 5. Barriers associated with low-intensity physical activity ....................... 45
Figure 6. Interpersonal barriers to physical activity .............................................. 46
Figure 7. Environmental barriers to physical activity ............................................ 47
Glossary of abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACSM</td>
<td>American College of Sports Medicine</td>
</tr>
<tr>
<td>ADLs</td>
<td>Activities of daily living</td>
</tr>
<tr>
<td>AHA</td>
<td>American Heart Association</td>
</tr>
<tr>
<td>ARNI</td>
<td>Action for Rehabilitation in Neurological Injury</td>
</tr>
<tr>
<td>ASA</td>
<td>American Stroke Association</td>
</tr>
<tr>
<td>HRQoL</td>
<td>Health-related quality of life</td>
</tr>
<tr>
<td>METs</td>
<td>Metabolic equivalents</td>
</tr>
<tr>
<td>PA</td>
<td>Physical activity</td>
</tr>
<tr>
<td>QoL</td>
<td>Quality of life</td>
</tr>
<tr>
<td>SAM</td>
<td>Step Activity Monitor</td>
</tr>
<tr>
<td>TPB</td>
<td>Theory of Planned Behaviour</td>
</tr>
<tr>
<td>TDF</td>
<td>Theoretical Domains Framework</td>
</tr>
<tr>
<td>UK</td>
<td>United Kingdom</td>
</tr>
<tr>
<td>USA</td>
<td>United States of America</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organisation</td>
</tr>
</tbody>
</table>

Acknowledgements

I am grateful to the following, without whom this research would not have been possible:

- The volunteers who assisted in the development of the questionnaire and all those who took part in this research
- Professor Barbara Singer, The University of Western Australia
- Christopher Mercer, Western Sussex Hospitals NHS Foundation Trust
- Christina Koulouglioti, Western Sussex Hospitals NHS Foundation Trust
- Sussex NHS Research Consortium
- The Association of Chartered Physiotherapists Interested in Neurology
- The neuro-physiotherapy teams at St. Richard’s Hospital, Worthing Hospital and Sussex Community Trust
- All those who assisted with recruitment for this research
- Linzi Meadows, Manchester Neurotherapy Centre
- Stephen Cox, Acting Chief Executive Officer, Jackson Cox Enterprises
Declaration

Having completed my course of study and research towards the degree of Master of Neurological Rehabilitation by coursework and research, I hereby submit my thesis in accordance with the regulations and declare that the thesis is my own composition.

All sources have been acknowledged and my contribution is clearly identified in the thesis.

____________________________   _________________
Signature     Date
Chapter 1 - Introduction

The barriers encountered by people living in the United Kingdom (UK) who have had a stroke in undertaking physical activity (PA) have not been extensively studied. This investigation explores the factors influencing PA participation in a group of people living in the south of England who have had a stroke. Stroke a leading cause of death in the UK and worldwide, estimated to result in five million deaths annually (1). There are over 150,000 strokes in the UK every year and it is estimated that there are 1.1 million people who have had a stroke living in the UK (2). The average age for stroke onset is 75 (3), and the incidence in the UK is around 25% higher in men than women (2). Reports suggest that approximately two-thirds of people who suffer a stroke survive, and many are left with at least some neurological impairment (4). Indeed, stroke is the leading cause of major disability in the UK (5), where it is estimated there are 300,000 stroke survivors living with long-term moderate or severe disability (6). Furthermore, stroke has been associated with reductions in wellbeing, community participation and quality of life (QoL) (7, 8). The economic costs associated with stroke are also large, costing the UK in the order of £8.2 billion each year (9).

Strong evidence exists in support of the benefits of PA for people both with and without a history of stroke (10-14). Research has shown that participation in regular PA is linked to a reduction in stroke risk and improvements in a range of domains including: cardiorespiratory fitness; strength; function; balance; body composition; mental wellbeing and QoL (10-13, 15-19). ‘Physical activity’ is defined by the American College of Sports Medicine (ACSM) as ‘body movement that is produced by the contraction of skeletal muscles and that increases energy expenditure’, with exercise defined as ‘planned, structured, and repetitive movement to improve or maintain one or more components of physical fitness’ (20, p1511). By this definition, exercise is a type of PA (21) and these are the definitions that will be used in this thesis. Physical activity occurs across a range of domains including leisure-time, occupational, transport-related and domestic (22). Much of the research considering the impact of PA in people who have had a stroke has focused on exercise, however recent literature indicates that engaging in low-intensity PA including performance of day-to-day tasks and reducing sedentary behaviours may confer health benefits, particularly in those who are deconditioned post-stroke (23-25).

Based on the available evidence, guidelines and consensus statements have been produced which make recommendations regarding PA for people who have had a stroke that are broadly similar to those for older adults (12, 13). The American Heart Association (AHA) and American Stroke Association (ASA) recommend that people
who have had a stroke engage in 30 minutes of moderate-intensity exercise on most
days to reduce the risk of further stroke along with other associated risk factors (12).
Where the individual is unable to meet these guidelines, they are recommended to
engage in as much PA as possible.

Despite the evidence, research suggests that many people who have had a stroke are
insufficiently active to reap these benefits and in fact are deconditioned to an extent
likely to impact on performance of routine activities of daily living (ADLs) (26-30). PA
levels are measured in a number of ways, including self-report, physiological
monitoring and the use of activity monitors such as accelerometres. Field et al. (30)
undertook a systematic review and meta-analysis of levels of PA following stroke.
Twenty-six studies were included, involving 1105 participants in 14 countries. In all but
four studies, participants were required to be ambulatory and PA was measured either
using activity monitors such as pedometers or accelerometers, or by self-report. The
summary estimate produced by the meta-analysis of step-count data was 4355.2 per
day. This falls below the recommended daily step count of 6000 for healthy older
adults and the 6500-8500 recommended for individuals with chronic illness/disability
(31). In studies that considered activity intensity and frequency, people who have had
a stroke were found to undertake low-intensity as opposed to high-intensity activity,
and to be engaging in PA for as little as 20% of the recording period, even when time
spent sleeping was excluded. Many people who had had a stroke did not achieve the
recommended levels of PA, despite most being ambulatory. That participants in this
review were relatively high functioning may mean that PA levels are overestimated for
the wider stroke population and for those who are more impaired. The results of the
review suggest that better walking ability and balance were associated with increased
PA levels while low mood was associated with reduced PA. Age, demographic factors
and co-morbidities did not tend to be associated with level of PA.

The reasons for reduced PA levels in people who have had a stroke are likely to be
multifactorial. Bauman et al. (32) proposed an ecological model of the correlates and
determinants of PA which includes individual, interpersonal, environmental, policy and
global influences. This thesis will focus on individual, interpersonal and environmental
domains. At the level of the individual, both psychological and biological factors are
influential. Interpersonal factors include social support along with cultural norms and
practices. Environmental factors include the social environment, the built environment
and the natural environment (33). Individual factors influencing PA participation
include stroke-related disability and socioeconomic status, along with factors relating to
individuals’ knowledge, perceptions and experience of PA, and their self-efficacy (3, 21,
28, 29, 34-46). Interpersonal and environmental factors include lack of social support,
lack of transport, and challenges relating to appropriate facilities and programs, and an environment conducive to being active (3, 21, 35-38, 40, 46). Many of these studies have been undertaken in the USA and generalisability is limited in some cases by the predominantly small urban homogenous populations sampled. Additionally, these studies have largely focused on determinants and barriers relating to exercise, as opposed to the broader term ‘physical activity’, which may be more relevant to the stroke population. A better understanding of the issues influencing PA participation in people who have had a stroke, and any differences related to socioeconomic factors in the UK, has the potential to inform clinical practice and the development of public health policy, with the ultimate objective of improving the function, participation and QoL of people who have had a stroke.

In the following literature review, the benefits of PA for both normal and stroke populations will be discussed. An overview of the methods used to measure PA levels in people following stroke will be provided along with a section highlighting the literature surrounding PA levels and fitness in people with stroke who live in the community. The literature review will conclude with a section relating to the individual, interpersonal and environmental barriers that community-dwelling people who have had a stroke encounter to being physically active, which is the major focus of this thesis.

Chapter 2 – Literature review

2.1 Benefits of physical activity in non-stroke populations.
The benefits of exercise have been studied extensively in non-stroke populations, and it has been described as ‘the one miracle drug that is hard to get people to take’ (47). High level evidence (Class I, Level A (48)) demonstrates the efficacy of exercise in reducing the risk of stroke, coronary heart disease, diabetes mellitus, some cancers, hypercholidemia, hypertension, musculoskeletal conditions, osteoporosis, obesity, mental health problems and premature mortality (10, 11, 49-54). High level evidence also exists in support of exercise to improve physical fitness and overall health (50, 51). The growing evidence base has contributed to the development of guidelines and consensus statements from respected bodies such as the AHA, the ASA, the ACSM and the World Health Organisation (WHO) (20, 50-52). There is broad consensus that adults should engage in 150 minutes of moderate-vigorous activity per week to optimise health benefits, and these recommendations have been adopted internationally by various governments including in the UK (53). Resistance and flexibility exercise are recommended on two days per week and for older adults, balance exercises are also recommended on two days a week. Table 1 summaries the PA recommendations for older adults (50, 52). Importantly, the authors of these
Table 1. Exercise recommendations for older adults*

| Recommendation: Moderate-intensity aerobic exercise for 30 minutes 5 days/week or vigorous-intensity aerobic exercise for 20 minutes 3 days/week or a combination to achieve a total energy expenditure of ≥500-1000 METs/week. | Level of evidence | Class I, Level A for moderate-intensity aerobic exercise  
Class IIa, Level B for combination of moderate- and vigorous-intensity exercise |
| --- | --- | --- |
| Evidence of benefit | Improved aerobic fitness, function, body composition, cognition, QoL; pain management  
Reduction in risk of: stroke, cardiovascular disease, metabolic syndromes, breast and bowel cancers, hypertension, mental health problems and premature mortality; reduced disability |
| Notes | Moderate-intensity exercise may be accumulated in 10 minute bouts  
Moderate-intensity equates to 5-6 on 10 point scale; vigorous equates to 7-8  
If unable to exercise to these levels, individuals encouraged to be as active as their condition/fitness allows |

<table>
<thead>
<tr>
<th>Recommendation: Resistance exercises for major muscle groups on 2 non-consecutive days/week</th>
<th>Level of evidence</th>
<th>Class IIa, Level A</th>
</tr>
</thead>
</table>
| Evidence of benefit | Improvements in strength, power, function, sarcopenia, osteoarthritis; some evidence for improved mood  
Reduction in risk of: falls, osteoporosis |
| Notes | 10-15 repetitions per set  
Functional tasks such as stair climbing, sit to stand recommended |

<table>
<thead>
<tr>
<th>Recommendation: Flexibility exercises for major muscle groups 2 days/week</th>
<th>Level of evidence</th>
<th>Class IIb, Level B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of benefit</td>
<td>Recommended to maintain flexibility for regular physical activity and daily life</td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>Sustained stretches held for 10-30 seconds</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation: Neuromuscular training 2-3 days/week</th>
<th>Level of evidence</th>
<th>Class IIa, Level A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence of benefit</td>
<td>Recommended to reduce falls risk and maintain function</td>
<td></td>
</tr>
<tr>
<td>Notes</td>
<td>Exercises and activities focusing on balance, coordination and agility</td>
<td></td>
</tr>
</tbody>
</table>

* Aged over 65 or 50-64 with clinically significant chronic conditions or functional limitations that affect movement ability, fitness, or physical activity
guidelines highlight that exceeding these recommendation is likely to result in additional benefit and that exercising to levels below these recommendations will also confer health benefits (50, 51).

Despite evidence to support the benefits of being physically active, PA levels in the general population have been observed to be reducing, with inactivity considered to be a global health problem (54, 55). The WHO estimates that 3.2 million deaths each year are attributable to insufficient PA (56) and almost 20 years ago it was found that increasing fitness had a similar effect on reducing mortality as stopping smoking (57). Alongside these findings, research suggests that increasing sedentariness in both work and leisure domains is contributing to additional health problems due to the detrimental effects of prolonged sitting (25, 58). These effects include increased abdominal adiposity and an increased risk of developing diabetes and cardiovascular disease, which are known to be risk factors for a variety of non-communicable diseases including stroke.

In light of the risks and prevalence of inactivity, recent public health programs in the UK have espoused a message to simply ‘move more’ (59, 60). The National Health Service in the UK has launched the Change4Life program (www.nhs.uk/change4life/), which aims to encourage people to increase their PA levels through a variety of leisure-based and day-to-day activities. A number of authors (24, 58, 61) suggest the potential importance of reducing sedentary time and focusing on a ‘whole-of-day’ approach to the promotion of PA, which is likely to be of particular importance in deconditioned, inactive and low-functioning populations, such as people who have had a stroke. However, Murphy et al. (62) suggest caution where recommendations relating to day-to-day PA are concerned. They undertook a cross-sectional survey of 4563 adults in Northern Ireland, collecting self-reported data on height, weight and volume and intensity of domestic PA completed in bouts of 10 minutes or more. They found that time spent in moderate- or vigorous-PA was negatively associated with leanness, and suggested a number of potential explanations for this finding. Heavier participants may perceive domestic physical activities to be more physically demanding, overestimate the intensity or duration of their activities, or increase their energy intake as result of the exertion. The authors suggest that guidance be made clearer about the intensity of PA required to allow it to count towards meeting PA recommendations, as distinct from that low-intensity PA that helps to reduce sedentary time.

In order to increase understanding of the benefits of PA which was below recommended levels, Woodcock et al. (63) undertook a systematic review and meta-
analysis of cohort studies investigating the effects of *non-vigorous* PA on all-cause mortality, which included data on almost one million participants. Non-vigorous PA included activities falling into light- or moderate-intensity categories. From the included papers, the authors extracted data on the weekly duration and intensity of PA and assigned a metabolic equivalent (MET) value to the activities. MET values are defined as the ratio of the work metabolic rate to a standard resting metabolic rate of $1.0 \text{kcal} \cdot \text{kg}^{-1} \cdot \text{h}^{-1}$ and 1 MET is considered the resting metabolic rate for a person at rest (64). They found that participating in non-vigorous PA was associated with a reduction in all-cause mortality. Greater amounts of activity resulted in larger mortality reductions, however the greatest overall benefit was found in moving from sedentary behaviours to low levels of activity. The propensity for the greatest benefits of PA to be conferred to the least fit or those who move from an inactive to an active lifestyle is supported by other authors (10, 23, 51). Wen et al. (23) investigated the minimum amount of leisure-time PA required for reduced mortality and extended life expectancy in a study of Taiwanese participants. The cohort consisted of 416,175 healthy individuals aged 20 years or older who were followed up between 1996 and 2008. The authors found that those who did an average of 15 minutes of moderate-intensity exercise daily demonstrated significant health benefits compared to inactive individuals; the majority of those classified as inactive undertook no leisure-time PA whatsoever. The largest health gains were demonstrated in the first one to two hours of exercise per week and individuals who were active, but at levels less than current recommendations, lived 3 years longer compared with those classified as inactive.

The AHA/ASA stroke prevention guidelines report there is high level evidence (Class 1, Level B) in support of the effects of PA in reducing the risk of first stroke (49) and strong evidence (Class Iib, Level C) that PA reduces the risk of subsequent stroke (12). Sacco et al. (12) suggest that that the improvements in BP and weight-management mediated by PA are major factors resulting in reduction of stroke risk. A reduction in stroke risk is significant since approximately 30% of stroke survivors are at risk of a subsequent stroke (65). The link between stroke risk and PA was investigated in the review by Warburton et al. (10), which included 25 observational and case-control studies. The studies involved 479,336 largely Caucasian participants from Western countries. Across the studies, an average risk reduction of 31% for first stroke was demonstrated, with the authors reporting that the methodological quality of the included studies was generally good. Strong evidence was also found to support the benefits of PA in adults for falls prevention, bone health, psychological well-being, overall QoL and functional independence, supporting the findings of a number of other authors (50, 66, 67). Warburton et al. (10) noted that brisk walking appeared to protect against stroke,
an important finding as it is a cost-free form of PA commonly undertaken by those engaging in recreational PA. In a recent study involving 2417 participants in Hong Kong who did not regularly engage in any regular non-walking moderate to vigorous PA, Lee et al. (68) found that number of steps taken rather than time spent walking was the most important determinant of the protective effects of walking on wellbeing and a number of health conditions. These included hypertension, cancer, stroke, depression, HRQoL and heart rate.

Earlier research has also demonstrated positive associations between PA levels and stroke risk. Lee et al. (69) conducted a meta-analysis of 23 papers comparing individuals categorised in either low-, moderate- or high-activity groups. They found that moderate to high levels of PA were associated with reduced stroke risk. Highly active individuals demonstrated a 25% lower risk of stroke incidence or mortality compared to low-active individuals; moderately active individuals had a 17% lower risk of stroke incidence or mortality compared to low-active subjects. These authors highlight the heterogeneity of definitions of low-, moderate- and high-activity levels in the included studies, making it difficult to conclude on the amount and type of PA required to prevent stroke, however they did not otherwise comment on the methodological quality of the included studies. Nevertheless, these findings lend support to the evidence-base linking greater levels of PA and reduced stroke risk.

Wendel-Vos et al. (70) undertook a meta-analysis of observational data investigating the relationship between PA and stroke. They included 31 papers of varying methodological quality and delineated between occupational and leisure-time PA. High levels of occupational PA were associated with a 43% lower risk of ischaemic stroke than low levels and a 36% lower risk than moderate levels, though no clear definition of activity levels was given. Moderate levels of occupational activity were associated with a 36% lower risk of stroke compared with being inactive at work and leisure-time PA was associated with a 20-25% overall lower risk than being inactive. These findings are interesting as occupational PA levels have been reported to be decreasing (22); whereas leisure-time PA has been shown to be the most beneficial type of activity in terms of mental well-being (66).

In addition to the benefits on physical health, PA has been shown to be beneficial in promoting psychological health, wellbeing and cognitive function (50, 51, 66, 67, 71, 72). Exercise has been demonstrated to be efficacious in preventing and improving symptoms in people with depression and anxiety (51, 71) and there is strong evidence in support of this association in older adults (50). A link between PA and improvement in overall wellbeing has also been reported in older adults and is thought to arise from
the beneficial effects of PA on constructs such as self-concept, self-esteem and self-efficacy (21, 50, 67). Self-efficacy is described as the confidence in one’s ability to perform a task or specific behaviour (73). The strongest method of improving self-efficacy is mastery experience through successful completion of a task (74); PA can provide this experience along with improved fitness enabling greater capacity for the completion of daily tasks, potentially creating a change in affect (67). Cerin et al. (66) found that the greatest association between PA and mental wellbeing was associated with leisure-time PA, including gardening. In their meta-analysis of studies investigating the relationship between PA and mental well-being in older adults, Netz et al. (67) found that frequent short-duration bouts of moderate-intensity PA were the most effective in promoting mental well-being. The evidence supports the notion that participation in light-moderate-intensity enjoyable physical activities confers significant health and wellbeing benefits and furthermore, improved aerobic fitness has been shown to have beneficial effects on cognition and dementia risk in older adults (50, 72).

The evidence overwhelmingly supports the efficacy of PA in maintaining and improving health and wellbeing, and guidelines have been produced to inform PA prescription, recommendations and participation. Whilst individuals are to be encouraged to meet the recommended levels of PA, it has also been shown that that health benefits may be attained at PA levels below these recommendations (50, 51, 63, 75).

2.2 Benefits of physical activity in people who have had a stroke.

In people who have had a stroke, exercise has been shown to improve aerobic and musculoskeletal fitness, function and balance (10-13, 15-19, 76). Furthermore, a Cochrane review (77) found sufficient evidence to support the recommendation of aerobic training involving walking in improving gait speed and walking tolerance and independence. Researchers at the Geriatric Research, Education and Clinical Centre at the University of Maryland School of Medicine (Baltimore, USA) (16, 17, 27, 78-80) have extensively investigated the benefits of aerobic exercise after stroke, and in particular the use of treadmill training. Their work has demonstrated improvements in aerobic fitness, cardiovascular risk profiles and functional walking ability. A systematic review by Ada et al. (15) found that strengthening programs improve strength and activity in chronic stroke survivors and Warburton et al. (11) discuss the importance of musculoskeletal fitness in terms of the maintenance of functional abilities, for example rising from a chair. Evidence exists for the benefits of exercise in improving bone mass, reducing falls and improving balance in people who have had a stroke and in addition, for an association between PA and improved falls self-efficacy (66).

In people who have had a stroke, PA has also been shown to improve aspects of psychological wellbeing, QoL and cognition (18, 41, 81, 82). In a systematic review,
Cumming et al. found some evidence demonstrating that PA enhances cognition, although further high-quality studies are required (82). It is estimated that 30-40% of people who have had a stroke experience depression following their stroke (83, 84) and there is moderate evidence that increased PA may be useful in reducing the incidence and impact of depression in this population (18). Eng and Reime (85) recently published a systematic review and meta-analysis of the effects of structured exercise programs on depressive symptoms following stroke. Thirteen studies were included and a reduction in depressive symptoms was demonstrated at the conclusion of the programs, however this effect was not retained at longer-term follow up, suggesting that continued participation is necessary to sustain the benefits.

In people who have had a stroke, Sawatzky et al. (81) found that greater self-reported leisure-time PA was associated with a reduction in the negative impact of stroke on the mobility component of the QoL measure, the Health Utility Index Mark 3. A number of authors have investigated the links between PA and health-related QoL (HRQoL) in people who have had a stroke (18, 41, 86). Chen & Rimmer (18) undertook a meta-analysis of the effects of exercise on HRQoL after stroke and found moderate levels of evidence to support the use of resistance training and combined resistance/aerobic training. They suggest that exercise may offset some of the decline in HRQoL experienced by people who have had a stroke by reducing secondary conditions e.g. depression and pain, and by improving overall physical fitness, leading to higher levels of physical function. In line with PA recommendations, community-based interventions occurring > 150 minutes/week had the greatest effect on HRQoL. A positive relationship between PA and HRQoL was also demonstrated by Rand et al. (41). On the basis of their findings, they recommend that individuals with mild motor impairment be encouraged to be more physically active, including increasing walking, to confer benefits to HRQoL.

However, the positive link between PA and QoL has not been unanimously supported. A systematic review by Meek et al. (87) found insufficient evidence to support a relationship between PA and QoL and a more recent study by McDonnell et al. (86) found that regular group exercise was not associated with improved QoL, although improvements in mood were found. The review by Meek et al. (87) was based on three randomised- or quasi-randomised controlled trials including 75 participants, contrasting with the nine randomised controlled trials and 426 participants included in the review by Chen and Rimmer (18). Furthermore, only two of the three included studies in the review by Meek et al. (87) utilised QoL measures and both were generic, in contrast to the stroke-specific measures used in five of the included studies in Chen and Rimmer’s (18) review. It may be that the stroke-specific measures were more sensitive to
changes in QoL in stroke survivors compared to the generic measures. While further research is needed, preliminary evidence suggests there may be a link between increased PA and improved HRQoL following stroke.

There is a growing qualitative literature emerging linking engagement in valued activities, such as PA, with benefits for people who have had a stroke including mediating adjustment and establishing the post-stroke 'self' (36, 88, 89). A number of authors have explored the factors that influence engagement with valued activities post-stroke (36, 89, 90), with the process of re-engagement thought to facilitate improvements in confidence and self-efficacy. Based on their study using interviews to explore the perceptions relating to PA of 38 people who have had a stroke, Morris et al. (36) discuss the importance of PA in adjusting to life post-stroke and how PA assists the individual to regain their sense of self and participate within their social context.

Based on the available evidence, guidelines and consensus statements have been produced for PA recommendations for people who have had a stroke which are broadly similar to those for older adults (12, 13). The AHA/ASA recommend that people who have had a stroke engage in 30 minutes of moderate-intensity exercise on most days to reduce the risk of further stroke, along with other associated risk factors (12). Where the individual is unable to meet these guidelines, they are recommended to engage in as much PA as possible and for those with ongoing disability, Gordon et al. (13) recommend a supervised exercise program. In the most recent AHA/ASA statement on PA and exercise recommendations for people who have had a stroke, Billinger et al. (91) have extended on earlier work by Gordon et al. (13) to create the more specific guidelines shown in Table 2.

In healthy populations, the promotion of adherence to PA guidelines, increasing day-to-day PA and reducing sedentary time are complementary approaches being adopted (59). The evidence in support of the benefits of exercise in people who have had a stroke is plentiful, however studies employing interventions aimed at increasing general PA and reducing sedentary time are lacking. Nonetheless, it is likely that deconditioned and inactive populations such those who have had a stroke have much to gain in terms of health benefits from this approach (10, 23, 51).
Table 2. Exercise recommendations for people who have had a stroke

<table>
<thead>
<tr>
<th>Setting/Exercise mode</th>
<th>Prescriptive guidelines</th>
</tr>
</thead>
</table>
| Hospital/Acute phase                                      | • Low-level walking, self-care activities  
• Intermittent sitting or standing  
• Seated activities  
• ROM activities, motor challenges  
• ~ 10-20 beats per minute increase in resting heart rate (HR)  
  Rating of Perceived Exertion (RPE) ≤11 (6-20 scale)  
  Frequency/duration as tolerated  
  Interval or work/rest approach |
| Inpatient/Outpatient/Rehabilitation                        | • Aerobic  
  • Muscular strength/endurance  
  • Resistance/circuit/functional  
  • Flexibility  
  • Neuromuscular  
  • Balance ex’s/Tai Chi, Yoga  
  • Recreational activities e.g. bat and ball  
  • Active video/computer games  
• 55-80% HRmax or RPE 11-14  
  3-5 days/week  
  20-60 minutes/session or multiples of 10 minutes  
• 1-3 sets of 10-15 repetitions of 8-10 exercises  
  50-80% IRM (repetition max)  
  2-3 days/week  
  Increase resistance as tolerated  
• Hold stretch 10-30 seconds, 2-3 days/week  
• 2-3 days/week |

2.3 Measuring physical activity in stroke populations

There is a range of methods for measuring PA levels including ‘direct’ measures such as MET values, pedometers and accelerometers, and ‘indirect’ measures, including self-report. Ainsworth and colleagues (64) have published an updated Compendium of Physical Activities in which activities across the different PA domains are classified and assigned a MET value. The MET values ascribed to a range of levels of activity are reported in Table 3. Notably, this form of measurement does not account for movement inefficiencies relating to disabilities and increased energy demands have been demonstrated with hemiparetic gait following stroke (28, 29, 92, 93). MET values for activity intensity are not used consistently throughout the literature, and varied definitions relating to what is meant by activity intensities make comparisons across the literature challenging.

Accelerometers monitor movement intensity, frequency and duration through one, two, or three planes and have been found to be reliable in neurological populations (94, 95); whilst pedometers are used to monitor step-count. Both have limited ability to measure activities such as cycling and swimming and it has been suggested that accelerometry may be confounded due to non-purposeful movement termed ‘fidgeting’ by Tudor-Locke et al. (31). Fini et al. (96) note that the psychometric properties of accelerometers are not well-established in stroke populations, whose measurement will differ from normal populations on account of their movement abnormalities. Examples
of accelerometers used in the literature include the StepWatch Activity Monitor (SAM; Orthocare Innovations, Oklahoma City, Oklahoma), the ActiGraph (ActiGraph, Pensacola, USA) and the activPAL™ (PAL Technologies Ltd., Glasgow, UK). Pedometers have been found to be less sensitive to slow walking (31, 97), hemiplegic gait (98) and have been infrequently used to measure PA levels in people who have had a stroke (99). Nonetheless, compared to accelerometry they are inexpensive, practical and require less personnel, time and expertise (31). Other methods of direct measurement for aerobic exercise include caloric expenditure and absolute oxygen uptake; relative measures of exercise intensity include heart rate reserve, percent of maximum heart rate, %VO$_2$max and %METmax (51).

**Table 3. MET values for variety of activity levels**

<table>
<thead>
<tr>
<th>Activity Level</th>
<th>MET Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sedentary activity</td>
<td>1.0-1.5 METs</td>
</tr>
<tr>
<td>Light-intensity activity</td>
<td>1.6-2.9 METs</td>
</tr>
<tr>
<td>Moderate-intensity activity</td>
<td>3-5.9 METs</td>
</tr>
<tr>
<td>Vigorous-intensity activity</td>
<td>≥ 6 METs</td>
</tr>
</tbody>
</table>

Prior to the development of activity monitors, investigations into PA levels were largely reliant on self-report questionnaires. Benefits of using self-report measures include practicality, low cost and low participant burden (100). Some of the potential disadvantages reported include recall and response bias, which may be particularly problematic in people with memory and cognitive problems post-stroke (21), an inability to capture the absolute level of PA, problems with validity and reliability (99) and poor correlations with activity monitors (41, 98). Prince et al. (99) undertook a systematic review of 148 papers comparing self-report and direct measures of PA in adults and found no clear trends regarding over- or under-reporting of PA; although the authors note that around a third of the papers were of low methodological quality. At higher levels of reported PA there was a trend towards greater discordance between the measurement methods, and females tended to report higher levels of PA compared to their accelerometry data. Relatively few studies using pedometry were identified, rendering it difficult to draw conclusions regarding the agreement of this type of data with self-report, although the trend was towards higher self-reported levels of activity compared with pedometer data. The authors of this review discuss the point that a number of self-report PA methods do not account for activity bouts of under 10 minutes, nor for PA of less intensity than a brisk walk, potentially meaning that activity levels are under-represented (99). A benefit of self-report highlighted by the authors is that they account for the perceptions of the individual and the types of activities undertaken.
Resnick et al. (98) compared self-report and physiologic PA measures in 87 ambulatory chronic stroke survivors (36 women, predominantly Caucasian and African-American). They used the SAM and found that participants overestimated PA levels when comparing these data with objectively measured data. The authors suggest that the higher perceptions of activity levels may relate to the exertion required to complete tasks, given the severely deconditioned population used in this study. The disparity may also relate to the fact that SAM measures steps only, and thus may fail to capture other physical activities undertaken which are potentially captured by self-report. These findings reinforce the need for careful interpretation of findings produced by either method of PA measurement.

A number of different self-report tools have been developed to measure the various domains of PA, some of which are completed as interviews either over the telephone or in person, with others completed by the individual independently. Examples include: the 7-day Physical activity Recall (101), the Physical Activity Scale for the Elderly (102) and the Global Physical Activity Questionnaire (103). The Physical Activity Scale for Individuals with Physical Disabilities (PA SIPD), although not validated for stroke, has been used with this population (36). No self-report tools which have been developed specifically to measure PA levels for this patient group are reported in the literature. In studies of post-stroke populations, self-report measures have tended to focus on barriers reported to PA participation rather than on actual PA levels.

These data support the notion that measurement of PA is an imperfect science, with each type of measurement having advantages and disadvantages. Selection of one measurement tool over the other will be largely dependent on the specific research question, the population studied and the resources available.

2.4 Physical activity levels and fitness in stroke populations
It is clear that PA is important for people who have had a stroke to optimise recovery and reduce the risk of further poor health. Despite the evidence in support of it, to date there has been little emphasis on continuing stroke rehabilitation into the chronic phase and on interventions to encourage aerobic training, prevent deconditioning and promote a healthy active lifestyle (21, 26, 104, 105). Furthermore, many stroke survivors continue to experience residual neurological deficits and stroke-related problems rendering PA participation more difficult. Accordingly, this population is at risk of losing any functional gains made initially post-stroke and experiencing further deconditioning and increasing sedentariness (11, 26, 27, 106, 107). These factors, along with stroke-related changes in body composition and metabolic abnormalities, can increase the risks of further adverse events (16). Ivey et al. (26) note that physical deconditioning is well-recognised as a health problem in stroke survivors, with reported
levels of fitness 40-60% below age-matched controls. In their study, Michael and Macko (28) found levels of deconditioning to an extent likely to impact on the ability to undertake routine day-to-day tasks. Rimmer et al. (38) have observed that individuals with disabilities are much less likely to engage in physically active lifestyles than those without a disability.

English et al. (108) undertook a systematic review of the literature investigating PA and sedentary behaviours in people who had had a stroke and were community-dwelling. Twenty-six studies involving 983 participants were included, most of whom were at least 6 months post-stroke and able to walk short distances independently. The overall methodological quality of included studies was reported to be good. The most common method of reporting PA levels (22 studies) was step count per day, with 15 studies using the SAM. In these papers, the average daily step count for stroke survivors was between 1389 (SD=797) (28) and 7379 (SD=3107) (109). This contrasts with the 5000-6000 steps taken/day by their age-matched sedentary counterparts (110) and the 3500-5500 for individuals with other forms of disability and chronic illness (111). English et al. (108) point out that step count alone does not give any information regarding the intensity of the activity or how the steps are accumulated i.e. in one long bout, or several shorter bouts. Five studies reported estimates of time on feet or spent walking, ranging between 2.7 and 4.5 hours a day for time on feet (112-114), and 3.8 hours (SD=1.1) (115) and 1 hour (SD not available) (116) for time spent walking. Although it has not been validated for use in stroke (108), step cadence was used in two studies to estimate walking intensity, with 45% (28) and 69% (115) of all walking activity reported to be light intensity, defined as ≤ 30 steps/minute. Two studies used a step cadence of ≥ 30 steps/minute to indicate at least moderate-intensity activity, with 32% (SD=11.2%) (115) and 42% (SD not available) (28) of walking time found to be moderate-intensity. Another study, which used heart rate to estimate activity intensity, found that subjects spent on average 2.5 hours or 13% of monitored time in light-intensity activities and 44 minutes or 7% of monitored time in moderate-intensity activity (117).

Three studies included in this review (108) investigated patterns of activity over the day in terms of bouts of stepping, defined by Manns et al. as any minute with ≥ 1 stride taken (115, 118) and by Roos et al. (116) as any 15 second interval starting with the participant taking ≥ 3 strides and ending when they stood still for ≥ 10 seconds. Participants in the studies by Manns et al. (115, 118) undertook an average of 62 (SD=18) (115) and 64 (SD=19) (118) stepping bouts per day. Participants in the study by Roos et al. (116) (n=51) accumulated 150 bouts of stepping per day. Two studies compared the stepping bouts of stroke survivors with controls (116, 118), with
participants matched for age and PA level in one of them (n=10 in each group) (118). The control subjects were found to undertake significantly more bouts of stepping per day than people who have had a stroke (116, 118). Data extracted by English et al. (108) from the study by Janssen et al. (113) suggest that post-stroke, people in a rehabilitation unit spent 66% of an 8 hour recording period either sitting or lying down.

Also included in the review (108) was a study by Alzahrani et al. (112), who found that a cohort of people living in the community post-stroke (n=42, 13 females) undertook fewer sit to stand transitions per day (57, SD=43) than controls (n=21, 10 females; sit to stand transitions 109, SD=91). Data from this study also showed that whilst subjects who had had a stroke demonstrated a similar amount of sedentary time compared to controls (7 hours of 10 monitored hours and 7.5 hours of 13 monitored hours respectively), controls accumulated their increased activity counts over a longer period of time. The authors (112) suggest that the reduced frequency of activity-counts can be explained by the slowness of movement of people who have had a stroke, rather than less time being active. Given it has been proposed that the uneconomical movements of people who have had a stroke result in higher energy expenditure (28, 29, 93, 98), the authors raise the possibility that the energy expenditure required to carry out these reduced activity-counts may be similar to normal. Thus, improvements in walking speed may allow increases in the amount of PA performed post-stroke.

Work by Rand et al. (41) was also included in this review (108). They investigated forty people post-stroke who were community-dwelling and ambulant (27 women), with mild motor impairment, quantifying PA levels with accelerometry and the PASIPD. They also considered the relationship of PA to HRQoL (measured by the Medical Outcomes Study Short-Form 36 (SF-36)). According to both activity measures, they found low levels of PA, with 60% of participants not meeting PA recommendations. From this study, English et al. (108) extracted data which showed that for 87% of recorded time, no activity counts were recorded in this cohort. After controlling for lower extremity impairment, daily PA explained around a quarter of the variance of the HRQoL of the participants. This suggests that PA is an important factor in determining HRQoL, but they note that it is also likely to be influenced by other variables such as cognition, mood, social support and socioeconomic status. Interestingly, the PASIPD explained similar variance in HRQoL as was explained by accelerometry data. The authors suggest this could reflect that HRQoL may be based on the perceptions of the individual in terms of the activities they undertake, highlighting the usefulness of both types of measures in quantifying PA levels and their impact on HRQoL.
To the author’s knowledge, only two studies have been undertaken in the UK investigating PA levels in people who have had a stroke (61, 119). The first recruited participants from a county very near where subjects were recruited for the present study (119). In this longitudinal study, Kunkel et al. (119) used the activPAL™ system to monitor activity levels of participants over six to seven hours in a day, with measurements taken on inclusion to the study (average 23 days post-stroke) and one, two and three years later. Seventy-four participants (35 females) completed at least one monitoring assessment, with 15 complete data sets obtained. When all cases were analysed, participants in hospital spent approximately 94% of recorded time in sitting and lying. This did improve over time, with participants at year three spending 74% of recorded time sitting or lying, 18% spent standing and 9% walking at 5 steps/minute. The authors report that when translated to steps per 8 hours of recording, the step range is similar to that reported in two investigations by Michael et al. (28, 29) (2838 +/- SD steps/day and 1389 +/- 797 steps/day). Analyses on complete data sets showed no correlations with variables such as age, gender or stroke type, and activity levels; although better balance was correlated with increased activity levels at all post-tests. The authors acknowledge the impact of the variability and small size of the sample on statistical analyses, however their findings are in keeping with prior research. Although PA levels did improve somewhat over the three years, they were found to be very low at all time-points post-stroke. The authors also acknowledge the limitations imposed by the limited wearing time of the activity monitor compared to other studies, as best practice guidelines suggest that accelerometers be worn for a minimum of 24 hours and ideally over three to seven days (120).

Tieges et al. (61) also conducted a longitudinal study, investigating the extent of sedentary behaviours in the first year after stroke using a convenience sample of 96 participants (32 females, average age 72) assessed at one, six and twelve months post-stroke. Bouts of time spent sedentary (i.e. either sitting or lying) were measured using the activePAL™ (PAL Technologies, Glasgow UK), which was worn by participants for up to seven consecutive days. The majority of participants (79) had experienced a mild stroke according to their National Institute of Health Stroke Score (NIHSS). Participants were found to spend on average 81% of their day being sedentary and accumulated sedentary time in prolonged bouts, with cross-sectional analysis showing sedentary time to be greater in those with a higher NIHSS score and lower functional ability. Sedentary behaviour was not shown to change significantly over the first year following stroke and was independent of functional ability, suggesting that factors other than physical ability are involved in determining PA levels following stroke.
While a number of these papers report on small convenience samples, and acknowledge the limitations of measurement tools such as activity monitors and self-report, taken together it becomes clear from these data that stroke survivors are typically a highly inactive and deconditioned population. Many samples contained more men than women, who have been shown to be less active in healthy populations (32, 121). Most studies included people who were ambulant and had mild-moderate stroke related disability, who could be expected to be more active than their more impaired counterparts. Resultantly, PA levels may be overstated by these studies and many people who have had a stroke may be even more inactive and deconditioned than is currently reported. The evidence is strongly in favour of the importance of PA in both stroke and non-stroke populations and evidence is emerging from studies in the latter population that health and well-being benefits may be attained from engaging in lower-intensity physical activities, and particularly those that are enjoyed and valued by the individual. It is suggested that benefits are to be found from increasing day-to-day PA levels and reducing sedentary time (24), particularly in deconditioned populations.

2.5 Barriers to physical activity in stroke populations

PA levels amongst many older non-disabled adults are insufficient and evidence suggests that individuals encounter a number of barriers to engaging in PA. Franco et al. (122) undertook a systematic review and thematic analysis of the qualitative literature on this topic and found that themes for barriers to engaging in PA highlighted in the included studies include social influences, physical limitations, access, and motivation and beliefs. Whilst some barriers to engagement in PA may be experienced across both stroke and non-stroke populations, increased understanding of the barriers specific to individuals living with long-term disability including stroke is important. Much of the research into barriers to PA experienced by people who have had a stroke has focused on individual, interpersonal and environmental factors. Individual barriers include stroke-related disability along with aspects relating to social cognition theories, which will be discussed below. In the review of PA and sedentary behaviours by English et al. (108), seven studies found that walking speed was associated with PA levels (steps per day or accelerometer-derived activity counts) (21, 29, 117, 123-126); these PA measures were also associated with walking ability demonstrated by the six-minute walk test in five studies (21, 41, 124, 125, 127). Peak oxygen uptake, a measure of physical fitness, was associated with steps per day in five studies (28, 98, 117, 118, 128), and depression (43, 117) and reduced QoL were negatively associated with step count and accelerometer-derived activity counts (125). Michael et al. (29) have suggested that, in the presence of severe aerobic deconditioning, the effects of balance problems on ambulatory activity may be magnified, potentially creating a vicious cycle of inactivity and deconditioning. The papers included in the review by
English et al. (108) did not find factors such as age and sex to be significant predictors of PA levels (43, 117, 127). Several studies found associations between balance measures and PA measured by steps per day or accelerometry (29, 41, 125, 129). The importance of balance on PA levels is supported by the studies by Alzahrani et al. (42) and Rand et al. (41) who both found that physical impairments such as reduced balance, endurance and motor function were correlated to the amount of PA undertaken. A later paper by Alzahrani et al. (124) reported that the ability to negotiate stairs was a significant predictor of PA levels and that endurance measured by the six minute walk test was correlated with activity counts.

According to Michael and Macko (28), individual factors influencing PA behaviour in people who have had a stroke include the severity of stroke symptoms, depression, changes in life-role and issues with social support. In their study, step activity was strongly associated with aerobic fitness, which supports the notion that improving aerobic fitness may assist people to increase PA levels post-stroke. Fatigue was rated as severe for 42% of participants and stroke survivors have reported fatigue to be one of the worst symptoms that they experience (130). However, fatigue was not strongly associated with step count and a recent review also found a lack of association between fatigue and levels of PA (131). Nevertheless, on the basis of their findings Michael et al. (28, 129) hypothesise that post-stroke, people may modify their behaviour in order to prevent distress related to fatigue symptoms associated with PA. This has the potential to further exacerbate deconditioning. Indeed, Rand et al. (95) hypothesised that the low activity levels observed in relatively high-functioning stroke populations may be attributable to ‘learned non-use’ (132) rather than being strictly a function of stroke-related impairments. This term is also used by Eng et al. (133) when describing the cycle of sedentariness and disability caused by fear of falling; (see Figure 1).

![Figure 1. Cycle associated with inactivity](image)

Researchers have increasingly sought to understand the barriers that people who have had a stroke encounter to being physically active using social cognition models of health behaviour such as the Social Cognitive Theory (134), the Transtheoretical Model (135) and the Theory of Planned Behaviour (136). These models incorporate
psychological constructs which are thought to influence human behaviour, including self-efficacy. According to Bandura, there are four main sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion and physiological feedback (137). Mastery experiences, thought to be the most reliable source of efficacy information (138), involve the individual gaining positive experiences in a task or skill, whereas vicarious experience is obtained by comparing and modelling oneself on others. Verbal persuasion acts to increase the individual’s belief in their abilities and is given by a significant other, be that close family members/friends or professionals. Physiological feedback is produced by the individual’s own physiological state and can relate to positive or negative emotions.

Jones and Riazi (139) undertook a systematic review of studies investigating the concepts of self-efficacy and self-management after stroke. They contend that self-efficacy beliefs can influence the health behaviour of individuals by determining how they feel, think, behave and motivate themselves in relation to their health, and how they cope with set-backs. The review included 22 articles and found that self-efficacy is associated with outcomes including QoL, depression, ADLs and to some extent, physical functioning. A number of studies included in the review by Jones and Riazi (139) investigated self-efficacy in relation to falls and balance. As many as two thirds of people living in the community post-stroke have experienced a fall, and many are repeat fallers (140). The review reported that Andersson et al. (141) found fear of falling was significantly associated with poor physical function and earlier falls. Fear of falling was also associated with fatigue severity (129), reduced balance ability (142) and reduced balance self-efficacy (143). Pang and colleagues investigated the impact of self-efficacy on balance and falls, finding balance self-efficacy to be associated with community reintegration (144) and falls-related self-efficacy to be associated with the occurrence of falls (145).

In other studies, self-efficacy relating to balance has been shown to be an independent predictor of PA levels after stroke (43, 44). Schmid and Rittman (146) investigated the consequences of post-stroke falls in 132 males who had had a stroke, finding that falls resulted in activity and participation limitation, increased dependence and development of fear of falling. Increased dependence on others may also limit participation in PA (147). Loss of mobility has been linked to post-stroke depression, which in itself can contribute to poorer and slower functional recovery, higher morbidity and mortality, less participation in activities and lower QoL (74). Many of these factors have the potential to erode self-efficacy, which may be a more important determinant of disability and QoL than physical impairments (84). One large predictive cohort study that was included in Jones and Riazi’s review (139) found that perceived behavioural control and self-
efficacy were predictive of walking limitation and recovery (45). If an individual’s perception of their ability to be active is poor, they are clearly at risk of succumbing to this cycle of inactivity.

A number of studies have been undertaken in the USA which have included the investigation of barriers to PA as reported by individuals who have had a stroke. While the general term ‘physical activity’ is used in these papers, the research undertaken is predominantly in relation to exercise. Rimmer et al. (148) used the Barriers to PA and Disability Scale (B-PADS) to investigate PA in a population of 83 people who had had a stroke. The B-PADS consists of 34 questions, 31 of which require a yes/no response. Three are open-ended, with two requesting further explanation of a previous ‘yes’ response. The two main barriers to exercise reported by participants in this study were the cost of membership fees at fitness facilities (61%) and lack of transport (57%); however lack of motivation was reported by 37% of participants. These barriers were more frequently reported by individuals in the lower socioeconomic cohort, who also, on average, expressed a greater number of barriers to exercise. Socioeconomic factors have been found to influence health behaviours and outcomes along with PA participation in the general population in England, with regional differences noted. The 2012 Health Survey of England (149) reported continuing evidence of health inequalities, including in the south of England, with pockets of deprivation apparent alongside areas of relative wealth.

The focus of the questionnaire survey by Shaughnessy et al. (39) was also on factors relating to exercise participation in 312 people who had had a stroke. They found that exercise self-efficacy, exercise history and outcome expectation influenced exercise behaviours in their cohort. Zalewski et al. (21) used both self-report (the 7-day PAR, which is completed as a one on one interview), and accelerometry to investigate the PA levels in their cohort of 20 people who had had a stroke. Participants reported a variety of barriers to PA including a lack of willpower, skill, social influence and social support. The findings of Damush et al. (40), who used focus groups to explore the barriers and facilitators to exercise in 13 people post-stroke, supported those reported previously by these other authors. Like those in the study by Rimmer et al. (148), participants reported barriers including a lack of knowledge of where and how to safely exercise and of the benefits of exercise post-stroke, and also a lack of motivation (148). The generalisability of these studies is limited somewhat by predominantly involving small urban homogenous samples. Furthermore, participants in all the studies discussed were mobile in the community, which may limit the generalisability of these findings to those who are less mobile post-stroke.
Notably, all of these studies were undertaken in the USA, and many of the participants were of African-American origin. In their study, Shaughnessey et al. (39) found that white participants were more likely to hold positive beliefs relating to the outcomes of participation in exercise, and these authors suggested that participants of African-American origin may have lower self-efficacy and poorer outcome expectations for exercise. Minority groups have also been shown to be less physically active and less likely to meet PA guidelines (150). Mama et al. (151) undertook a systematic review of the psychosocial factors influencing PA levels in healthy minority African-American and Hispanic populations, and found that social support was the most common psychosocial factor reported, followed by motivational readiness and self-efficacy. The influence of the reported differences in PA beliefs, barriers and facilitators between ethnic groups needs to be further understood to ensure the effectiveness of interventions aimed at increasing PA levels in both healthy populations and those with a long term health condition.

Since the planning and ethical approvals stage for the present research, a number of additional papers have been published concerning the barriers to PA that community-dwelling chronic stroke survivors encounter. These include review articles along with qualitative studies of British and Irish populations. Morris et al. (36) undertook a review of the literature investigating the influence of psychological and social factors on uptake and maintenance of PA after stroke. The review included 20 papers, half of which used qualitative methodologies, investigating participants in predominantly community-based settings. These studies included 1855 participants and methodological quality was generally good overall. The review found both psychological and social factors to be important in the uptake and maintenance of PA, with self-efficacy being of particular importance. The following table (Table 4), summarised from Morris et al. (35) lists the psychological and social factors which were found to be influential in their review.

**Table 4. Psychological and social factors influencing physical activity after stroke**

<table>
<thead>
<tr>
<th>Psychological factors</th>
<th>Social factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Self-efficacy</td>
<td>The role of:</td>
</tr>
<tr>
<td>Locus of control</td>
<td>- Family and friends in supporting PA after stroke</td>
</tr>
<tr>
<td>Competence to be physically active</td>
<td>- Health professionals</td>
</tr>
<tr>
<td>Motivational barriers</td>
<td>- Exercise professionals</td>
</tr>
<tr>
<td>Self-determination as a facilitator for PA</td>
<td>- Other people with stroke and disability</td>
</tr>
<tr>
<td>Beliefs about PA</td>
<td>- Group exercise</td>
</tr>
</tbody>
</table>

A systematic review of the perceived barriers and motivators to PA after stroke was undertaken by Nicholson et al. (3), considering physical and environmental barriers along with psychological and social factors. Six papers were included, two of which have been discussed previously (40, 148). Five of the included studies used qualitative
methodologies, which were reported to be strong. The review reported on data from 174 people who had had a stroke, 57% of whom were women and the average age of participants in the various studies ranged from 54.2 to 70.5 years. Four of the six studies were undertaken in the USA; the one study included in this review that was undertaken in the UK explored the barriers that people who have had a stroke report to re-engaging with valued activities, including physical activities (89). According to this review, the barriers most commonly reported were: environmental (access, transport, cost), stroke- and health-related barriers, embarrassment and fear of a further stroke. These authors also highlight the potential issues relating to a lack of clear definition of what is meant by PA amongst researchers, clinicians and people who have had a stroke alike.

A subsequent paper by Nicholson et al. (37) used a qualitative methodology to explore perceptions of people who have had a stroke relating to barriers and facilitators to PA. Thirteen participants (eight women and five men) who were mobile with or without an aid were recruited from a list of potential participants from a previous study, using computer-based random selection. Interviews to explore this topic were conducted in the home. The authors used the Theoretical Domains Framework (TDF) to investigate the influences of personal and environmental factors on PA behaviours. The TDF, originally described by Michie et al. (152), was developed through an expert consensus process as a model of behaviour change which incorporates the consideration of both personal and environmental contextual influence, as a basis for implementing health research. It consists of twelve domains thought to be able to explain behaviour change, which are shown in Table 5. Nicholson et al. (37) found that the most commonly reported domains in their investigation were ‘Beliefs about capabilities’, ‘Environmental context and resources’, and ‘Social influences’. The least commonly reported were lack of skills and difficulties with memory and attention. Self-efficacy was the construct reported most frequently and, when low, acted as a barrier to PA participation. Lack of personal or professional social interaction, influence and support were perceived as barriers to PA participation, along with lack of transport. This study reported that negative affect, manifesting as feelings of fatigue, pain, frustration and fear of falling was commonly identified as a barrier to PA. Lack of energy and the cost of programs were identified as barriers to being more physically active, whereas lack of motivation was not found to be an issue.

A later paper by Morris et al. (36) used a qualitative approach to investigate the contextual factors and perceptions that influence PA participation following stroke. One-to-one interviews were conducted with 38 people who had had a stroke, with equal numbers of males and females represented. The majority of participants (n=26)
Table 5. Theoretical domains framework (37)

<table>
<thead>
<tr>
<th>Knowledge</th>
<th>Behavioural regulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge</td>
<td>Goal/target setting</td>
</tr>
<tr>
<td>Knowledge about condition/scientific rationale</td>
<td>Action planning</td>
</tr>
<tr>
<td>Skills</td>
<td>Self-monitoring</td>
</tr>
<tr>
<td>Skills</td>
<td>Goal priority</td>
</tr>
<tr>
<td>Competence/ability/skill assessment</td>
<td>Generating alternatives</td>
</tr>
<tr>
<td>Practice/skills development</td>
<td>Feedback</td>
</tr>
<tr>
<td>Interpersonal skills</td>
<td>Moderators of intention-behaviour gap</td>
</tr>
<tr>
<td>Coping strategies</td>
<td>Project management</td>
</tr>
<tr>
<td></td>
<td>Barriers and facilitators</td>
</tr>
<tr>
<td>Social/professional role &amp; identity</td>
<td></td>
</tr>
<tr>
<td>Identity</td>
<td>Nature of behaviour</td>
</tr>
<tr>
<td>Professional identity/boundaries/role</td>
<td>Routine/automatic/habit</td>
</tr>
<tr>
<td>Group/social identity</td>
<td>Breaking habit</td>
</tr>
<tr>
<td>Social/group norms</td>
<td>Direct experience/past behaviour</td>
</tr>
<tr>
<td>Alienation/organisational commitment</td>
<td>Representation of tasks</td>
</tr>
<tr>
<td></td>
<td>Stages of change model</td>
</tr>
<tr>
<td>Emotion</td>
<td></td>
</tr>
<tr>
<td>Affect</td>
<td>Motivation &amp; goals</td>
</tr>
<tr>
<td>Stress</td>
<td>Intention; stability of intention/certainty of intention</td>
</tr>
<tr>
<td>Anticipated regret</td>
<td>Goals (autonomous, controlled)</td>
</tr>
<tr>
<td>Fear</td>
<td>Goal target/setting</td>
</tr>
<tr>
<td>Burn-out</td>
<td>Goal priority</td>
</tr>
<tr>
<td>Cognitive overload/tiredness</td>
<td>Intrinsic motivation</td>
</tr>
<tr>
<td>Threat</td>
<td>Commitment</td>
</tr>
<tr>
<td>Positive/negative affect</td>
<td>Distal and proximal goals</td>
</tr>
<tr>
<td>Anxiety/depression</td>
<td>Transtheoretical model and stages of change</td>
</tr>
<tr>
<td>Memory, attention &amp; decision processes</td>
<td></td>
</tr>
<tr>
<td>Memory</td>
<td>Environmental context &amp; resources</td>
</tr>
<tr>
<td>Attention</td>
<td>Resources/material resources (availability and management)</td>
</tr>
<tr>
<td>Attention control</td>
<td>Environmental stressors</td>
</tr>
<tr>
<td>Decision making</td>
<td>Person/environment interaction</td>
</tr>
<tr>
<td></td>
<td>Knowledge of task environment</td>
</tr>
<tr>
<td>Social influences</td>
<td></td>
</tr>
<tr>
<td>Social support</td>
<td>Beliefs about consequences</td>
</tr>
<tr>
<td>Organisational development</td>
<td>Outcome expectancies</td>
</tr>
<tr>
<td>Leadership</td>
<td>Anticipated regret</td>
</tr>
<tr>
<td>Teamworking</td>
<td>Appraisal/evaluation/review</td>
</tr>
<tr>
<td>Group conformity</td>
<td>Consequents</td>
</tr>
<tr>
<td>Organisation climate/culture</td>
<td>Attitudes</td>
</tr>
<tr>
<td>Social pressure</td>
<td>Contingencies</td>
</tr>
<tr>
<td>Power/hierarchy</td>
<td>Reinforcement/punishment/consequences</td>
</tr>
<tr>
<td>Professional boundaries/roles</td>
<td>Incentives/rewards</td>
</tr>
<tr>
<td>Management commitment</td>
<td>Beliefs</td>
</tr>
<tr>
<td>Supervision</td>
<td>Unrealistic optimism</td>
</tr>
<tr>
<td>Inter-group conflict</td>
<td>Salient events/sensitisation/critical incidents</td>
</tr>
<tr>
<td>Champions</td>
<td>Characteristics of outcome expectancies –</td>
</tr>
<tr>
<td>Social comparisons</td>
<td>physical, social, emotional; sanctions/rewards,</td>
</tr>
<tr>
<td>Identity; group/social identity</td>
<td>proximal/distal, valued/not valued,</td>
</tr>
<tr>
<td>Organisational commitment/alienation</td>
<td>probably/improbable, salient/not salient,</td>
</tr>
<tr>
<td>Feedback</td>
<td>perceived risk/threat</td>
</tr>
<tr>
<td>Conflict – competing demands, conflicting roles</td>
<td></td>
</tr>
<tr>
<td>Change management</td>
<td></td>
</tr>
<tr>
<td>Crew resource management</td>
<td></td>
</tr>
<tr>
<td>Negotiation</td>
<td></td>
</tr>
<tr>
<td>Social support; personal/professional/organisation,</td>
<td></td>
</tr>
<tr>
<td>intra/inter-personal, society/community</td>
<td></td>
</tr>
<tr>
<td>Social/group norms; subjective, descriptive,</td>
<td></td>
</tr>
<tr>
<td>injunctive norms</td>
<td></td>
</tr>
<tr>
<td>Learning and modelling</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Beliefs about capabilities</td>
</tr>
<tr>
<td></td>
<td>Self-efficacy</td>
</tr>
<tr>
<td></td>
<td>Control – of behaviour and material and social</td>
</tr>
<tr>
<td></td>
<td>environment</td>
</tr>
<tr>
<td></td>
<td>Perceived competence</td>
</tr>
<tr>
<td></td>
<td>Self-confidence/professional confidence</td>
</tr>
<tr>
<td></td>
<td>Empowerment</td>
</tr>
<tr>
<td></td>
<td>Self-esteem</td>
</tr>
<tr>
<td></td>
<td>Perceived behavioural control</td>
</tr>
<tr>
<td></td>
<td>Optimism/pessimism</td>
</tr>
</tbody>
</table>
were aged between 61 and 80, with four participants aged over 80. All participants were over six months post-stroke. Purposive sampling was used to optimise variation between participants, who were selected from records which were available to community stroke liaison nurses. Factors such as knowledge, beliefs and experience of PA were found to influence participants’ perceptions relating to its importance and the potential benefits resulting from PA, along with their self-efficacy for PA. Social and environmental factors such as support, transport and weather were also found to be influential on their PA participation.

A focus group process was used by Lennon et al. (46) to explore the barriers that people who live in the community post-stroke encountered to adopting healthy lifestyles, including engaging in PA. Participants were volunteers from stroke support services in Dublin, who were selected using purposive sampling to ensure representation of lower socioeconomic groups, women, and older adults. Four groups of five to six participants were held. In keeping with previous research, subjects reported that a range of personal and environmental barriers existed to PA. These included stroke-related disability, reduced balance, fear of falling, fatigue, pain, poor motivation, self-efficacy and confidence, and a lack of social support and control over their activities. A lack of knowledge of how to adapt PA to accommodate for their disability was also identified. Environmental barriers included uneven pavements and windy weather conditions and gyms were viewed unfavourably, particularly by younger females. This is significant in light of the development of gym-based programs for people who have had a stroke, which have been evaluated in the literature in recent years (153, 154).

To the author’s knowledge, there have been no studies undertaken in England that explore the barriers to engaging in PA reported by people living in the community following stroke. Evidence suggests that measures of population health such as life expectancy vary both within England and the UK as a whole, with life expectancy for both women and men higher in England than in Wales, Northern Ireland and Scotland (155). Furthermore, premature deaths from cardiovascular disease are higher in Northern Ireland than the south of England, and higher still in Wales and Scotland (156). Data published by the Stroke Association in 2015 show that the percentage of the population who have had a stroke is 1.74% for England, 1.79% for Northern Ireland, 2.02% for Wales and 2.16% for Scotland (157). It is clear that regional differences exist in terms of health outcomes and inequalities within the UK. Further large multi-centre studies investigating the barriers to engaging in PA reported by people living with stroke in communities within the UK are necessary to examine any
regional differences and to help inform the development of programs to address this issue.

In summary, stroke is a leading cause of death and disability worldwide. Despite the clear evidence in support of PA for reduction of stroke risk and improvements in health and wellbeing in both people who have had a stroke and healthy populations, inactivity and sedentary behaviours continue to be a global problem. In populations without neurological conditions, even relatively small increases in PA have been shown to be associated with significant improvements in health and risk factors, with a number of studies demonstrating that the greatest benefit was seen in sedentary individuals adopting small amounts of activity (10, 23, 51). However, evidence suggests that the message in support of increased PA is failing to reach these populations, with stroke survivors demonstrated to be a particularly inactive and deconditioned group.

Taken together, the literature suggests that the barriers to PA which people who have had a stroke encounter are multifactorial and occur due to the combination of individual, interpersonal and environmental factors. These include level of disability, factors such as self-efficacy, and socioeconomic status and social context, which contribute to, and interact with, beliefs about and behaviours relating to PA. It is likely that public health policies and programs aiming to increase PA participation will need to be modified for neurologically impaired populations. Much of the research investigating PA levels and barriers to PA participation in people who have had a stroke has been undertaken in predominantly urban ethnic minority populations in the USA, whose experience may not be representative of people living with stroke in the UK. In recent years, studies undertaken in Scotland and Ireland have emerged, however to the author’s knowledge, this is the first study investigating the barriers to PA participation reported by people who have had a stroke and who live in the community in England, and which has made a clear delineation between ‘physical activity’ and ‘exercise’. This is important because those who are most severely deconditioned may be able to benefit from, and more easily adhere to, simply increasing daily PA levels, at least as a starting point for health gain (24, 108). Increased understanding of the barriers to engagement in PA following stroke is important both at a local level, to support the commissioning of targeted services, but may also be useful to inform programs targeting similar demographics in other areas of England. This study aims to contribute to the growing body of literature exploring the barriers that people living in the community with stroke encounter to being active. Despite strong evidence supporting the benefits of PA following stroke, numerous studies have found that stroke survivors are often particularly inactive and deconditioned, thus an improved understanding of the factors that influence PA behaviours after stroke is imperative. Furthermore,
increased understanding of the interaction between personal, interpersonal, environmental factors, and how they impact on PA behaviours and perceived barriers to PA, has the potential to enhance the success of interventions aimed at improving PA levels in order to improve the health, community participation and quality of life of people who have had a stroke.

This research addressed the following questions:

1. What personal, interpersonal and environmental barriers to participation in PA do people who have had a stroke, who live in the south of England, and who are between six months and five years post-stroke report, and are they broadly similar or different to those described in related studies from the USA, Scotland and Ireland?

2. What proportion of the study population who have had a stroke, who live in the south of England and who are between six months and five years post-stroke, meet ACSM PA recommendations?

3. What is the influence of factors such as age, gender, level of physical function, fear of falling, beliefs regarding PA, available supports and socioeconomic status on self-reported PA levels post-stroke?

Chapter 3 – Methods

3.1 Study design
This research used a mixed methods design; both quantitative and qualitative data were collected.

Phase 1 of the study utilised a customised questionnaire, based on existing tools, designed to determine self-reported PA beliefs, behaviours and barriers amongst a group of community-dwelling people who had had a stroke. The questionnaire also collected demographic and socioeconomic data along with self-reported level of physical activity and functioning. Phase 2 utilised a series of focus groups to further explore the knowledge, opinions and attitudes to PA of a group of people living in the community after stroke. This quantitative/qualitative approach was utilised to allow more in-depth discussion using focus groups of the factors influencing PA participation that were highlighted in returned questionnaires.

3.2 Phase 1 – Questionnaire
Questionnaire survey of community based people who had had a stroke.
3.2.1 Survey development

The questionnaire tool (Appendix 1) utilised was developed specifically for this research, as no other suitable tool was identified after an extensive literature search. The main purpose of the expanded survey was to capture data related to the combined domains of: beliefs about PA, current levels of PA post-stroke and factors influencing current PA, along with self-reported barriers to being more physically active. A 4-point Likert scale was used to determine whether participants agreed or disagreed with various statements relating to their PA behaviours, beliefs, and self-reported barriers. This allowed data to be dichotomized. To capture PA levels, the following descriptions were used:

- **Low-intensity** – You would not feel short of breath doing the activity.
- **Moderate-intensity** – You would feel a little short of breath doing the activity. You would still be able to carry on with a conversation.
- **High-intensity** – You would feel short of breath doing the activity. You would not be able to speak full sentences.

Level of functional mobility was captured by asking participants to indicate their ability against a series of descriptors, and to provide an estimate of the distance that they could walk both indoors and outdoors. Lord et al. (158) have defined community ambulation as “independent mobility outside the home, which includes the ability to confidently negotiate uneven terrain, private venues, shopping centres and other public venues” (152: p236). For the purposes of this research, the ability to walk 200 metres or more was assumed to be sufficient to be able to access the community. It is acknowledged that inferring a link between being able to walk 200 metres and being able to undertake the more complex activities suggested by the term ‘community ambulatory’ means that this definition can only be used as an estimate of actual ability.

The written survey drew on elements of the questionnaires used in previous studies identifying the barriers which people who have had a stroke have previously reported to exercising. These include the Barriers to Physical Activity and Disability Survey (148), the Barriers to Being Active Quiz (21), and the Short Self-Efficacy for Exercise Scale and the Short Outcome Expectation Scale used by Shaughnessy et al (39). These questionnaires focused on factors influencing exercise behaviours as opposed to the broader domain of ‘physical activity’ that was the focus of the present research. As such, questions from these surveys were modified to reflect the focus of the present study on ‘physical activity’. According to the Theory of Planned Behaviour (TPB), human behaviour is determined by *behavioural beliefs, normative beliefs and control beliefs* (136). Behavioural beliefs are defined as beliefs relating to the likely
consequences of the behaviour in question. Normative beliefs are beliefs about the normative expectations of others, while control beliefs are beliefs about the existence of factors that may act as barriers or facilitators to performance of the behaviour. The TPB was used as a framework for the questions used to explore the design of the questionnaire to facilitate the exploration of the beliefs and attitudes of participants towards PA, and any relationship these factors may have with demographic variables and self-reported PA levels. The co-ordinating supervisor of the project provided guidance and feedback in the development phase and the questionnaire was reviewed by a group of experienced neurological physiotherapists along with eight volunteers from local stroke clubs before being finalised. Suggested adaptations related predominantly to reader accessibility, with the most significant adaptation being the addition of a paragraph explaining why information regarding household income was sought. It was suggested that this additional explanation may encourage more respondents to provide this information. The questionnaire was also reviewed by the NHS National Research Ethics Service, which is responsible for ethical review for all research undertaken in the NHS (see Appendix 4), along with the University of Western Australia’s Human Research Ethics Committee (see Appendix 5). No changes to the proposed questionnaire were requested by either ethical review body.

3.2.2 Survey Procedures
Convenience sampling was used with potential participants identified using databases of patients admitted to the acute and community trusts locally. Lists from acute services were provided to the principal researcher by the Sentinel Stroke National Audit Program (SSNAP) Co-ordinator at St. Richard’s Hospital and the Band 7 neuro-physiotherapist at Worthing Hospital; these individuals were not otherwise involved in this research. A list of potential participants was also identified by the community therapy service covering patients discharged from St. Richard’s Hospital. Invitations to participate were mailed to individuals identified through these methods. Community neuro-physiotherapists in Worthing and Brighton were provided with a copy of the inclusion and exclusion criteria along with study packs to hand out to potential participants they saw in the course of their work. A number of private neuro-physiotherapists also assisted recruitment in this way, and fliers were put up in the waiting area of the different practice sites of one local private neuro-therapy organisation. It was made clear to potential participants that involvement in the study was entirely voluntary and the care that they received would not be altered by their decision to participate or not. The principal researcher also visited local stroke groups and invited members to participate.
Potential participants were provided with a study pack which included an invitation letter, participant information leaflet (Appendix 2), the questionnaire and a stamped self-addressed envelope for the return of completed questionnaires. The contact details of the principal researcher were included in the study pack to allow anyone requiring any further information to contact the researcher by phone or email to clarify any questions before deciding to participate. The packs also contained a reply slip for individuals interested in participating in the focus groups to provide their contact details.

The questionnaire was designed to take approximately 20 minutes to complete and participants were permitted to be assisted by a family-member or carer if necessary. Consent was inferred by the decision to return the completed questionnaire, using the stamped self-addressed envelopes provided in the study packs.

3.2.3 Participants
For inclusion into this study, participants were required to be: over 55 years of age, able to communicate in English, living in a community setting, at least six months and not more than five years post-stroke and able to provide informed consent. They were also required to have sufficient memory, cognitive and communication abilities to write or dictate responses to questions in a questionnaire relating to their PA behaviours, and perceived barriers to undertaking PA. This was inferred by completion of the questionnaire, with focus group volunteers contacted by telephone to confirm communication abilities and informally ascertain cognitive abilities through conversation and developing plans for the proposed focus groups.

3.2.4 Sample size estimation
While it was not possible to use a statistical power calculation to determine optimal sample size for this study, a sample of 80 has been suggested as the minimum acceptable to achieve a moderate effect size for studies based on the Theory of Planned Behaviour, using multiple regression analyses (136, 159). Furthermore, other similar studies have reported on study populations ranging from 20 to 312 participants (21, 39, 148). Consequently the target of 100 completed questionnaires was set, representing an achievable middle ground. In order to achieve this response rate, it was anticipated that 300 study packs would need to be given out.

3.2.5 Data management and analysis
Questionnaires were numbered to allow tracking and accurate response rate reporting, and returned questionnaires were dated on the day of receipt by the principal researcher. Demographic data were extracted and used to describe the sample population. Quantitative responses such as reported duration, frequency and intensity of current PA participation and the type and frequency of reported barriers were
tabulated, and are reported as percentages. Quantitative data were analysed using SPSS version 19. Spearman's rank correlation coefficient (Spearman's Rho) was used to explore associations between self-reported PA and the following variables: age, gender, level of physical function, fear of falling, beliefs regarding PA, available supports and socioeconomic status. To allow statistical analysis, functional mobility status was determined using data elicited from question 7 on the questionnaire, which relates to level of independence and distance able to mobilise. Participants were allocated to the following functional mobility categories: wheelchair-bound, household ambulatory, or community ambulatory. For all statistical tests a probability of p<0.05 was adopted as the criteria representing meaningful differences. For all tests of association, the strength of correlations were defined as: 0–0.3 weak, 0.4–0.6 moderate and >0.6 strong (160). Qualitative data were extracted from the questionnaires regarding beliefs relating to PA and the type and frequency of reported barriers; these were used to inform subsequent focus group discussion topics. Planned analyses of relationship data were undertaken using Spearman's rank correlation coefficient (Spearman's Rho) and Chi-Square tests for non-parametric categorical data. Raw questionnaire data can be found in Appendix 6. The Cronbach alpha score for the ‘Barriers’ section of the questionnaire was 0.696.

3.3 Phase 2 - Focus groups

Focus group discussions were used to complement the data obtained by the self-report questionnaire with the aim of capturing information from a greater number of participants than could be achieved by a series of one-to-one interviews, within the resources available to this research. Although the questionnaire included open-ended questions and space for participants to elaborate on their views relating to this topic, this opportunity was taken up infrequently, and the focus groups provided the opportunity for a small number of participants to discuss their views, particularly relating to the barriers to participating in PA, in greater detail. Initial analysis of questionnaire data suggested that participants experienced a range of personal, interpersonal and environmental barriers to PA and had varying levels of knowledge relating to the benefits of PA and how to increase their PA levels. This information informed to development of focus group prompts to explore participants’ beliefs, knowledge and experience relating to PA, along with any barriers and enablers for PA participation. Focus group prompts were also developed with reference to the TDF domains, to ensure that questions were asked across the areas covered by the TDF in order to gain detailed information relating to the personal, interpersonal and environmental barriers to engaging in PA reported by the sample population. Data from focus groups provided a rich source of information about the knowledge and
beliefs about PA as well as the barriers and facilitators that were experienced by people who were living in the community post-stroke when seeking to engage in PA.

3.3.1 Procedures
Participants were provided with information regarding the focus groups prior to, and again at the time of, the focus groups and written informed consent was obtained prior to the commencement of the focus groups. According to the requirements of the sponsoring body (Sussex NHS Research Consortium), focus groups were held in wheelchair-accessible rooms at St. Richard’s Hospital, Worthing Hospital and Bognor Regis War Memorial Hospital. Light refreshments were provided and participants were provided with travel expenses reimbursement of up to £10. The focus groups were semi-structured using a series of questions (Appendix 3) to guide discussions and they were facilitated by the principal researcher, who was not known to participants.

Michie et al. (152) argue the importance of applying psychological explanations of behaviour change in implementation research, rather than models that simply predict behaviour. The TDF, developed by Michie and colleagues (150) was used as a framework to develop the semi-structured prompts for the focus group discussions in the present research, both as a means of understanding the factors that may influence behaviour and behaviour change in the participants, and with the aim to provide data useful for future implementation research. The TDF encompasses a range of factors across personal, interpersonal and environmental domains, which are thought to influence human behaviour. It acts as a classification system, contrasting with other qualitative research methods which take an inductive approach. The TDF was previously used by Nicholson et al. (37) to explore perceived barriers and facilitators to PA post-stroke in a series of one-to-one interviews with 13 participants in Scotland. For the present study, excerpts from the focus group data were allocated to relevant TDF domains to gain a broad understanding of the factors influencing the PA behaviours of the participants. The principal researcher facilitated the focus groups, ensuring that all participants had the opportunity to share their ideas. Discussion points were paraphrased and summarised to confirm agreement and to tease out any areas of disagreement. Discussions were audio-recorded and transcribed verbatim to allow thematic coding of transcripts to be undertaken. Notes were also taken during the discussions by the local project supervisor, a physiotherapist with research experience. The local project supervisor did not participate in discussions, and provided feedback regarding the group facilitation to the principal researcher after each focus group. Following the first focus group, and after discussion with the co-ordinating supervisor, minor changes were made to two questions relating to enablers of PA, to improve
clarity. The focus groups generally lasted about two hours with a break midway. Participants were encouraged to indicate if they needed additional rest breaks.

### 3.3.2 Participants

Convenience sampling was used for focus group participants. Survey participants interested in taking part in the focus groups returned a completed reply slip containing their contact details in the stamped self-addressed envelope provided with the initial survey. Participants who had indicated they had no residual physical deficits on their returned questionnaire were excluded from consideration for participation in the focus groups. Volunteers were contacted by phone to determine a mutually suitable time for the focus group to be conducted. This allowed the principal researcher to ascertain the language capabilities of volunteers and whether they would attend with a carer. Carers were permitted to assist individuals with expressive language impairments but were otherwise requested to allow them to contribute to and direct the discussion. Figure 2 demonstrates the number of participants in each of the focus groups.

For the Chichester focus group, two women and a man who volunteered were excluded since they reported on their questionnaires that they experienced no residual deficits following their stroke. Two volunteers were not able to attend on the allocated day and one volunteer was excluded as they did not complete the questionnaire. No participants were excluded from the Bognor Regis group, however one volunteer who had agreed to come, was unable to do so on the agreed day. Two volunteers were excluded from the Worthing group. One reported no residual deficits and the other reported that he had experienced a head injury prior to his stroke.

---

**Figure 2. Focus group participants for each study location**

- **Chichester**:
  - N = 10
  - Excluded N = 6
  - Took part N = 4

- **Bognor Regis**:
  - N = 5
  - Excluded N = 0
  - Took part N = 4

- **Worthing**:
  - N = 6
  - Excluded N = 2
  - Took part N = 4
3.3.3 Sample size estimation
The decision to hold three focus groups of four to five participants was taken based on work by Francis et al. (161). These authors suggest that a sample size of 13 is sufficient to ensure that data saturation is reached in theory-based interview studies. Data were coded after the first two focus groups to determine the TDF domains and other themes emerging from the discussion. A third focus group was then undertaken. Since no further themes were identified, it can be concluded that data saturation had been reached.

3.3.4 Data management and analysis
Audio recordings of focus groups were transcribed verbatim and the transcripts read in their entirety by the principal researcher and the co-ordinating supervisor. Content analysis was performed by coding the interview transcripts to the TDF (see Table 5). The TDF was adopted as the guiding framework for this component of the research after an extensive review of behavioural theories, to incorporate a range of individual, interpersonal and environmental influences on behaviour. Statements contained in the transcripts were assigned to one or more of these domains by two researchers (SJ and BS) by comparing the statements to the constructs that form each domain. Statements assigned to each domain were coded to the individual participant to allow identification of similarities and differences in responses within and between participants. The nature and frequency of reported barriers and enablers to participation in PA were recorded.

During the study, contact details were kept for those participants who provided them for the purposes of participation in the focus groups, dissemination of study results, or providing information relating to physical activity to those who requested it. These details were kept on a password-protected PC. Research data generated by the study were stored within a lockable filing cabinet, in a locked office at St. Richard’s Hospital and were only accessible only to the principal researcher. All electronic data were stored on a password-protected PC. All data obtained for this research, including direct quotes, were anonymised. Following the conclusion of the study, evidence of valid consent was retained for the researchers’ records, however no other personal data was kept.

Ethics approval was received from the NHS Health Research Authority National Research Ethics Service Committee South East Coast – Brighton and Sussex (approval number - 13/LO/1870, Appendix 4) and the Human Research Ethics committee at the University of Western Australia (approval number - RA/4/1/6589, Appendix 5).
Chapter 4 – Results

The main aims of this research were to better understand the barriers to PA participation reported by a group of people who had had a stroke living in the south of England, using questionnaires and focus groups, and to compare reported barriers to those described in others studies undertaken in Scotland, Ireland and the USA. In addition, data on self-reported levels of PA were collected to determine if participants undertook the recommended amount of weekly PA. This study also sought to determine the association between self-reported PA and various demographic factors and beliefs and barriers relating to PA.

4.1 Questionnaires
A total of 322 questionnaires were distributed and 76 questionnaires were returned, representing a 23.6% response rate.

4.1.1 Sample characteristics
Characteristics of the study sample are described in Tables 6 and 7, which demonstrate that participants in this study were broadly representative of stroke survivors in the UK in terms of age and gender. The vast majority of respondents who disclosed their ethnicity identified as White British (85.5%), with 11.8% preferring not to report this. Approximately a fifth of respondents preferred to not disclose their combined annual household income and there were significant missing data for the education question.

4.1.2 Self-reported physical activity levels
Data relating to self-reported PA levels and sedentary behaviour are shown in Table 8. When PA data in Table 8 were dichotomised, results showed that 35 participants (46%) reported that they met the recommended amount of PA through moderate-intensity PA and 7 respondents (9.2%) reported they met the PA guidelines through high-intensity PA. Forty-four participants (75.9%) reported that they undertake low-intensity PA every day. The question with the most missing responses related to engagement in high-intensity PA (Table 8).

4.2.2.1 Physical activity preferences
The majority of participants indicated that they would like to increase the amount of PA that they undertake, however there were more varied responses with regard to whether they would want to undertake such activity with others who had had a stroke (Figure 3).
Table 6. Demographic characteristics of the survey cohort

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category</th>
<th>Frequency</th>
<th>Total missing data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>Mean</td>
<td>74.97</td>
<td>7 (10.1%)</td>
</tr>
<tr>
<td>Gender</td>
<td>Males</td>
<td>42 (55.3%)</td>
<td>3 (3.9%)</td>
</tr>
<tr>
<td></td>
<td>Females</td>
<td>31 (40.8%)</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>White British</td>
<td>65 (85.5%)</td>
<td>9 (11.8%)</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>2 (2.6%)</td>
<td></td>
</tr>
<tr>
<td>Education</td>
<td>Secondary School</td>
<td>22</td>
<td>20 (26.3%)</td>
</tr>
<tr>
<td></td>
<td>Further education</td>
<td>27</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Higher education</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Income</td>
<td>&lt; £5000</td>
<td>6 (7.9%)</td>
<td>16 (21.1%)</td>
</tr>
<tr>
<td></td>
<td>£5000 - £10 000</td>
<td>9 (11.8%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>£10 000 - £15 000</td>
<td>13</td>
<td>(17.1%)</td>
</tr>
<tr>
<td></td>
<td>£15 000 - £20 000</td>
<td>7</td>
<td>(9.2%)</td>
</tr>
<tr>
<td></td>
<td>£20 000 - £25 000</td>
<td>11</td>
<td>(14.5%)</td>
</tr>
<tr>
<td></td>
<td>£25 000 - £30 000</td>
<td>5</td>
<td>(6.6%)</td>
</tr>
<tr>
<td></td>
<td>&gt; £30 000</td>
<td>9 (11.8%)</td>
<td></td>
</tr>
</tbody>
</table>

Table 7. Self-reported physical activity and sedentary behaviours

<table>
<thead>
<tr>
<th></th>
<th>High intensity*</th>
<th>Moderate intensity+</th>
<th>Low intensity ~</th>
<th>I often sit for &gt; 2 hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly disagree</td>
<td>44 (78.6%)</td>
<td>16 (24.6%)</td>
<td>7 (12.1%)</td>
<td>14 (19.2%)</td>
</tr>
<tr>
<td>Disagree</td>
<td>5 (8.9%)</td>
<td>14 (21.5%)</td>
<td>7 (12.1%)</td>
<td>13 (17.8%)</td>
</tr>
<tr>
<td>Agree</td>
<td>3 (5.4%)</td>
<td>9 (13.8%)</td>
<td>13 (22.4%)</td>
<td>22 (30.1%)</td>
</tr>
<tr>
<td>Strongly agree</td>
<td>4 (7.1%)</td>
<td>26 (40%)</td>
<td>31 (53.4%)</td>
<td>24 (32.9%)</td>
</tr>
<tr>
<td>Missing data</td>
<td>20 (26.3%)</td>
<td>11 (14.5%)</td>
<td>18 (23.7%)</td>
<td>3 (3.9%)</td>
</tr>
</tbody>
</table>

Table 8. Stroke characteristics of the survey cohort

<table>
<thead>
<tr>
<th>Variable</th>
<th>Category/Number</th>
<th>Frequency</th>
<th>Missing data</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 1 stroke</td>
<td>Yes</td>
<td>14 (18.4%)</td>
<td>2 (2.6%)</td>
</tr>
<tr>
<td></td>
<td>No</td>
<td>60 (78.9%)</td>
<td>2 (2.6%)</td>
</tr>
<tr>
<td>Time since stroke</td>
<td>6-11 months</td>
<td>21 (27.6%)</td>
<td>2 (2.6%)</td>
</tr>
<tr>
<td></td>
<td>12-23 months</td>
<td>32 (42.1%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>24-35 months</td>
<td>15 (19.7%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>36-60 months</td>
<td>6 (7.9%)</td>
<td></td>
</tr>
<tr>
<td>Side of body affected</td>
<td>Left</td>
<td>30 (39.5%)</td>
<td>10 (13.1%)</td>
</tr>
<tr>
<td></td>
<td>Right</td>
<td>31 (40.8%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Both sides</td>
<td>5 (6.6%)</td>
<td></td>
</tr>
<tr>
<td>Severity of impairment</td>
<td>Hemiplegia</td>
<td>36 (47.4%)</td>
<td>7 (9.2%)</td>
</tr>
<tr>
<td></td>
<td>Monoplegia (arm)</td>
<td>8 (10.5%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Monoplegia (leg)</td>
<td>6 (7.9%)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>No residual physical effects</td>
<td>19 (25%)</td>
<td></td>
</tr>
<tr>
<td>Community ambulator</td>
<td>45</td>
<td>59.2%</td>
<td>3 (3.9%)</td>
</tr>
<tr>
<td>Household ambulator</td>
<td>25</td>
<td>32.9%</td>
<td></td>
</tr>
<tr>
<td>Wheelchair bound</td>
<td>3</td>
<td>3.9%</td>
<td></td>
</tr>
</tbody>
</table>

Data for Table 8 taken from:
* Question 9. I do high-intensity PA for 20 minutes three times per week
+Question 10. I do moderate-intensity PA for at least 30 minutes on five days per week
~Question 11. I do low-intensity PA every day
4.1.3 Barriers to physical activity

4.1.3.1 Personal barriers

Questionnaire data related to personal barriers to PA are represented in Figure 4. Barriers including stroke-related disability, pain and fatigue were reported by more than a third of participants, with fear of falling being the most frequently reported personal barrier to PA, reported in 35 of 72 valid responses (48.6%). Spearman’s Rho correlations demonstrated a statistically significant negative relationship between fear of falling and self-reported moderate-intensity PA (Rho -0.308, p=0.014) and low-intensity PA (Rho -0.402, p=0.002). These results suggest that participants who experience fear of falling are less likely to engage in low- and moderate-intensity PA. A highly significant negative relationship was found between functional mobility level and fear of falling (Rho -0.644, p=0.000), with poorer function tending to be associated with greater fear of falling; a highly significant negative relationship was also found between functional mobility level and both self-reported low- and moderate-intensity PA (Rho 0.625, p=0.000 and Rho 0.458 p=0.000 respectively). These results indicate an expected relationship, that is, improved mobility tends to be linked to increased self-reported PA, with the relationship stronger for low-intensity PA. A significant negative relationship was seen between self-reported low-intensity PA and agreement with the statement ‘I often sit for more than 2 hours at a time’ (Rho -0.455, p=0.000). These results indicate that participants who sit more tend to undertake less low-intensity PA.
Figure 4a. Personal barriers to physical activity

- Pain prevents me from being more physically active
- I am too tired to be physically active
- I am too depressed to increase my physical activity levels
- I am afraid of falling
- I am embarrassed about how I look when I am being active
- I would feel comfortable exercising in a gym
I don’t know how to increase my physical activity levels

I can’t move around easily enough to be more physically active

I am not physically able to do things like gardening

I am not physically able to do any housework

I know how to exercise using gym equipment

Figure 4b. Personal barriers to physical activity
A statistically significant negative relationship was also found between self-reported low-intensity PA and the belief that increasing PA levels would not be health-improving (Rho -.337, p=0.013) or may cause another stroke (Rho -.305, p=0.035). The results indicate that the more participants held negative beliefs relating to PA, the less likely they were to engage in low-intensity PA. Relationships between PA and influential variables are shown in Figure 5. Questions relating to gyms and socioeconomic variables demonstrated a lower response rate amongst participants. No relationship was found between self-reported PA levels and income and a weak relationship was found between self-reported moderate-intensity PA and a greater level of education ($X^2=12.753, p=0.047$).

4.1.3.2 Interpersonal barriers

Questionnaire data for interpersonal barriers to PA are represented in Figure 6. Lack of social support was the most commonly interpersonal barrier to PA reported by this group (38.4%, n=25), followed by lack of transport (28%, n=19). It is worth noting that there was considerable missing data relating to questions on interpersonal barriers, particularly concerning gyms (see also Figure 7). A number of respondents indicated that they would have preferred the option to record ‘I don’t know’ for these questions. Correlational analysis demonstrated no relationships between self-reported PA and interpersonal barriers including social support, transport and knowledge of gym staff.

---

**Figure 5. Barriers associated with low-intensity physical activity**

4.1.3.2 Interpersonal barriers

Questionnaire data for interpersonal barriers to PA are represented in Figure 6. Lack of social support was the most commonly interpersonal barrier to PA reported by this group (38.4%, n=25), followed by lack of transport (28%, n=19). It is worth noting that there was considerable missing data relating to questions on interpersonal barriers, particularly concerning gyms (see also Figure 7). A number of respondents indicated that they would have preferred the option to record ‘I don’t know’ for these questions. Correlational analysis demonstrated no relationships between self-reported PA and interpersonal barriers including social support, transport and knowledge of gym staff.
4.1.3.3 Environmental barriers

Data for environmental barriers to PA are represented in Figure 7. The most frequently reported environmental barrier to PA reported by this group was inclement weather (41.6%, n=27). There were considerable missing data for the questions relating to knowledge of community-based programs and gym facilities. Correlational analysis demonstrated no relationship between self-reported PA and the availability and accessibility of community-based programs and facilities.
4.2 Focus groups

The aim of the focus groups was to expand on the information generated through the questionnaires. They were undertaken using a semi-structured format with questions to guide discussions exploring the knowledge and beliefs of participants relating to PA and to elicit information about their perceived barriers to PA (Appendix 3). Three focus groups were held, each with four participants (see Appendix 7 for consent forms). Focus groups were recorded and transcribed verbatim. Transcript content was categorised using the TDF (Appendix 8). Themes were identified, with no new themes emerging from focus group three, indicating data saturation was achieved. Results are reported using the twelve domains of the TDF with illustrative quotes from participants included.

Figure 7. Environmental barriers to physical activity
4.2.1 Focus group sample characteristics

Demographic details for the participants in the three focus groups are reported in Tables 9 to 11. All participants identified as White British. Two participants had mild aphasia but were able to communicate effectively within the group settings. All participants were ambulatory in the community except one, who was only ambulant indoors.

Table 9. Focus group 1 cohort characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Participant 2</th>
<th>Participant 3</th>
<th>Participant 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>67</td>
<td>55</td>
<td>71</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Male</td>
<td>Male</td>
</tr>
<tr>
<td>Stroke chronicity (months)</td>
<td>24 – 35</td>
<td>24 – 35</td>
<td>24 – 35</td>
</tr>
<tr>
<td>Side affected</td>
<td>Right</td>
<td>Right</td>
<td>Right</td>
</tr>
<tr>
<td>Type of stroke</td>
<td>Haemorrhage</td>
<td>Infarct</td>
<td>Infarct</td>
</tr>
<tr>
<td>Lives with</td>
<td>Husband</td>
<td>Wife</td>
<td>Wife</td>
</tr>
<tr>
<td>Education*</td>
<td>Higher</td>
<td>Higher</td>
<td>Higher</td>
</tr>
<tr>
<td>Income</td>
<td>£25 000 –</td>
<td>£30 000 –</td>
<td>£20 000 –</td>
</tr>
<tr>
<td></td>
<td>£30 000 –</td>
<td>£35 000 –</td>
<td>£20 000 –</td>
</tr>
</tbody>
</table>

*SS – Secondary school; Further education - eg. Diploma; Higher education - Bachelor’s Degree or above.

Table 10. Focus group 2 cohort characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Participant 2</th>
<th>Participant 3</th>
<th>Participant 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>64</td>
<td>79</td>
<td>67</td>
</tr>
<tr>
<td>Gender</td>
<td>Male</td>
<td>Female</td>
<td>Male</td>
</tr>
<tr>
<td>Stroke chronicity (months)</td>
<td>6 – 11</td>
<td>12 – 23</td>
<td>24 – 35</td>
</tr>
<tr>
<td>Side affected</td>
<td>Right</td>
<td>Right</td>
<td>Right</td>
</tr>
<tr>
<td>Type of stroke</td>
<td>Haemorrhage</td>
<td>Haemorrhage</td>
<td>Infarct</td>
</tr>
<tr>
<td>Lives with</td>
<td>Wife</td>
<td>Husband</td>
<td>Wife</td>
</tr>
<tr>
<td>Education*</td>
<td>SS</td>
<td>Further</td>
<td>Higher</td>
</tr>
<tr>
<td>Income</td>
<td>Not disclosed</td>
<td>£5000 –</td>
<td>over £35 000</td>
</tr>
<tr>
<td></td>
<td></td>
<td>£10 000</td>
<td></td>
</tr>
</tbody>
</table>

*SS – Secondary school; Further education - eg. Diploma; Higher education - Bachelor’s Degree or above.

Table 11. Focus group 3 cohort characteristics

<table>
<thead>
<tr>
<th>Participant</th>
<th>Participant 2</th>
<th>Participant 3</th>
<th>Participant 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>80</td>
<td>76</td>
<td>69</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>Female</td>
<td>Female</td>
</tr>
<tr>
<td>Stroke chronicity (months)</td>
<td>6 – 11</td>
<td>12 – 23</td>
<td>12 – 23</td>
</tr>
<tr>
<td>Side affected</td>
<td>Left</td>
<td>Left</td>
<td>Right</td>
</tr>
<tr>
<td>Type of stroke</td>
<td>Not known</td>
<td>Infarct</td>
<td>Haemorrhage</td>
</tr>
<tr>
<td>Lives with</td>
<td>Alone</td>
<td>Son</td>
<td>Alone</td>
</tr>
<tr>
<td>Education*</td>
<td>Higher</td>
<td>SS</td>
<td>SS</td>
</tr>
<tr>
<td>Income</td>
<td>£5000 –</td>
<td>over £35 000</td>
<td>£5000 –</td>
</tr>
<tr>
<td></td>
<td>£10 000</td>
<td></td>
<td>£10 000</td>
</tr>
</tbody>
</table>

*SS – Secondary school; Further education - eg. Diploma; Higher education - Bachelor’s Degree or above.
4.2.2 Thematic coding - Theoretical Domains Framework
The focus groups provided data for all twelve of the TDF domains. Discussion content was most frequently linked to the 'Motivation and goals' domain, closely followed by the domain 'Environmental context and resources'. The next two most frequently discussed domains were 'Skills' and 'Beliefs about capabilities', however this was not uniform across the focus groups. Focus group 1 discussed 'Skills' a great deal more than did the other two groups and focus group 2 discussed 'Beliefs about capabilities' much more than did the other groups. The next most frequently discussed domain was 'Emotion', however this was discussed much less frequently than the top four domains. The least frequently discussed domain was 'Memory, attention and decision processes'. When text was coded as either a barrier or enabler of PA, the domain most frequently represented for barriers to PA was 'Environmental context and resources', closely followed by 'Skills'. The next two most frequently represented domains were 'Beliefs about capabilities' and 'Emotion'. For barriers discussed by this group, the two most infrequently represented domains were 'Memory, attention and decision processes' and 'Knowledge'.

4.2.2.1 Motivation and goals
The domain ‘Motivation and goals’ refers to the factors that drive individuals to be active, and was highlighted by participants as both a barrier and an enabler for PA. Poor motivation was a barrier to PA participation for some focus group members despite knowledge of its importance. Although potentially exacerbated by the stroke, reduced motivation was not necessarily seen to be something caused by it, but as an expression of pre-stroke behaviours.

*I think what I find, I find it’s difficult to set aside any time to actually go and walk somewhere. Like you were saying earlier, the time disappears and... and you think - that’s a day gone already and I really should have spent half an hour just walking somewhere, just to do something physical... because I’m, I’m lucky because I can be physically active and I can move around, but it’s easy to get back into the old habits of not bothering to exercise.* [Male, aged 55]

Along with exercise, PA was seen as an avenue to increased independence, fuelled by 'determination' and 'willpower', along with comparisons to others who were perceived to be more impaired. Nonetheless, even for participants who reported being fairly active, maintaining motivation was an ongoing challenge.

*I think “must do the garden today” ... “oh, I’ll do it in a minute” ... “oh, I’ll have a cup of tea” ... “oh, I’ll do it tomorrow”. And I’m lacklustre as it were. I never used
to be like this. And it upsets me, I’m a physical man. I would go out and I’d do the garden, clean the windows, it wouldn’t worry me, do the decorating. But now I get frustrated, upset with myself. [Male, aged 64]

Pets along with supportive networks of family and friends provided external motivation for participants, who expressed goals around returning to, or increasing, participation in valued leisure activities including gardening and walking.

Yeah I think it’s important [PA], and I’ve got a dog. You have to go out. My wife is always saying y’know you must keep active. She’s the one behind me (laughs). [Male, aged 69]

And in a sense, the um, the ah, I mean, I’m sure for me, I think when I analyse the incentives um the incentive of um working at improvement was not simply for myself but for those near and dear to me. [Male, aged 71]

4.2.2.2 Environmental context and resources

Barriers identified in this domain include the physical environment in which to be active and the resources available to support such behaviour. Knowledge of available community-based supports and programs such as exercise classes and walking groups varied amongst participants and some participants expressed that they would not be interested in such programs in any case. This is similar to the results from the questionnaire illustrated in Figure 3. Participants reported using the internet along with community and leisure centres and GP surgeries as sources of information. Inclement weather including windy, rainy or icy conditions was reported as a barrier for some participants and poorly maintained pavements were highlighted as reducing the safety of walking in the local environment.

If I am walking out then I do get worried that I’m going to fall, but then again the pavements are so awful, I’m looking down the whole time, which you shouldn’t do, you should walk upright – I know the exercise says you should be upright. [Female, aged 76]

I’d be much more careful now of going out in icy weather, simply for the quandary of balance... [Male, aged 71]

Well it’s the weather I think, I don’t like the weather. It’s not I feel cold...but when the weather’s wet and windy. When it’s cold it’s alright, but when it’s windy it’s horrible. [Male, aged 69]
Support provided by health professionals such as physiotherapists was perceived to be useful in facilitating engagement in PA, although participants perceived that resources were lacking meaning that input was insufficient and halted prematurely.

*I think thanks to the good Physios and OTs, I went quite quickly.*

[Male, aged 67]

*I think it was 6 weeks I came; it all sort of, kind of disappeared after that, and...although I was determined...ah, to do what I could for myself...It's all down to money. There's not enough money in the system.* [Male, aged 55]

### 4.2.2.3 Skills

'Skills' refers to the individual’s assessment of their skills and abilities, and their coping strategies. Lack of physical skills and abilities to be able to undertake PA was reported by a number of participants, and support from family members was often required to make it possible. The inability to drive for some participants was linked to a reliance on others to get around and access PA opportunities, and this lack of independence was frustrating for some.

*One of the things I go to is aqua gym, because that is really good for me, to go swimming, but I cannot dry myself properly...I can walk that, it takes about 40 minutes to walk, um, but, I have to have my husband pick me up cause I cannot dry myself properly.* [Female, aged 67]

*I thoroughly enjoyed my yoga but I can’t do that now, it’s out of the question. I can’t drive to it, so...* [Female, aged 75]

Poor balance emerged as a theme throughout all three focus groups and was linked to fear of falling, which in turn resulted in behavioural adaptations to minimise the risk of falls, for example using walking aids when walking outdoors.

*Do you find that you can walk in the house alright, but you go out and it’s wide, there’s no wall to suddenly touch? I mean I can walk in the house without a walker, but I can’t go out without it. Y’know, I would be lost.* [Female, aged 80]

*I would also say you need balance too...to move on. There are a lot of things that I want to do....but I want to get my balance is....at the top. You have to want to do things first...first, the will...the want...but then, for me, it is the balance, and then...I can move on.* [Female, aged 67]
And you know, I find I have to think about balance, where I probably never did before. [Male, aged 71]

I can’t play golf anymore, because my balance is upset. And I can’t ride my bike anymore which I used to every weekend. [Male, aged 67]

Poor upper limb function was also discussed as a barrier to PA in that many day-to-day PA tasks that may be undertaken such as, cooking, housework and gardening are largely bimanual.

I find the most frustrating thing is this hand, you know I mean I can do all that and everything else, but I can’t use it properly. I can’t use it for cooking, it’s most peculiar. [Female, aged 80]

Reduced upper limb function was also linked to changes in how some participants were able to interact with their grandchildren.

Picking them up - I’ve got two granddaughters, and my niece is a two-and-a-half year old. I used to go and pick them up, but now I’m much more wary. I can pick them up with my left arm, but I’m always scared in case I drop them, so I don’t any more. [Male, aged 67]

Participants talked about the need to practice tasks and develop coping strategies to improve their skills with a given task, acting as an enabler for PA participation.

You usually don’t do it very well a couple of times…and then, well three times just to get it right. You just, you get used to that being normal...

[Male, aged 55]

4.2.2.4 Beliefs about capabilities
‘Beliefs about capabilities’ links with constructs included in social cognition models of human behaviour including self-efficacy, self-esteem, self-confidence and perceived behavioural control. Attitudinal constructs such as optimism and pessimism are also included in this domain. Some participants reported a lack of confidence as a barrier to PA participation, but where PA could be undertaken, confidence was improved.

Confidence, I find that’s my problem. Confidence. I feel that I am staggering but I don’t think I am…. I think it [PA] gives you confidence. I mean, I’m doing things more than I did… [Female, aged 76]
Participants reported increased confidence through mastery experiences and also vicarious experience in comparing themselves to others.

_But I did go...to the theatre a couple of times and I must say walking down with nothing to hold on to, I just said to my daughter you go and I’ll wait til most of the audience is gone and I could grab other peoples’ seats. But the first time I was absolutely dreading it. And we went a month later and it wasn’t so bad._ [Female, aged 80]

_...that is one thing that, I think that...there’s a lot of older people that can hardly walk...you know, your first thought is - I’m the least disabled..!_ [Male, aged 71]

Reliance on others to help facilitate PA reduced perceived behavioural control for some participants, acting as a barrier to PA participation. Attitudes towards barriers varied amongst participants, which may have related to pre-stroke personality traits, the impact of the stroke on self-efficacy, confidence and identity, or a combination of these factors.

_I can’t do anything. I can’t cook, I can’t do anything at all. My husband does it all for me._ [Female, aged 75]

4.2.2.5 Emotion

‘Emotion’ refers to the influence of affective factors on PA participation. Participants reported that undertaking PA resulted in both physical and emotional benefits.

_I had endorphins kicking in, and that sort of feel-good factor, and actually that is part of, when you get exercise, you actually feel better._ [Male, aged 55]

However some participants reported fear of falling, which acted as a barrier to PA participation.

_I find I’m scared of falling because if no-one saw me I wouldn’t be able to get up again._ [Female, aged 76]

Some participants reported that although they were motivated to undertake PA, they were not physically able to do what they wanted to do, which was both frustrating and upsetting. Fatigue was reported by a number of participants and limited ability to participate in PA, being experienced both as a physical phenomenon by some with mental fatigue being more problematic for others.
It's difficult to do things but you have to push yourself, and it's not easy, because you are so tired all the time. [Female, aged 79]

4.2.2.6 Nature of behaviour

'Nature of behaviour' refers to past experience of PA and routine behaviours. Both constructs were perceived to be important by participants, with PA more difficult to initiate and maintain if a routine were not established.

…if I'm honest I must admit, maybe it's because I was fairly unactive [sic] in the first place... [Male, aged 55]

However, for others, PA was very much a part of their pre-stroke life and identity. When asked about the benefits of PA, one participant responded:

Because I've always done it, it's hard to think of a question like that. I mean, I miss being able to do less than I could before my stroke. You know, I was walking 15 miles before my stroke. That's why I'm only walking 4 now. The fact that there are benefits has always been clear from childhood. Which, obviously it's a fortunate thing, I had that kind of childhood. [Male, aged 71]

Past experience of PA, particularly of activities that were enjoyed, was a motivator for participants who were able to return to the activity in some capacity,

Two weeks ago I went back to badminton. I used to play badminton 3 times a week before the stroke, and....I'm only a quarter as good as I was, but I had a few games and I enjoy it... [Male, aged 71]

However, an inability to return to previously valued activities was very discouraging for some participants.

So I was used to being very fit and active. The stroke, immediately, some of the stuff that I did, I couldn't do it anymore. Because, physically, I'm not capable of doing it. [Female, aged 75]

4.2.2.7 Social/professional role and identity

This domain refers to how PA is linked to an individual's identity and is influenced by social norms. Those participants who were unable or only partially able to return to previously valued roles such as employment, domestic ADLs, DIY and childcare for grandchildren felt this loss strongly.
I can’t babysit the grandchildren, that’s one of my worst things...But it means I’m not so much in their life...I mean I can physically do it, but I would think oh my god supposing something happened. [Female, aged 69]

...because my life changed so much, because I was working full time and then all of a sudden there was nothing… [Female, aged 75]

I thought, walking the dog, cleaning the garden, decorating - was just what I did. Now I sit and look at the television. That’s about it, can’t do anything else. [Female, aged 75]

Nonetheless, where participants identified as an ‘active person’, resuming these valued activities was both a motivator and a means of building self-efficacy. A number of participants reported how people within their social network enabled them to participate in PA, through encouragement, practical support and shared experience.

Oh well myself and a friend used to go for a long long walk once a week and now we get on a bus and go to Rustington and go to a café and get poached eggs and walk along the next bus stop but that’s as far as she walks with me now. [Female, aged 80]

...which requires, in the house, patience on my wife’s part, because again, it would be quicker for her to do them. [Male, aged 71]

I’ve got a wife who nags me. To make sure I go. “Are you going to the pool this morning before we go to the stroke thing this afternoon?” … “yes, dear”. [Male, aged 67]

4.2.2.8 Social influences
‘Social influences’ refers to the social interactions, both personal and professional, that influence PA participation post-stroke. Participants in the focus groups generally reported being well supported through networks of family and friends. Support and encouragement from close family members was perceived as an enabler for PA participation, however where this was relied on, it had the potential to act as a barrier to PA participation. This was particularly so if transport was required to access PA opportunities and the individual could not get there themselves.

Now I can’t get out at all. Unless my husband is prepared to drive me. It is difficult, not driving myself. [Female, aged 75]
Public and professional figures were also reported to be influential in aiding recovery. Well-known individuals with chronic diseases such as journalist Andrew Marr were seen as positive role models and testament to what can be achieved despite experiencing a stroke. Professionals such as physiotherapists were perceived to be important to help establish an exercise routine at home upon discharge, however a common perception was that this input was too brief and participants reported difficulty maintaining motivation and worries about ‘doing it right’.

Over time, the importance of professional reassessment.

I think, having reappraisals from time to time, with either Physios, or… I mean, I know there are lots of people, strokes affect tens of hundreds every year, so the medical profession has to deal with those who’ve got them. But being reassessed, how far along you’ve got. Whether what you’re doing is OK. It’s like having the validation that what you’re doing is OK, would help me. [Male, aged 67]

4.2.2.9 Behavioural regulation

‘Behavioural regulation’ refers to the processes which participants used to support their PA behaviours. Some participants set small achievable goals, with achievement enhancing self-confidence and self-efficacy. However some participants found that their goals were impossible to meet, and if they were unable or unwilling to make adjustments to the activities concerned, this acted as a barrier to engagement in some activities.

I don’t know if I’ll ride a bike again, but because I’m scared I’d fall off and break my collarbone, break my arm or bash my head, I just don’t do it…. So that’s, that’s affected my confidence. I’ve been in the garden with golf clubs. Cause I used to play, couple of times a week, and I can do ‘that bit’ to there, but I don’t know if I’ve strong enough forearms to force the ball forward, and I’m worried if I did swing right through, if I’d overbalance as well. So my confidence in that stopped, and I haven’t played golf for two-and-a-half years. Which is very frustrating… [Male, aged 67]

4.2.2.10 Knowledge

‘Knowledge’ refers to participants’ knowledge around PA and their condition. Participants demonstrated sound knowledge of the benefits of PA but expressed a preference to have access to professional support to reassure them that they weren’t doing ‘too much’ and risking harming themselves or a contributing to the risk of having a further stroke.
I'd like somebody to tell me I'm doing enough or I'm not doing enough. Or I'm doing too much...There is a risk that you could do too much. I don't think I do, but I'd like somebody who does know, to come and see what I do and say “well that's alright”, or “no, you need to do more ... or less ... or you run the risk of…” [Male, aged 67]

Knowledge of available programs and facilities to support PA participation varied amongst participants, and many participants were interested in obtaining further information relating to local services.

None I know of. But I'm sure there are. But I don't know of them. I would have quite liked to go to that stroke help thing… [Female, aged 76]

Those participants who were aware of available programs shared this with other group participants, and the internet was highlighted as an additional source of information.

Well these classes I've been to up in Bognor, they keep impressing each time, you know “don't give up now, find a gym to carry on with your work, and just don't give up!” [Female, aged 79]

I go to exercise class once a week at surgery, yes, and that's good, it is. And I think, ‘do I really have to go?’ and then I do. I mean it’s all gentle exercise. [Female, aged 76]

I think I've the stimulus I need, and I think I could find more, um...you can find everything on the web if you look for it. [Male, aged 71]

4.2.2.11 Beliefs about consequences

The domain ‘Beliefs about consequences’ refers to the attitudes and beliefs participants hold about the consequences of undertaking PA and the associated outcome expectancies. Focus group participants generally demonstrated positive beliefs relating to PA, although where fear of falling was present, this acted as a barrier to PA. Reported instances of activity limitation appeared to be sensible in light of risks associated with physical impairments.

It frustrates me because I um, I don't think I'd be safe on a ladder and so therefore the most basic tasks in the garden or in the house...um, I'm glad I did virtually all the necessary decorating before I was taken ill, which was right-handed. [Male, aged 71]
Nonetheless, the predominant sentiment from focus group participants was a belief that if they kept at it, further improvements would ensue.

*I will just keep walking, just keep walking. I will do my utmost with the Physio.*

[Female, aged 75]

*But I'll, I will find something and I mean, like you, I like walking and walking in winter…but, whether I'll be able to do that, I don't know. You just keep trying.*

[Male, aged 71]

4.2.2.12 Memory, attention and decision processes
This domain refers to the influence of cognitive processes on PA participation. While some participants reported memory impairments, they were not generally perceived to be sufficient to limit PA participation. However, participants were insightful into the detrimental impact that poor cognition may have on a stroke survivor’s ability to participate in rehabilitation and PA.

*Well, the first one is your mental activity has to be, there has to be a desire to be physically active to start with. If you've got no desire, if you've got no will...then, you're not going to be physically active. Especially if Eastenders is more attractive...than sailing, or something. So I think it has to start, originally, in the brain. And if that is injured, or not working to it’s fullest, then it can be very easy to sort of...get in the doldrums and not wish to do anything physical. Yeah, I would say, it would start in there.*

[Male, aged 55]

4.2.2.13 Other
- Some focus group participants reported that pain influenced their ability to engage in PA. However, pain was of musculoskeletal origin and often linked to pre-existing problems rather than neuropathic pain.
- The effects of medications were discussed by some focus group participants. Some reported that their medications had a detrimental effect on their energy levels and alertness and thus their ability to engage in PA.
- Most focus group participants indicated they had access to the internet which was used as a resource for information relating to their condition and also to local opportunities for PA and other activities.
4.3 Summary
Around half of participants in this study reported that they do not undertake sufficient PA to meet the guidelines for improvements in health and wellbeing. Questionnaire participants reported a number of barriers to undertaking PA, including stroke-related disability, fear of falling, pain, fatigue, reduced social support, difficulties with transport and inclement weather. Statistical analyses demonstrated relationships between self-reported PA and a number of variables including mobility level, fear of falling, pre-stroke history of undertaking PA and beliefs and perceptions relating to health and PA. Focus group participants discussed the factors influencing their ability to undertake PA and the data generated were coded using the TDF. Across all three focus groups, the TDF domains most commonly represented in discussions were ‘Motivation and goals’ and ‘Environmental context and resources’. When text was coded as either a barrier or enabler of PA, the two most commonly represented domains were ‘Environmental context and resources’ and ‘Skills’.

Chapter 5 – Discussion
This study aimed to explore levels of PA post-stroke, knowledge and beliefs about PA and the factors reported to influence PA, in a group of people living in the south of England who had had a stroke, using questionnaires and focus groups. Participants were largely representative of stroke survivors in the UK. Although the sample was very homogeneous with regard to ethnicity (White British), it was representative of the local community. The questionnaire survey was used to gain an insight into the self-reported PA levels among participants and also their beliefs relating to PA and perceived barriers to engaging in PA. It also allowed the exploration of relationships between self-reported level of PA and a number of variables. Only about half the study participants reported activity levels that would meet the ACSM guidelines for PA post-stroke. In addition, participants reported considerable sedentary behaviour. In agreement with existing literature, questionnaire data from this study demonstrated that people who had had a stroke report a number of personal, interpersonal and environmental barriers to engaging in PA. These include fear of falling, pain, fatigue, reduced physical function, reduced social support, difficulties with transport and adverse weather.

Focus groups were used to allow topics derived from existing literature and from the current questionnaire findings to be discussed in greater depth, with the TDF used as a framework for data coding. The TDF includes twelve domains that may be used to
understand the factors that influence behaviour, and the semi-structured schedule of questions used in this study allowed participants to discuss both barriers and enablers of PA which fell into all TDF domains.

5.1 Benefits of physical activity in chronic stroke survivors
Data from both the questionnaires and focus groups suggest that many participants are aware of the benefits of PA, with ‘Knowledge’ being one of the least commonly TDF domains discussed in the focus groups. Focus group participants reported knowledge of the benefits of PA including disease prevention, weight loss, social opportunities and general well-being, as well as a mark of the progress made since their stroke. However some focus group participants highlighted that they would like more guidance on how much PA to do, suggesting that knowledge relating to safe levels of PA was lacking. This is similar to participants in the study by Rimmer et al. (148) who reported a lack of knowledge of how and also where to safely exercise. As with focus group participants in the present study, knowledge of available programs and facilities to support PA participation varied, although this may also reflect variations in the availability of such supports local to participants. Despite knowing how important it is to undertake regular PA, self-reported PA levels were relatively low in this study, with questionnaire data showing that around half of participants were not meeting PA guidelines. Additionally, almost two thirds of participants reported that they often sit for over two hours at a time, which has been shown to be detrimental to health (25, 59, 162), even though around two thirds of survey participants could be categorised as community ambulators (able to walk at least 200 metres), and as having a relatively high level of physical functioning. These findings are consistent with those from other studies in which participants have demonstrated low levels of PA despite having good functional abilities (28, 95). The findings of this study resonate with theories of social cognition that state that human behaviour is influenced by a number of interlinked factors (134-136) which would suggest that knowledge of the benefits of PA on its own is unlikely to change behaviour. This is significant as health professionals often rely on educating patients and information-giving as the main means of influencing their behaviour. This method was demonstrated to be ineffective by Boysen et al. (163) who found that repeated instructions to remain active did not influence PA behaviour a year after stroke. Other authors have reported that people who have had a stroke have expressed a lack of knowledge and skills relating to how to increase their PA levels (36, 40, 148). Although many participants in this study did not feel that lack of knowledge relating to PA was an issue for them, over a quarter of questionnaire respondents did report this as a barrier, suggesting this area does need to be addressed for some people who have had a stroke. The most appropriate way to provide this information is likely to vary from person to person and flexible delivery may
be key to the success of such strategies. Flexible, individualised delivery of services is advocated by Jones et al. (164), who have contributed to the growing literature on self-efficacy and self-management post-stroke.

Most focus group participants viewed PA as something they had always done, meaning it helps to shape their identity. These findings are consistent with those of Robison et al. (89) who undertook semi-structured interviews with 19 people who had had a stroke and eight informal carers, exploring the resumption of valued activities post-stroke. Interviews were undertaken twelve months post-stroke and explored the ongoing effects of stroke, experiences of trying to resume important pre-stroke activities and the factors that influenced progress. Influential factors were found to relate to physical or cognitive disability, the environment, social support and the adaptability of the individual, with an inability to resume activities impacting on individuals’ sense of self and quality of life. In a qualitative study exploring the perceptions of people who had had a stroke relating to PA, Morris et al. (36) discuss the concept of identity continuity whereby PA facilitates a link, and aids adjustment to, their post-stroke selves. For participants who previously valued participation in PA, being able to return to it, even if in a modified manner, represented a sense of life ‘getting back to normal’. This process of attempting and problem-solving activities was also reported by Eriksson & Tham (165), who discuss the benefits of positive risk-taking in gaining and monitoring progress and sustaining hope for its continuation. Returning to previously valued activities has been linked with life satisfaction post-stroke (90) and Morris et al. (36) discuss PA as a mediator of this process. Participants in the study by Morris et al. (36) expressed a view that the benefits of PA were broad, conferring health benefits as well as helping to re-establish identity, adjust to the effects of the stroke and support participation in valued activities and life roles. Similarly, in the present study, focus group participants indicated that they understood the health benefits of participation in PA but that these were only part of the reason that they engaged in PA, with other benefits being much more about restoring their sense of self and their role within their family and/or social group.

The literature on the benefits of PA for stroke survivors is extensive and participants in this study generally demonstrated a good knowledge of the benefits of PA, although this may be a function of the tendency for individuals with well-formed opinions to participate in such research. However, Pollock et al. (166) found that a group consisting of people who had had a stroke, caregivers and health professionals, identified as one of the top 10 research priorities the question of whether exercise and fitness programs are beneficial in improving function, QoL and avoiding subsequent stroke. This demonstrates the existence of a knowledge gap, although theories of
human behaviour (134-136) would suggest knowledge alone is unlikely to be sufficient in facilitating behaviour change and engagement in PA amongst those who undertake little PA.

5.2 Physical activity levels amongst study participants

There are a number of ways to measure PA in people who had had a stroke including accelerometry and self-report. Both methods have their strengths and limitations. This study utilised self-report, asking participants to either agree or disagree with a series of statements based on the ACSM PA guidelines. Just over half of survey respondents (N=35, 53.8%) reported that they met the guidelines through moderate-intensity PA, meaning that a significant proportion do not. Physical activity is often overstated using self-report, and it is also worth noting that eleven of 76 participants preferred not to answer the question on moderate-intensity PA, so the proportion of participants not meeting PA guidelines may be higher. This is significant, particularly in light of the fact that the study sample was relatively high functioning, with 61.6% identified as community ambulators. A small proportion of participants (N=7, 12.5%) reported that they met PA guidelines through high-intensity PA. Encouragingly, 75.8% of respondents (N=44) reported they did low-intensity PA every day, although again, there were significant missing data (N=18, 23.7%).

What is not clear is how people who have had a stroke can be facilitated to move from low levels of PA to levels which will confer improved fitness and greater health benefits, although there is emerging literature suggesting that social cognition theories of human behaviour may be useful in supporting such a change (134-136). These theories would suggest that understanding the individual’s underlying beliefs about the behaviour, their motivational readiness and self-efficacy related to the behaviour, and the context in which the behaviour would be undertaken, are all important (134-136). This would require less reliance on the didactic provision of information and more emphasis on a partnership approach of identifying and problem-solving barriers to PA and providing the necessary support to engage in it and ultimately self-manage on an ongoing basis (139, 164). This process of ownership of the behaviour change is key, as a number of studies report that following the conclusion of interventions, participants return to inactivity and the benefits gained decline (167, 168).

Participants in focus group 1 identified that public figures who had suffered a stroke or other chronic illnesses, such as journalist Andrew Marr, acted as a positive role model for them. The benefits of support and encouragement from others who have been through similar experiences underpins the rationale for services such as Expert Patient Programs and stroke clubs and groups, with vicarious experience thought to help build self-efficacy. Some focus group participants and questionnaire responders expressed
a willingness to participate in group activities with other stroke survivors. However this was unacceptable to other participants, with 34 questionnaire respondents (47.9%) strongly disagreeing with the statement: ‘I would be happy to do physical activities with others who have had a stroke’. This may be linked to issues around self-identity and/or pre-existing attitudes towards disability. A number of participants in this study expressed views similar to that shared by one focus group participant:

> You don’t really want that label, to hang around with “stroke victims”.
> [Female, aged 75]

Issues with self-image such as embarrassment with how they look whilst being physically active were not identified as significant barriers to PA, although almost half of respondents reported they would not feel comfortable exercising in a gym. Knowledge relating to the availability and accessibility of community-based programs and leisure centres varied amongst participants. These findings suggest that an individualised approach is required to support PA behaviours amongst people who have had a stroke, which takes into account their individual preferences and ensures information is available through a variety of sources.

### 5.3 Barriers to physical activity in stroke populations

In agreement with the existing literature, participants in this study reported a number of personal, interpersonal and environmental barriers to undertaking PA, which were reported here using the framework of the TDF. In an earlier study using the TDF, Nicholson et al. (37) found that the most commonly reported domains were ‘Beliefs about capabilities’, ‘Environmental context and resources’ and ‘Social influences’. These domains will be discussed further below along with others which are relevant for the data related to the present study.

#### 5.3.1 Personal barriers

**5.3.1.1 Beliefs about capabilities**

Despite the fact that the majority of participants in the present study were relatively high functioning, fear of falling was the most frequently reported barrier for engagement in PA. There was a highly significant inverse relationship between self-reported low-intensity PA and fear of falling and a significant inverse relationship between moderate-intensity PA and fear of falling. Fear of falling was also raised by focus group participants (see section 4.2.2.3) and has been reported by others who have had a stroke in previous studies (141, 144-146). Fear of falling can be linked to the specific self-efficacy construct ‘balance self-efficacy’, and it has been suggested that poor balance self-efficacy can result in people who had a stroke limiting their PA levels, contributing to ‘learned non-use’ and a cycle of deconditioning (28, 95, 129, 133).
Indeed, balance self-efficacy has been shown to be an independent predictor of activity levels after stroke (43, 44). There was a relationship demonstrated by the questionnaire data of this study between functional mobility level and fear of falling, which could suggest that some individuals are limiting their mobility due to fear of falling.

A qualitative study by Horne et al. (169) exploring the meaning of ‘confidence’ amongst people who had had a stroke found that this was linked to concepts of self-efficacy and self-esteem, and poor confidence has been demonstrated to be a barrier to engagement in PA (3, 35, 37). In the present study, some focus group participants appeared to use the term ‘confidence’ to express these constructs, and poor confidence was a barrier for some participants in engaging in PA. This also has the potential to contribute to a cycle of activity limitation and further deconditioning. Participants in the study by Pollock et al. (166) identified the question of how to improve confidence post-stroke as one of the top 10 research priorities, lending weight of the importance of this construct amongst people who have had a stroke. The constructs of ‘confidence’ and ‘self-efficacy’ are linked, with Bandura (73) describing self-efficacy as confidence in one’s ability to perform a task or specific behaviour. As described previously, there are thought to be four main sources of self-efficacy: mastery experiences, vicarious experiences, verbal persuasion and physiological feedback, with mastery experiences the most reliable source (138). Successful engagement in valued and enjoyable PA has the potential to deliver mastery experiences to people who had had a stroke, thereby building the confidence and skills to sustain and build on the behaviour for continued and increasing benefit.

5.3.1.2 Skills
The next cluster of most frequently reported barriers by the survey participants included difficulties in undertaking housework, gardening and in being able to move around sufficiently to effect an increase in their PA levels. Kubina et al. (90) describe how the level of impairment post-stroke does not necessarily predict participation restriction. Despite the relatively high level of functional mobility amongst many participants in this study, difficulties in completing day-to-day tasks were reported by over a third. Participants experiencing these difficulties may have reduced potential to increase their day-to-day PA levels, which is thought to be a useful starting point in reducing sedentary behaviours and for increasing engagement in PA (24, 25, 59). The results of this, and other studies, suggest that the reasons for this are multifactorial. A significant proportion of participants in this study reported fear of falling and fear of further stroke as barriers to PA participation, and the levels of PA reported by almost half the survey cohort do not meet the recommended amount of PA. It is therefore likely that they are
deconditioned and it may be that performing activities beyond routine ADLs, such as getting washed and dressed, are beyond their fitness reserve. In a study by Michael and Macko et al. (28) participants were found to have insufficient fitness to complete ADLs post-stroke. This research group have also demonstrated that improvements in fitness post-stroke are possible, however if participants experience fearfulness related to PA they are likely to require support from professionals to gradually increase engagement, even in incidental PA, with the provision of mastery experiences to increase confidence and independence.

If completing tasks such as housework and gardening was part of the individual's pre-stroke role and identity, an inability to undertake these tasks is likely to have a detrimental impact on their self-efficacy, confidence and mood. Focus group participants spoke of the difficulties they had in accepting the need for partners and family members, or paid workers, to undertake household and gardening tasks that they had done before their stroke. Adjusting to how their stroke and related impairments impact on their identity and self-perceptions is an important step in stroke recovery (89, 90). Difficulties with this adjustment can leave some people who had had a stroke with feelings of embarrassment related to factors such as how they look and any assistance that they require. This can in turn contribute to avoidance behaviour and reduced social participation, as well as reduced levels of engagement with PA (36, 170). However, few respondents to the study questionnaire indicated that embarrassment was a barrier to engagement in PA. A willingness and ability to adapt to limitations and to problem-solve activities to enable them to be successfully performed was highlighted as important across all three focus groups. Similar to the findings by Robison et al. (89), this willingness depended on the task in question and was linked to how important it was for the participant to be able to perform the task, and how important it was to them for the task to be performed ‘correctly’. The following exchange illustrates this:

And I've got a bicycle...and last week, my husband took me on that. I could...I used to be able to ride it, but now I can't. I keep falling off. So yes, last week, he took me round and held on to me, in case I fell off. I didn't have the balance right. [Female, aged 67]

Did you ever, have you tried a tricycle? [Male, aged 71]

That's cheating! [Female, aged 67]

An inability to return to previously valued activities impacted on sense of self and QoL and those participants who were less able to accept adaptations appeared to have less satisfaction with their life post-stroke.
I can’t walk. Not to any extent anyway. So I just don’t. I walk about the house and that’s it. Don’t even walk all the way around my garden...I don’t because I don’t want to see what somebody else has done to it. [Female, aged 75]

5.3.1.3 Motivation and goals
Within the focus groups, goal-setting was discussed in terms of behavioural intentions and these appear to be used both to monitor and continue progress and also to help build self-efficacy and confidence. The majority of survey participants indicated that they would like to increase their PA levels. This contrasts with the findings of a number of other investigators, who have reported that a lack of motivation is an issue impacting on PA participation post-stroke (37, 40, 148). For focus group participants in this study, other barriers appear to be more influential and they were generally motivated to undertake PA. For some participants, this was because they enjoyed PA and being active was part of their identity; while others were motivated to remain active for the health benefits. All focus group participants acknowledged that it was not always easy to maintain their motivation, and many reported the benefits of social support to enable them to do this. Participants in focus group one felt that a lack of determination and motivation may be a barrier for other people, but not for themselves. They perceived themselves to be very motivated in staying active through activities they enjoyed such as walking and swimming, and emphasised the importance of enjoyment of the activities in sustaining motivation. A number of authors have discussed the importance of a positive and hopeful attitude along with determination and resilience in pursuing a return to valued activities post-stroke; they highlight the need for the clinician to support this whilst also supporting adjustment and ensuring that goals are not over-ambitious to the point of being unrealistic, as continuous failure to meet goals is likely to erode self-confidence (170, 171).

5.3.1.4 Beliefs about consequences
From the survey data, significant relationships were found between self-reported PA levels and beliefs and perceptions relating to health and PA. There was a positive relationship between greater self-reported low-intensity and moderate-intensity PA levels and better perceived general health, and an inverse relationship between self-reported PA and the belief that increasing PA will not improve health. There was also a relationship between low-intensity PA and the belief that too much PA may bring on another stroke. In their review, Nicholson et al. (3) found that fear of re-stroke acted as a barrier to engagement in PA. This may suggest that individuals who hold this belief are limiting their PA levels and suggests an area of education which needs to be addressed during stroke rehabilitation. The present results concur with those of other studies which found that outcome expectation, that is the outcome one expects to
occur as a result of a given behaviour, influences PA levels (35, 39). There was also a relationship between self-reported low-intensity PA and self-reported history of participation in PA. Shaughnessy et al. (39) also found that participants’ history of exercise behaviour influenced PA levels in their cohort. Participants in focus group one identified themselves as ‘active people’ and demonstrated insight into the fact that individuals who were less active and/or not interested in PA were unlikely to attend the focus group.

*I think that...we are all physically active people. And those who are not physically active, are not here. And that is a problem. You are not looking at...like...we are all like people. We are all physically active. And therefore, people who are not physically active people, haven't come.* [Female, aged 67]

The focus groups allowed further discussion of beliefs about consequences and these were related to positive beliefs enhancing PA participation. Participants identified that engagement in PA is health-enhancing, as well as beneficial in terms of well-being, participation and identity continuity. The results from this study support the notion that the beliefs held by an individual about their general health and the effects of PA, along with a history of PA participation will influence their PA behaviour post-stroke.

5.3.1.5 Socioeconomic factors
Fourteen out of 76 participants preferred not to answer the question asking if they felt they could pay for gym memberships or classes if they wanted to, however 24 participants disagreed with this statement, indicating that cost may be a factor for some participants. That said, no relationship was found between self-reported PA and income in this study. This may relate to the fact that the majority of participants in this study were ambulant and many were community ambulators, meaning they were able to undertake PA through walking and day-to-day tasks without the need to pay for participation in programs or gym memberships.

Conversely, the majority of participants in the study by Rimmer et al. (148) reported that the cost of gym memberships and programs was a barrier to engagement in exercise. The differences in results may relate to socioeconomic differences between the cohorts and/or the delineation made between 'exercise' and the broader term 'physical activity' explored in the present research. 'Physical activity' includes day-to-day physical activities including activities such as gardening and walking, which do not encompass a cost burden. Given that fourteen participants did not answer the question relating to paying for gym memberships, this may indicate that this question was not perceived to be relevant, particularly since the study focus was on 'physical activity' rather than 'exercise'. Alternatively, it could represent a gap in knowledge.
relating to the cost of existing programs to support PA and exercise, or a preference to not disclose if finances would act as a barrier or not.

The difference in socioeconomic demographic between these two studies may also help explain the different findings in terms of perceived barriers relating to cost and also transport. Participants in the study by Rimmer et al. (148) were urban and predominantly from a low-income ethnic minority group, with lower income being associated with more perceived barriers to exercise. In contrast, participants in the present study were predominantly semi-rural, white and demonstrated greater diversity in terms of self-reported income levels. Differences in beliefs relating to PA and engagement in PA have been shown to vary between different ethnic groups (39, 150, 151). Results from the questionnaire data of the present study showed a weak but significant relationship between self-reported moderate-intensity PA and education, with participants who had more post-secondary school education more likely to undertake moderate-intensity PA. The findings relating to the impact of socioeconomic factors on PA participation for this cohort were mixed, which can be seen as a positive finding of the research since socioeconomic status is not able to be addressed through PA interventions.

5.3.1.6 Other

Pain and fatigue were reported as barriers by the study sample as frequently as the difficulties in undertaking day-to-day PA described above, and these factors were also raised by focus group participants. Fatigue management and/or prevention has been highlighted as one of the top 10 research priorities by stroke survivors, caregivers and stroke professionals (166). The prevalence of post-stroke fatigue reported in the literature varies from 30-68% (131) and it has been suggested that it may be related to reduced cardiovascular fitness, although the direction of this relationship has not been fully established. Nonetheless, fatigue has the potential to contribute to a cycle of activity limitation and deconditioning (129, 172) and those participants experiencing fatigue would benefit from interventions to help address this, to optimise their function and QoL. Whilst highlighting the need for further research in their review, Duncan et al. (131) conclude that it is very likely that exercise can be beneficial in addressing post-stroke fatigue. Since this review, Zedlitz et al. (173) have published the results of a randomised controlled trial comparing the effects on fatigue of cognitive therapy, and cognitive therapy combined with graded activity training (N=83). Whilst both groups demonstrated improvements in a range of measures related to fatigue, the impact of stroke and endurance, greater improvements were demonstrated in the group receiving both interventions. These findings lend support to the notion that interventions involving PA have the potential to improve post-stroke fatigue. Based on expert
opinion, advice leaflets available from the Stroke Association in the UK also recommend pacing of activities and breaking up periods of activity with rests as required. This type of ‘energy conservation’ may need to be combined with a graded PA program for maximum benefit on a range of post-stroke impairments, activity limitations and participation restrictions.

The causes of post-stroke pain vary, however focus group participants spoke of generalised pain often described as ‘aches’ and frequently related to PA levels. Pain of musculoskeletal origin has the potential to be improved by increased PA levels, but understandably can act as a barrier if not safely and appropriately managed. In contrast with results from studies in the USA and UK, depression was not a frequently reported barrier in this questionnaire cohort of the present study. This may relate to the fact that respondents were relatively high functioning. It may also reflect a sampling bias, with individuals suffering from depression potentially less likely to volunteer to participate in research such as this.

In keeping with the literature, (3, 21, 35-37, 39, 40, 148) this study demonstrates that people who live in the community post-stroke report a number of barriers to undertaking PA which are likely to have a detrimental impact on PA uptake, even if it is perceived to be beneficial and important. There is an emerging literature advocating that health professionals work in partnership with people living in the community after stroke to identify potential barriers to returning to valued activities and facilitate a client centred problem-solving approach to addressing them (36, 89, 90, 139, 164). Drawing on social cognitive theory, a greater understanding of the individual’s beliefs relating to PA may assist the health professional to support engagement in PA. In this study, there was an association between lower levels of self-reported PA and a belief that PA may bring on another stroke and between lower self-reported PA and a belief that increased PA would not improve health. Even if individuals had received advice regarding PA and were aware of the benefits, these negative beliefs clearly have the potential to act as a barrier to engagement in PA.

5.3.2 Interpersonal barriers

5.3.2.1 Social influences
In keeping with the literature from both the USA and the UK, interpersonal factors including reduced social support and difficulties with transport were perceived as a barrier to PA by some participants (3, 21, 35, 148), although this was more evident from the questionnaire data than from the focus group discussions. This stands to reason, as those attending things such as a focus group are demonstrating the ability to get out and about, whether this relies on social support or not. Individuals with
greater impairments are likely to be more reliant on social support and assistance with transport both to undertake PA and to get out and about. Those who did require support to get out expressed frustration regarding their lack of autonomy and independence, as has been previously reported in a number of other studies (36, 90, 170).

The role of health professionals may be considered under this domain and also ‘Environmental context and resources (see below). As other studies have found (36, 37, 89, 153), participants in this study expressed that the involvement of a health professional such as a physiotherapist was helpful in assisting them to maintain and increase their PA levels, although the feeling of some participants was that such input had ceased prematurely. Very few participants indicated that they had been given advice to engage in regular PA by their GP and a number of focus group participants expressed that they had not been followed up by their GP after their stroke as they expected, with the view being expressed that their GP was ‘too busy’. Previous research has suggested that a recommendation to engage in PA by a physician can be effective (40), and increased focus on medical professionals encouraging PA during their consultations has been called for in the literature (174). A number of focus group participants expressed a preference for regular reviews to provide them with confidence that they were ‘on the right track’. The value of reviews is recognised within the stroke guidelines from the National Institute for Health and Care Excellence (NICE) (175) and the Royal College of Physicians (176), where a review at 6 months post-stroke and then at regular intervals thereafter is recommended. One of the objectives of this review is to establish the unmet needs of the stroke survivor, and sign-post them to the relevant services. However, data from the UK Sentinel Stroke National Audit Programme (177) show that only 17% of stroke survivors had this review, demonstrating a gap in the application of clinical guidance to clinical practice which is likely to require additional resources to be successfully filled.

5.3.3 Environmental barriers

5.3.3.1. Environmental context and resources

The most frequently reported environmental barrier reported by this cohort was the weather, despite data collection being undertaken between March and November (i.e. not during the Northern hemisphere winter). Adverse weather was also reported as a barrier in the study by Damush et al. (40). Focus group participants agreed that snow and icy conditions were best avoided and cold weather in itself was a barrier for some, but not all, participants, although most preferred to avoid rainy conditions. The challenge that windy conditions provide for individuals with balance impairment was also raised by focus group participants, who discussed further issues relating to the
built environment including poor pavements and inadequate lighting, as barriers to PA participation.

Missing data for self-reported PA was greatest for the question relating to high-intensity PA. This could be because participants engage in low- and/or moderate-intensity PA and not high-intensity PA, and alternative structuring of these questions may have enabled this to be explored. There were a significant amount of missing data for the questions relating to the gym and community-based PA programs. Some participants suggested that an option to record ‘I don’t know’ would have improved the questionnaire, suggesting there is a lack of knowledge on this topic amongst some participants. It may also be that questions relating to gyms are not perceived to be relevant by some people who had had a stroke. Taking into account missing data, 47.4% of participants in this study indicated they would not know how to use gym equipment and 43.4% indicated that they would not feel comfortable exercising in a gym, an issue highlighted elsewhere in the literature (178). However, some participants were aware of gym and community-based programs and were accessing them, highlighting the importance of understanding not only the barriers to PA but also the features that may be enabling to a variety of people with different experiences of PA and individual preferences.

In an attempt to address issues surrounding PA participation post-stroke, particularly following discharge from physiotherapy services, exercise referral schemes have been developed and there is an emerging literature evaluating the experience of people who had had a stroke in taking part in such programs (154, 178). Some participants have expressed a lack of confidence in the stroke-specific knowledge of exercise professionals, and a preference for the ongoing involvement of a physiotherapist (178). Further development of the skills of exercise professionals may help this, with physiotherapists potentially playing a part both in building these skills and also increasing the confidence of program participants in the skills of exercise professionals. Another program has been developed recently by a young stroke survivor, who founded Action for Rehabilitation in Neurological Injury (ARNI). This is a 12-week multi-modal group-based community-based program that incorporates functional, fitness, strength and sensorimotor training along with psychological interventions addressing motivation, self-efficacy, attitudes and beliefs and function-based problem-solving (179). Norris et al. (179) conducted focus groups exploring the experience of 22 stroke survivors who had completed the program and found that participants reported it had a positive influence on function and participation post-stroke. Participants were also positive with regards to the community-based, non-medicalised nature of the program. Kilbride et al. (180) evaluated the effectiveness of the program.
using measures of impairment, activity and participation and found improvements in all domains. As yet, no longer-term evaluations have been undertaken to establish whether the benefits and positive PA behaviours are sustained following the completion of structured programmes such as ARNI. The need for more studies including longer-term follow up is highlighted by Morris et al. (181), who undertook a systematic review of the literature on interventions aimed at promoting long-term participation in PA after stroke. Eleven studies involving 1704 participants were included, with the authors concluding that there is evidence that tailored counselling, either alone or with a tailored supervised exercise program, improves long-term PA participation and functional exercise capacity more than tailored supervised exercise with general advice. These authors advocate the use of a tailored theory-driven approach in the promotion of PA long-term.

The studies by Morris et al. (36) and Nicholson et al. (37), published since ethical approval was gained for the present research, used one-to-one interviews to explore the views on PA held by people who have had a stroke. Nicholson et al. (37) used the TDF as a framework in their research and found that the most commonly reported domains were ‘Beliefs about capabilities’, ‘Environmental context and resources’ and ‘Social influences’. In the present research, the most frequently discussed domains were ‘Motivation and goals’ and ‘Environmental context and resources’ and, when transcript text was coded in terms of barriers, the most frequently discussed domains were ‘Nature of behaviour’ and ‘Skills’. These differences may be explained by a number of factors. In their paper, Nicholson et al. (37) explored both barriers and facilitators to PA and while facilitators were discussed in the present study, investigating barriers to PA was the primary focus. The participants in the qualitative investigation by Nicholson et al. (37) were recruited from the database of a separate study investigating the feasibility and accuracy of pedometers post-stroke. This means that all participants were ambulatory, and had an interest in participating in research. In contrast, participants in the present study were recruited predominantly after being approached by mail once they had been identified from lists of patients within the local Trusts within which this research was conducted. This approach meant that, provided they could get to the focus group venue, more impaired stroke survivors were able to participate in the qualitative component of the study. In addition, questionnaire data were gathered from participants who potentially had greater physical impairments than in those who participated in the research by Nicholson et al. (37). Thus, the differences in study cohorts may help explain the different focus of discussions within the groups.
5.4 Summary
Previous research investigating PA levels after stroke has not sufficiently differentiated between exercise and the PA undertaken as part of day-to-day activities, where increases in the latter category may be of particular importance in severely deconditioned populations (21, 40). Additionally, the majority of the research investigating PA levels and barriers to PA in people who have had a stroke has been undertaken in community ambulators, potentially overstating activity levels in the post-stroke population as a whole. The present research investigated the levels of self-reported PA, beliefs and knowledge about PA, as well as the barriers that a cohort of people who have had a stroke living in the south of England report to undertaking PA, as distinct from exercise. The recruitment method allowed inclusion of more impaired participants, helping to gain a broader view of self-reported PA and associated barriers to engagement in PA.

The results of this study broadly agree with findings from the existing literature. Many of the study cohort reported that they undertook low levels of PA and spent long periods of time being sedentary. Participants reported a number of interlinked and overlapping personal, interpersonal and environmental barriers to engaging in PA, some of which demonstrated correlations with self-reported PA. Personal barriers included stroke-related disability, reduced self-efficacy, negative beliefs and knowledge relating to PA and affective barriers including fear, pain and fatigue. Interpersonal barriers included reduced social support, including a reliance on others for transport and a perceived lack of support from professionals such as physiotherapists and GPs. Environmental barriers included the weather and poor pavements. Some participants expressed a lack of knowledge relating to community based facilities and programs to support PA, and ambivalence about whether they would feel comfortable to, or wish to, access them, even if they had better knowledge of available resources. The cost of accessing programs was also reported to be problematic for some participants.

Relationships were found between self-reported low– and moderate–intensity PA and better perceived general health and between low-intensity PA and having a prior history of engaging in PA. There was a highly significant inverse relationship between self-reported low-intensity PA and fear of falling, and a significant inverse relationship between moderate-intensity PA and fear of falling. There was also a relationship between functional mobility level and fear of falling. Significant inverse relationships were found between self-reported moderate-intensity PA and beliefs that PA could cause another stroke and/or would not be health-improving.

Participants in the focus groups also reported a number of barriers to participation in PA across personal, interpersonal and environmental spheres. Using the TDF as a
framework in the present study, commonly reported domains include ‘Motivation and goals’, ‘Environmental context and resources’, ‘Nature of behaviour’, and ‘Skills’. Specific barriers highlighted include fear of falling, fatigue, pain, stroke-related disability, reduced social support, poor self-efficacy and negative beliefs relating to PA. Knowledge relating to how to undertake PA safely and of available community-based programs and facilities, as well as the impact of associated costs, were also found to be problematic for some participants, although knowledge of the benefits of PA was generally sound.

Whilst further research is required to expand on these and other findings of the present study, attention must also be focused on the development and testing of interventions underpinned by models of human behaviour such as social cognition theories which could address the barriers identified by this and related research. Such multi-modal interventions are likely to be more successful in supporting and sustaining changes in PA behaviours than information-giving and education alone. Many people who have had a stroke are not sufficiently active to meet PA guidelines and in fact are severely deconditioned. Improvements in PA uptake in this group is essential in order to improve their health, function, well-being and quality of life, and to reduce the burden of this disease on health care systems and society.

5.5 Implications
This research has implications for both clinical practice and more broadly, public health policy. The current findings build on existing literature regarding the barriers that people who have had a stroke report to engaging in PA, which is very relevant for clinicians working in this area. The current approach of information-giving and education regarding the benefits of PA is likely to be ineffective without gaining an understanding of the individual’s beliefs and knowledge relating to PA, their social context and preferences, and the barriers that they are likely to encounter to being more active. A number of the barriers reported are stroke-related physical impairments, which could be the focus of increased attention during stroke rehabilitation. This study gives an insight into the barriers reported by a cohort of community-dwelling people who have had a stroke, who live in the south of England, which are broadly similar to those reported in the literature. As such, clinicians may find that the present findings are useful in understanding the barriers that the patients who they treat may encounter, although an individualised approach will still be necessary, and the results of this research need to be interpreted in the context of the limitations outlined below. Furthermore, it is likely that individuals with greater impairments will require greater support to be able to engage in physical activity and more broadly, valued occupational and leisure activities.
These findings could also have implications for public health policy and the development of public health programs such as Change4Life. After stroke, there is strong evidence in support of the benefits of PA (10, 11, 16, 27, 28, 79, 91, 168) and this population is also likely to benefit from even small increases in PA and a reduction in prolonged sedentary behaviours, which have demonstrated benefits in healthy populations (23-25, 59, 162). Improvements in the health and wellbeing of people who have had a stroke not only has obvious important implications for them, but also for health and social care budgets in terms of reducing the financial and social burden of ill-health. Effectively addressing the barriers that people who have had a stroke report to engaging in PA will require sufficient resources for health and community-based services to facilitate this. Ongoing support is likely to be required to sustain engagement in PA to ensure that people who have had a stroke maintain these behaviours and achieve continued benefit; however the nature of such supports is likely to vary from individual to individual. In the same way that the built environment is seen to contribute or impede the health of communities in general, addressing environmental barriers such as poor pavements and optimising outdoor spaces and green gyms may also be helpful in supporting them to increase and/or maintain PA levels.

It is unlikely that a ‘one size fits all’ approach will be successful in addressing the barriers to engaging in PA that are experienced by people living in the community after stroke. Successful interventions are likely to benefit from being guided by theories of human behaviour and behaviour change methods, with the focus on building individuals’ problem-solving abilities and self-efficacy to allow them to overcome barriers as they arise. A number of different approaches may be useful, including motivational interviewing, the TPB and the principles of self-management advocated by Jones and colleagues (139, 164). Understanding what motivates the individual, genuinely engaging them in goal-setting processes and supporting them to practice reacquired skills in different contexts is likely to help optimise engagement and build confidence for participation in PA. For some individuals, accessible and targeted education regarding the benefits of PA and reassurance regarding its safety will be important. In their systematic review of interventions to promote long-term participation in PA after stroke, Morris et al. (181) found that tailored counselling alone or with tailored supervised exercise was more effective in improving long-term PA participation than was tailored supervised exercise with general advice. These findings support the importance of taking an individualised approach in supporting people who have had a stroke to be more active.
5.6 Strengths and limitations

The findings of this study complement those of studies undertaken recently in Scotland and Ireland (35-37, 46); helping to develop a greater understanding of the factors that influence engagement in PA amongst people who have had a stroke in the UK and Ireland. Differences in findings between this and other studies may be partly explained by the differences in measurement tools and methodologies used. The studies in the USA focused on barriers to ‘exercise’, as a subset of the more general term ‘physical activity’ that was employed in this study, and the study by Shaughnessy et al. (39) investigated ‘exercise self-efficacy’. This thesis explicitly focused on the broader theme of ‘physical activity’ as opposed to ‘exercise’, which may be more relevant for a greater number of people who have had a stroke. The quantitative component of the present research was enhanced by the qualitative aspect, which added depth and gave voice to the experience of the study participants.

Despite an extensive literature search, no suitable existing questionnaire was identified and consequently the questionnaire used was developed for this study. It has not been validated, and the use of different measurement constructs and tools makes comparisons with other studies difficult. However the questionnaire developed was based on other surveys used in similar populations and on a well described theoretical framework (TPB) to underpin the structure of the questionnaire. However, the questionnaire does not include questions that sufficiently explore the constructs of intention and perceived behavioural control, and this limitation is acknowledged. On reflection, it may have been useful to have included a question on whether the participant was currently having physiotherapy or engaging in a community-based PA program, and if they had any co-morbidities likely to influence their PA levels. However, the present data add to the knowledge about factors which may limit or enable PA in people who are living in the community post-stroke, particularly in the context of UK specific PA barriers and facilitators.

The use of the TDF in analysing the focus group transcripts meant that data were allocated against the pre-determined domains of the TDF. This contrasts with other qualitative research methodologies which take an inductive approach, using relevant frameworks to analyse the data to look for emergent themes. Using pre-determined categories rather than an inductive approach may mean that emergent themes were missed or their importance not fully explored, and this limitation is acknowledged.

There are a number of potential sources of bias for this research. The sample was one of convenience and the recruitment methods meant that a proportion of those who were approached to participate were either recently or currently receiving ongoing care following their stroke, for example by a physiotherapist, or they were attending a stroke
Such individuals are potentially more likely to volunteer for research such as this and may also represent a more active cohort than is representative of the whole stroke population. This may mean that PA levels of the cohort studied are overstated. It is known that people who have had a stroke have a tendency to overstate their PA levels when compared to data collected via other measurement methods such as accelerometry (41, 98). Furthermore, individuals who volunteer for research may have well-established views and beliefs relating to PA which may differ to non-responders. Indeed, in the review by Nicholson et al. (3), participants in four of the six studies included were already participating in research into PA after stroke, making them potentially a somewhat skewed cohort, particularly regarding their views about and attitudes to PA.

Participants with significant cognitive impairments and severe aphasia were not able to participate in the focus groups, meaning their views may not be represented by the current data. The views of questionnaire non-responders may also not be represented, and the findings of this study must be interpreted in the context of the self-selected group studied. Whilst representative of the local population, ethnic diversity in this sample was minimal, which limits the generalisability of these results to other ethnic groups. A sample of 80 has been suggested as the minimum acceptable to achieve a moderate effect size for studies based on the TPB, using multiple regression analyses (136, 159). The aim was to get 100 completed questionnaires, however only 76 were returned during the recruitment period. Small numbers of volunteers for the focus groups meant that convenience sampling was used. Had there been more volunteers, purposive sampling would have been able to be used, which could have ensured greater representation of cohort characteristics. This implies that the present findings may not be generalisable to other populations of people who have had a stroke, and particularly not those with more severe post-stroke impairments. A larger and more diverse sample would improve the generalisability of the results of this research.

The availability of patient details was also greater for patients who had had their stroke more recently; more individuals were invited to participate who were in the first couple of years post-stroke, meaning they had not had as long to adjust and adapt to their post-stroke life. Amongst relevant studies in which stroke chronicity was reported, the majority of participants were over five years post-stroke (36, 39), or under one year post-stroke (37, 40). As such, this study adds breadth to the data available on this topic, with further studies required to add greater depth and increased generalisability.

Another source of potential bias relates to the influence of the researchers on the data. Whilst the principal researcher was not actively involved in the care of any participants
during this research, the principal researcher is a physiotherapist at a local hospital and this may have influenced participants’ responses both to the questionnaire and in the focus groups. The impact of social desirability in participants’ responses cannot be discounted, but is an unlikely source of bias, particularly in the anonymous questionnaires. It is acknowledged within qualitative research that the experience and beliefs of researchers themselves may have an influence on data collected, and on data coding, when using methodologies such as focus groups (182). The principal researcher is inexperienced in conducting this type of research; however attempts were made to reduce the impact of any bias by having the focus groups observed by the local supervisor, who provided feedback during breaks and also afterwards, and the coding of the transcripts being undertaken both the principal researcher and the academic supervisor, who was not involved at all in data collection. Although both neurological physiotherapists, the two researchers who coded the focus group data have very different backgrounds and live in different countries, reducing the possible impact of their opinions and attitudes to the topic on the collection and analysis of the data.

5.6 Future directions
Topics related to PA, physical functioning and confidence feature in the top 10 research priorities elucidated by Pollock et al. (166), from extensive stakeholder consultation, demonstrating that these are particularly important to people who have had a stroke in the UK. Further research is required to better understand the barriers that people who live in the community following a stroke encounter to engaging in PA, and to elaborate what can help motivate and sustain a behaviour change, with the ultimate aim of encouraging more stroke survivors to meet current PA guidelines. To date, studies in the UK and Ireland have involved small relatively homogenous stroke populations in discrete regions. Larger multi-centre investigations which include individuals with cognitive and language deficits and from diverse ethnic backgrounds would be useful, since studies in the USA have found variations in beliefs relating to PA and PA uptake between white and minority populations (39, 150, 151). In terms of socioeconomic and health inequalities, there continues to be a ‘north/south divide’ in England and research comparing any differences in PA uptake and reported barriers to PA in these regions would also be important to inform health and social policy. The development and testing of theory-driven interventions specifically tailored for people who have had a stroke, which support behaviour change and maintenance of effective levels of PA, is likely to be critical to effect an increase in activity levels in this population as a whole, and to reduce the financial and social burden of stroke on the individual, their support team and the larger community.
Chapter 6 – Conclusions

The main aims of this study were to gain insight into the barriers to participation in PA which are reported by a group of people living in the south of England who have had a stroke, and any relationship between reported barriers and self-reported level of PA, using questionnaires and focus group discussions. The following conclusions may be drawn from this study:

- Approximately half of participants (54%) in this study do not undertake sufficient moderate-intensity PA to meet recommended guidelines for health and wellbeing.
- Almost two-thirds of participants (63%) report that they often sit for prolonged periods.
- Self-reported participation in low-intensity PA was negatively influenced by fear of falling, stroke-related disability, sedentary behaviours and negative beliefs relating to PA.
- Self-reported participation in low-intensity PA was positively influenced by better perceived general health and having a history of engagement in PA.
- Participants reported a number of interlinked and overlapping barriers to participation in PA covering personal, interpersonal and environmental domains.
- Personal barriers to participation in PA include: stroke-related disability, fear, pain, and fatigue. Poor self-efficacy and negative beliefs relating to PA also act as barriers to PA participation. Focus group participants highlighted that maintaining motivation for undertaking PA could be difficult, even when the benefits of PA were well understood. A number of focus group participants felt that they would benefit from support and advice to ensure they are engaging in PA safely.
- Interpersonal barriers to participation in PA include a lack of social support and difficulties with transport.
- Environmental barriers to participation in PA include adverse weather and problems with the built environment including poor pavements.
- Questionnaire and focus group participants had varying knowledge relating to available community-based programs and facilities to support PA; opinions varied in terms of desire to undertake PA with others and/or in a gym setting.
References


36. Morris JH, Oliver T, Kroll T, Joice S, Williams B. From physical and functional to continuity with pre-stroke self and participation in valued activities: A qualitative
52. WHO Global recommendations on physical activity for health. 2010.


90. Kubina L-A, Dubouloz C-J, Davis CG, Kessler D, Egan MY. The process of re-engagement in personally valued activities during the two years following stroke. Disability and Rehabilitation. 2013;35(3):236-43.


174. Church TS, Blair SN. When will we treat physical activity as a legitimate medical therapy...even though it does not come in a pill? British Journal of Sports Medicine. 2009;43:80-1.


Appendices

Appendix 1 – Questionnaire
Appendix 2 – Participant information leaflet
Appendix 3 – Focus group prompts
Appendix 4 – NHS ethical approval letter
Appendix 5 – University of Western Australia ethical approval letter
Appendix 6 – Raw questionnaire data
Appendix 7 – Focus group consent forms
Appendix 1 - Questionnaire

A questionnaire on:

**Participation in physical activity by people who have had a stroke**

*I am conducting a study about physical activity in people who have had stroke.*

*I am interested in how physically active you are at the moment and what might influence your levels of physical activity - including barriers that you can identify to being more active. I would appreciate you responding to some questions about this. There are no right or wrong answers to these questions; I am interested in your views. A family member, carer or a member of the research team may help you to complete the questionnaire if you wish.*

*I will also be holding some focus groups where you will have the opportunity to discuss these issues in more detail, if you wish to. If you are interested in participating in one of the focus groups, please complete and return the enclosed reply slip.*

*If you have any questions, please feel free to contact me – Shae Jackson (see below).*

Ph. 07772467451
Email: shae.jackson@wsht.nhs.uk

Please return the completed questionnaire (and focus group reply slip if appropriate) using the stamped addressed envelope attached to the address below.

Shae Jackson - Physiotherapist (Principal Investigator)
Physiotherapy Department
St. Richard’s Hospital
Spitalfield Lane
Chichester
West Sussex
PO19 6SE

*Thank you for taking the time to participate in this survey*
Please complete the following demographic questions. **This information is confidential and will not be shared with anyone else.**

<table>
<thead>
<tr>
<th>Gender</th>
<th>Age</th>
<th>Ethnicity</th>
<th>Highest Educational Award</th>
<th>Postcode</th>
</tr>
</thead>
</table>

**This section relates to you and your stroke.** Please circle to indicate your answer.

1. My general health is good.
   - Strongly disagree
   - 1
   - 2
   - 3
   - 4
   - Strongly agree

2. Before my stroke, I was an active person.
   - Strongly disagree
   - 1
   - 2
   - 3
   - 4
   - Strongly agree

Please give some examples of the types of activities you used to do.

3. Have you had more than one stroke?
   - Yes
   - No

4. Please indicate how long ago you had your most recent stroke.
   - 6 – 11 months
   - 12 – 23 months
   - 24 – 35 months
   - 36 – 60 months

5. Please indicate which side of your body has been most affected by your stroke(s).
   - Right
   - Left
   - Both

6. My stroke affects my:
   - Arm + leg
   - Arm
   - Leg
   - No residual physical effects

7. Please tick to indicate the statement(s) that best describe your mobility level.

<table>
<thead>
<tr>
<th>Indoors</th>
<th>Outdoors (please give the approximate distance that you can walk)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I walk without a walking aid</td>
<td></td>
</tr>
<tr>
<td>I walk with a walking aid</td>
<td></td>
</tr>
<tr>
<td>I walk with someone close by</td>
<td></td>
</tr>
<tr>
<td>I walk with someone physically helping me</td>
<td></td>
</tr>
<tr>
<td>I propel myself in a wheelchair</td>
<td></td>
</tr>
<tr>
<td>I am in a wheelchair and someone else pushes it</td>
<td></td>
</tr>
<tr>
<td>I am bedbound</td>
<td></td>
</tr>
</tbody>
</table>

Research in the USA shows that financial issues can influence physical activity levels after stroke. For this research, I would like to try to understand if your financial circumstances influence your physical activities. It would be helpful if you would provide an estimate of your annual household income. This information will be anonymous and not shared with anyone else. Please circle your answer:

8. Less than £5000
   - £5000 - £10 000
   - £10 000 - £15 000
   - £15 000 - £20 000
   - £20 000 - £25 000
   - £25 000 - £30 000
   - £30 000 - £35 000
   - over £35 000
This section relates to your current physical activity levels.

'Physical activity' is a more general term than 'exercise'; it can include things like doing housework or gardening, or even getting washed and dressed. 'Exercise' is a specific type of physical activity and can include things like walking, playing golf or going to the gym. When we refer to physical activity below, we want you to think about both types in your responses.

Physical activity can be undertaken at different intensities. These are defined as:

- **Low intensity** – You would not feel short of breath doing the activity.
- **Moderate intensity** – You would feel a little short of breath doing the activity. You would still be able to carry on with a conversation.
- **High intensity** – You would feel short of breath doing the activity. You would not be able to speak full sentences.

9. I do **moderate intensity** physical activity for at least 30 minutes on five days per week.
   (30 minutes continuously OR three bouts of 10 minutes)
   
   Strongly disagree 1  2  3  4  Strongly agree

   Please give some examples of the types of **moderate intensity** activities you do.

10. I do **low intensity** physical activity every day.
    
    Strongly disagree 1  2  3  4  Strongly agree

    Please give some examples of the types of **low intensity** activities you do.

11. I do **high intensity** physical activity for 20 minutes three times per week.
    
    Strongly disagree 1  2  3  4  Strongly agree

    Please give some examples of the types of **high intensity** activities you do.

12. I often sit for more than 2 hours at a time.
    
    Strongly disagree 1  2  3  4  Strongly agree

13. I am unable to do any physical activity on a daily basis.
    
    Strongly disagree 1  2  3  4  Strongly agree

    Please add any additional comments you wish to make:

This section relates to your knowledge and beliefs regarding physical activity.

14. Increasing my physical activity levels will not improve my health.
    
    Strongly disagree 1  2  3  4  Strongly agree
15. I would be happy to do physical activities with others who have had a stroke.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

16. I would like to increase my physical activity levels.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

17. Too much physical activity could bring on another stroke.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

Please add any additional comments you wish to make:

This section relates to what your family, friends and others think of physical activity.

18. My doctor has told me to increase my physical activity levels.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

19. Most people who have had a stroke like me do not do regular physical activity.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

20. Other members of my family undertake regular physical activity.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

21. My family do not think it is important for me to be physically active.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

Please add any additional comments you wish to make:

This section relates to things that make it easy or otherwise for you to do physical activities

22. I don’t know how to increase my physical activity levels.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

23. I am too depressed to be more physically active.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

24. I am not physically able to do things like gardening.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

25. I am not physically able to do any housework.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

26. I am afraid of falling.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree

27. Pain prevents me from being more physically active.  
   Strongly disagree | 1 | 2 | 3 | 4 | Strongly agree
28. I am too tired to be physically active.  Strongly disagree 1 2 3 4 Strongly agree

29. I can’t move around easily enough to be more physically active.  Strongly disagree 1 2 3 4 Strongly agree

30. I am embarrassed about how I look when I am being active.  Strongly disagree 1 2 3 4 Strongly agree

31. My family/carers are able to help me to be physically active.  Strongly disagree 1 2 3 4 Strongly agree

32. The weather makes it difficult to be physically active.  Strongly disagree 1 2 3 4 Strongly agree

33. It is unsafe to walk around my local area.  Strongly disagree 1 2 3 4 Strongly agree

34. There are no programs I can join to help me to be more physically active.  Strongly disagree 1 2 3 4 Strongly agree

35. I don’t have any transport to get to gyms/clubs/classes/groups.  Strongly disagree 1 2 3 4 Strongly agree

36. I would feel comfortable exercising in a gym.  Strongly disagree 1 2 3 4 Strongly agree

37. I know how to exercise using gym equipment.  Strongly disagree 1 2 3 4 Strongly agree

38. The local gym has facilities and equipment for people with disabilities.  Strongly disagree 1 2 3 4 Strongly agree

39. I could afford to pay for gym memberships or classes if I wanted to.  Strongly disagree 1 2 3 4 Strongly agree

40. The staff at the local gym are knowledgeable about helping disabled people to exercise.  Strongly disagree 1 2 3 4 Strongly agree

Thank you for taking the time to complete and submit this questionnaire. Your opinions and insight are very valuable in understanding the factors that influence participation in physical activity after stroke.

Should you have any questions or concerns regarding this questionnaire or any of its questions, please contact:

Shae Jackson – Physiotherapist (Principal Investigator) Physiotherapy Department
St. Richard’s Hospital Spitalfield Lane Chichester West Sussex PO19 6SE
Email: shae.jackson@wsht.nhs.uk Ph. 07772467451
You can also get in touch if you would like any information regarding the benefits of regular physical activity and information on physical activity opportunities and services local to you.

Please return your completed questionnaire in the envelope provided to the address above.
Information about this research project:

What influences physical activity levels after stroke?

Have you had a stroke in the last 5 years? If so:

You are invited to take part in a research study. You are able to participate in this study if your stroke was between 6 months and 5 years ago.

Before you decide you need to understand why the research is being done and what it would involve for you.

Please take time to read the following information carefully. Talk to others about the study if you wish.

The following information tells you about the purpose of this study, what will happen to you if you take part and how the study will be conducted.

Please ask if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Contact information:

Shae Jackson – Physiotherapist (Principal Investigator)
Mobile: 01243831712
Email: shae.jackson@wsht.nhs.uk

What is the purpose of this research?

To look at the things that influence levels of physical activity for people who have had a stroke, from their perspective.

This research will investigate how physically active people are after a stroke and any barriers they face to being physically active.
Information about this research project:

What influences physical activity levels after stroke?

Why have I been chosen?

Participants for this research will have had a stroke between 6 months and 5 years ago.

Do I have to take part?

You do not have to take part in the study. If you decide to take part you are free to withdraw at any time without giving a reason. A decision to withdraw, or not to take part, will not affect your rights or the care you receive.

If you withdraw from the study, we will destroy all your personal identifiable information i.e. contact details, but we will need to use the data collected up to your withdrawal.

What will happen to me if I take part?

You will need to fill out a questionnaire. It will ask questions about how much physical activity you do, your opinions about physical activity and the things that make it more or less difficult to be physically active. A family member, carer or someone from the research team can help you complete the questionnaire. Your completed questionnaire will be stored without any information that can identify you.

After completing the questionnaire, you will be given the option of taking part in a small group forum at a later date to talk about the same topics. Issues like cost and financial constraints and the availability of support from family and/or friends may be discussed, if group participants identify these as barriers to participating in physical activity. The forum will take place at a convenient time for you, and light refreshments will be available. The small group forum will be recorded so that comments made by participants can be written down later, and grouped together in themes. In any publications or reports from this research, the information provided by individuals will be anonymised and pseudonyms used for any direct quotations. If you express interest in participating in the small group forums you might not be contacted, if more people are interested in participating than can be included for this research.
Information about this research project:

What influences physical activity levels after stroke?

What are the possible benefits of taking part?

You will have the opportunity to share your opinions on the things that influence levels of physical activity for stroke survivors. This information can help the development of services that can assist people to be more active after a stroke.

You will also be provided with some information about how to increase your own physical activity levels in day-to-day life as well as about services and opportunities that are local to you.

Once a date is decided, individuals who wish to participate in the small group forums will need to meet at a designated venue. The group forum will take approximately 2 hours. Reimbursement for travel costs will be provided up to a maximum of £10.

Will my information be kept confidential?

All information that is collected about you during the course of the research will be kept strictly confidential. Any information about you that is used in research reports, publications or presentations will refer only to your study number, with pseudonyms used for any direct quotations. The researcher will not share the information that you provide with anyone else, such as your GP or other health workers. However, in the unlikely event of any participant disclosing information that could potentially have a harmful effect on themselves or others, the physiotherapist (principal investigator) is duty-bound by professional conduct guidelines to report this to the appropriate authorities who can help.

What will happen to the results of the research?

At the end of the study, the data collected will be securely stored at Western Sussex Hospitals NHS Foundation Trust (sponsor) for 10 years in accordance with the Data Protection Act (1998). Access to this data will be limited to the researchers only. The results will be presented at conferences and will be published in research papers for scientific journals. We hope this will help inform clinicians of the results and improve the treatment of patients. We will send you a lay summary of our findings at the end of the study if you wish. If you would like a copy of the published results please let us know.
Information about this research project:

What influences physical activity levels after stroke?

What if something goes wrong?

If you have a concern or complaint about this study you should first contact the principal investigator: Shae Jackson (shae.jackson@wsht.nhs.uk) Tel: 01243831712

If you remain unhappy and wish to complain formally, please contact the Western Sussex Hospitals NHS Foundation Trust Patient Advice and Liaison Service: PALSChichester@wsht.nhs.uk or telephone 01243831822.

Who is organising the research and reviewing the study?

This study has been reviewed by the Health Research Authority’s National Research Ethics Service (South East Coast – Brighton and Sussex) and by the NHS organisation hosting this research.

Contact information:
Shae Jackson – Physiotherapist (Principal Investigator)
Mobile: 01243831712
Email: shae.jackson@wsht.nhs.uk
Appendix 3 - Focus group prompt questions

1. Can you tell me about the importance of physical activity from your perspectives?
2. What are the benefits of physical activity?
3. What risks might be associated with being physically active?
4. What physical activities do you like to do?
5. Are there any physical activities you haven’t been able to get back to doing since your stroke?
6. Do you feel confident in the physical activities that you currently do? (If no: What might increase your confidence in this activity?)
7. How does being active make you feel?
8. What makes it hard for you to undertake physical activities? ...Are there any things that make it difficult when you’re accessing your local community?
9. Do your activity levels vary according to the time of year? Why?
10. What would make it easier to be more physically active than you are right now? ...It might be things, money, people etc. (What motivates you to be physically active at the moment?)
11. Are your family and friends active people?
12. Do you think there are things other than physical ability that help you to be physically active? For instance, do you need determination or motivation...?
13. In the next 6 months, do you think that you will be more or less active, or about the same? (If answer ‘more active’: How are you planning to go about that?)
14. Are you aware of any supports you could access, for example clubs or groups, to help you maintain or increase your physical activity levels?
15 January 2014

Mr. Christopher Mercer
Consultant Physiotherapist
Western Sussex Hospitals NHS Foundation Trust
Worthing Hospital
Lyndhurst Rd.
Worthing, BN11 2DH

Dear Mr. Mercer

Study title: An exploration of factors influencing physical activity levels in community-dwelling chronic stroke survivors.

REC reference: 13/LO/1870
IRAS project ID: 120641

Thank you for your e-mail of 14th January 2014. I can confirm the REC has received the documents listed below and that these comply with the approval conditions detailed in our letter dated 30 December 2013

Documents received

The documents received were as follows:

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other: Invitation Letter</td>
<td>1.1</td>
<td>06 January 2014</td>
</tr>
<tr>
<td>Other: Follow Up Letter</td>
<td>1.1</td>
<td>06 January 2014</td>
</tr>
<tr>
<td>Other: Flier</td>
<td>1.1</td>
<td>06 January 2014</td>
</tr>
<tr>
<td>Participant Consent Form</td>
<td>1.1</td>
<td>06 January 2014</td>
</tr>
<tr>
<td>Participant Information Sheet</td>
<td>1.1</td>
<td>06 January 2014</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>1.1</td>
<td>06 January 2014</td>
</tr>
</tbody>
</table>

Approved documents

The final list of approved documentation for the study is therefore as follows:

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interview Schedules/Topic Guides</td>
<td></td>
<td>14 November 2013</td>
</tr>
</tbody>
</table>
You should ensure that the sponsor has a copy of the final documentation for the study. It is the sponsor's responsibility to ensure that the documentation is made available to R&D offices at all participating sites.

13/LO/1870 Please quote this number on all correspondence

Yours sincerely

Mr Thomas McQuillan
Assistant Committee Co-ordinator
E-mail: nrescommittee.secoast-brightonandsussex@nhs.net

Copy to: Ms. Sharon Jackson,
Ms. Helen Evans, Sussex NHS Research Consortium
30 December 2013

Ms. Sharon Jackson
Physiotherapy Department
St. Richard's Hospital
Spitalfield Lane
PO19 6SE

Dear Ms. Jackson

Study title: An exploration of factors influencing physical activity levels in community-dwelling chronic stroke survivors.

REC reference: 13/LO/1870
IRAS project ID: 120641

The Research Ethics Committee reviewed the above application at the meeting held on 12 December 2013. Thank you for attending to discuss the application.

We plan to publish your research summary wording for the above study on the NRES website, together with your contact details, unless you expressly withhold permission to do so. Publication will be no earlier than three months from the date of this favourable opinion letter. Should you wish to provide a substitute contact point, require further information, or wish to withhold permission to publish, please contact the Co-ordinator Danyal Enver.

Ethical opinion

1. The Committee noted that several contacts had been listed in Australia on the IRAS submission and inquired as to where the study would be based. Ms Jackson explained that Barbara Singer would act as a remote supervisor from Australia and that Mr Mercer would be the main supervisor based in England. She also stated that all of the study would be based in England with additional educational support only coming from Australia. The Committee was happy with this explanation.

2. The Committee inquired as to the process by which participants would be identified for the study. Ms Jackson explained that the research team had access to a stroke patients
database at the hospital in which she works and that this would be used to identify potential participants. At this point, she clarified; they would be sent information and questionnaires with the option of filling these out to take part in the study. The Committee was satisfied with this explanation although it inquired further regarding the focus group stage, asking how a lot of interest in the 16 places would be dealt with. Ms Jackson conceded that she had not thought about this and agreed to the Committee’s suggestion that the possibility of wanting to, but not being able to, take part in the focus group stage of the study be made explicitly clear in the PIS.

3. The Committee raised some concerns over capacity to take part in research. Ms Jackson explained that a capacity to consent assessment would take place when participants came in for the part of the study following the questionnaire stage. The Committee accepted this as satisfactory based on the study design limitations.

4. The Committee was unsure of the research team credentials regarding qualitative research experience. Ms Jackson stated that she had no direct experience of qualitative research, but did have experience of running groups, just not focus groups for research purposes. Mr Mercer stated that he had some experience, and both stated that Dr Singer would provide remote support from Australia. Mr Mercer stated that the RI at the site had offered support and had a wealth of experience. The Committee suggested that they be involved in the first focus groups. The research team was happy to take this suggestion.

5. The Committee noted that socio-economic questions would form part of the focus groups and decided that this ought to be mentioned in the PIS to warn participants. Ms Jackson agreed to this and took the suggestion that the Committee made regarding the arranging of those from similar socio-economic situations into the same focus groups for better, more open discussion.

6. Ms Jackson explained that no participants under 55 would be recruited as this group would not be subject to the same barriers. The Committee was happy to accept this study design feature.

7. The Committee inquired about the ‘pilot’ nature of the project and noted a previous reference to a larger study. Ms Jackson explained that she had wanted a larger,
multi-centre study but that this pilot with a manageable size was decided on initially. The Committee was happy to accept this as a resolution to this issue.

8. The Committee suggested that a tick box on the consent form be used to decide on a method of dissemination of results. Ms Jackson agreed to this.

9. Ms Jackson also agreed to the Committee’s request that she not use her mobile telephone or home computer for the study.

The members of the Committee present gave a favourable ethical opinion of the above research on the basis described in the application form, protocol and supporting documentation, subject to the conditions specified below.

**Ethical review of research sites**

**NHS Sites**

The favourable opinion applies to all NHS sites taking part in the study, subject to management permission being obtained from the NHS/HSC R&D office prior to the start of the study (see “Conditions of the favourable opinion” below).

**Conditions of the favourable opinion**

The favourable opinion is subject to the following conditions being met prior to the start of the study.

1. RI at the site (stated as support by the research team during the meeting) be consulted during the focus group stage of the study.

2. Focus groups to be divided (where possible) based on socio-economic groups in order to achieve better discourse.

3. Method of dissemination of results to be decided using a tick box on the Consent Form.

4. Mobile telephone and home computer not to be used during the study.

PIS Changes:
5. Reference to accessing of medical notes as part of the identification to take part in the “why have I been chosen” section to be made less explicit.

6. Possibility that those on the first section of the trial may not be able to go to the focus group stage to be made explicitly clear in the document.

You should notify the REC in writing once all conditions have been met (except for site approvals from host organisations) and provide copies of any revised documentation with updated version numbers. The REC will acknowledge receipt and provide a final list of the approved documentation for the study, which can be made available to host organisations to facilitate their permission for the study. Failure to provide the final versions to the REC may cause delay in obtaining permissions.

Management permission or approval must be obtained from each host organisation prior to the start of the study at the site concerned.

Management permission (“R&D approval”) should be sought from all NHS organisations involved in the study in accordance with NHS research governance arrangements.

Guidance on applying for NHS permission for research is available in the Integrated Research Application System or at http://www.rdforum.nhs.uk.

Where a NHS organisation’s role in the study is limited to identifying and referring potential participants to research sites (“participant identification centre”), guidance should be sought from the R&D office on the information it requires to give permission for this activity.

For non-NHS sites, site management permission should be obtained in accordance with the procedures of the relevant host organisation.

Sponsors are not required to notify the Committee of approvals from host organisations

Registration of Clinical Trials

All clinical trials (defined as the first four categories on the IRAS filter page) must be registered on a publically accessible database within 6 weeks of recruitment of the first participant (for medical device studies, within the timeline determined by the current registration and publication trees).

There is no requirement to separately notify the REC but you should do so at the earliest opportunity e.g when submitting an amendment. We will audit the registration details as part of the annual progress reporting process.

To ensure transparency in research, we strongly recommend that all research is registered but for non clinical trials this is not currently mandatory.

If a sponsor wishes to contest the need for registration they should contact Catherine Blewett (catherineblewett@nhs.net), the HRA does not, however, expect exceptions to be made. Guidance on where to register is provided within IRAS.
It is responsibility of the sponsor to ensure that all the conditions are complied with before the start of the study or its initiation at a particular site (as applicable).

Approved documents

The documents reviewed and approved at the meeting were:

<table>
<thead>
<tr>
<th>Document</th>
<th>Version</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Advertisement</td>
<td>1.0</td>
<td>14 November 2013</td>
</tr>
<tr>
<td>Interview Schedules/Topic Guides</td>
<td></td>
<td>14 November 2013</td>
</tr>
<tr>
<td>Investigator CV</td>
<td></td>
<td>10 September 2013</td>
</tr>
<tr>
<td>Letter of invitation to participant</td>
<td>1.0</td>
<td>14 November 2013</td>
</tr>
<tr>
<td>Other: letter from funder</td>
<td></td>
<td>06 November 2013</td>
</tr>
<tr>
<td>Other: Summary CV for student</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other: Summary CV for supervisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Participant Consent Form</td>
<td>1.0</td>
<td>14 November 2013</td>
</tr>
<tr>
<td>Participant Information Sheet</td>
<td>1.0</td>
<td>14 November 2013</td>
</tr>
<tr>
<td>Protocol</td>
<td>1.0</td>
<td>14 November 2013</td>
</tr>
<tr>
<td>Questionnaire</td>
<td>1.0</td>
<td>14 November 2013</td>
</tr>
<tr>
<td>REC application</td>
<td></td>
<td>14 November 2013</td>
</tr>
<tr>
<td>Referees or other scientific critique report</td>
<td></td>
<td>14 November 2013</td>
</tr>
</tbody>
</table>

Membership of the Committee

The members of the Ethics Committee who were present at the meeting are listed on the attached sheet.

Statement of compliance

The Committee is constituted in accordance with the Governance Arrangements for Research Ethics Committees and complies fully with the Standard Operating Procedures for Research Ethics Committees in the UK.

After ethical review

Reporting requirements

The attached document “After ethical review – guidance for researchers” gives detailed guidance on reporting requirements for studies with a favourable opinion, including:

- Notifying substantial amendments
- Adding new sites and investigators
- Notification of serious breaches of the protocol
- Progress and safety reports
• Notifying the end of the study

The NRES website also provides guidance on these topics, which is updated in the light of changes in reporting requirements or procedures.

Feedback

You are invited to give your view of the service that you have received from the National Research Ethics Service and the application procedure. If you wish to make your views known please use the feedback form available on the website.

Further information is available at National Research Ethics Service website > After Review

13/LO/1870  Please quote this number on all correspondence

We are pleased to welcome researchers and R & D staff at our NRES committee members’ training days – see details at http://www.hra.nhs.uk/hra-training/

With the Committee’s best wishes for the success of this project.

Yours sincerely

Dr Simon Walton
Chair

Enclosures: List of names and professions of members who were present at the meeting and those who submitted written comments
“After ethical review – guidance for researchers” [SL-AR2]

Copy to: Mr. Christopher Mercer, Western Sussex Hospitals NHS Foundation Trust
Ms. Sharon Jackson
Ms. Helen Evans, Sussex NHS Research Consortium
### Committee Members:

<table>
<thead>
<tr>
<th>Name</th>
<th>Profession</th>
<th>Present</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr Jill Adams</td>
<td>GP</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Dr Duncan Angus</td>
<td>Consultant Psychiatrist</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Dr John Bull</td>
<td>Consultant Physician (retired)</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Mr Gerard Cronin</td>
<td>Business Development Manager</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Prof Angie Hart</td>
<td>Professor of Child, Family &amp; Community Health</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Mr Bill Kent</td>
<td>Retired Civil Servant</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Miss Samantha Lippett</td>
<td>Lead Microbial Pharmacist</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Mr Maurice Marchant</td>
<td>Public Health Information Specialist (retired)</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Ms Nicola Mason</td>
<td>Specialist Midwife - Practice Development</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Dr Martin Parry</td>
<td>Consultant Paediatric Anaesthetist</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Dr Paul Seddon</td>
<td>Consultant Paediatrician</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Mrs Kathy Stott</td>
<td>Pharmacist</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Dr Simon Walton</td>
<td>Consultant in Anaesthesia and Intensive Care</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Mrs Susan Waton</td>
<td>School Librarian</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>Dr Stuart White</td>
<td>Consultant Anaesthetist</td>
<td>No</td>
<td></td>
</tr>
</tbody>
</table>

### Also in attendance:

<table>
<thead>
<tr>
<th>Name</th>
<th>Position (or reason for attending)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pat Butler</td>
<td></td>
</tr>
<tr>
<td>Mr Danyal Enver</td>
<td></td>
</tr>
<tr>
<td>Amanda Geel</td>
<td></td>
</tr>
<tr>
<td>Debbie Horney</td>
<td></td>
</tr>
<tr>
<td>Matthew Pope</td>
<td></td>
</tr>
</tbody>
</table>
Dear Professor Singer

HUMAN RESEARCH ETHICS APPROVAL - THE UNIVERSITY OF WESTERN AUSTRALIA

An Investigation of Factors Influencing Physical Activity Levels in Community-Dwelling Chronic Stroke Survivors

Student(s): Sharon Jackson - M Neuro. Rehab. - 20845628

Ethics approval for the above project has been granted in accordance with the requirements of the National Statement on Ethical Conduct in Human Research (National Statement) and the policies and procedures of The University of Western Australia. Please note that the period of ethics approval for this project is five (5) years from the date of this notification. However, ethics approval is conditional upon the submission of satisfactory progress reports by the designated renewal date. Therefore initial approval has been granted from 16 January 2014 to 01 February 2015.

You are reminded of the following requirements:

1. The application and all supporting documentation form the basis of the ethics approval and you must not depart from the research protocol that has been approved.
2. The Human Research Ethics Office must be approached for approval in advance for any requested amendments to the approved research protocol.
3. The Chief Investigator is required to report immediately to the Human Research Ethics Office any adverse or unexpected event or any other event that may impact on the ethics approval for the project.
4. The Chief Investigator must inform the Human Research Ethics Office as soon as practicable if a research project is discontinued before the expected date of completion, providing reasons.

Any conditions of ethics approval that have been imposed are listed below:

Special Conditions

None specified

The University of Western Australia is bound by the National Statement to monitor the progress of all approved projects until completion to ensure continued compliance with ethical standards and requirements.

The Human Research Ethics Office will forward a request for a Progress Report approximately 60 days before the due date. A further reminder will be forwarded approximately 30 days before the due date.

If your progress report is not received by the due date for renewal of ethics approval, your ethics approval will expire, requiring that all research activities involving human participants cease immediately.

If you have any queries please contact the HREO at hreo-research@uwa.edu.au.

Please ensure that you quote the file reference – RA/4/1/6589 – and the associated project title in all future correspondence.

Yours sincerely
Dr Mark Dixon
Associate Director, Research Ethics and Biosafety
<table>
<thead>
<tr>
<th></th>
<th>Q1 My general health is good</th>
<th>Q26 I am afraid falling</th>
<th>Q9 I do moderate intensity physical activity for at least 30 minutes on five days per week</th>
<th>Q10 I do low intensity physical activity every day</th>
<th>Q11 I do high intensity physical activity for 20 minutes three times per week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman's Rho</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>1.000</td>
<td>-0.441**</td>
<td>0.288*</td>
<td>0.331*</td>
<td>0.062</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>70</td>
<td>67</td>
<td>62</td>
<td>54</td>
<td>54</td>
</tr>
<tr>
<td>Q26 I am afraid falling</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>-0.441**</td>
<td>1.000</td>
<td>-0.308*</td>
<td>-0.402**</td>
<td>-0.130</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td></td>
<td>0.014</td>
<td>0.002</td>
<td>0.344</td>
</tr>
<tr>
<td>N</td>
<td>67</td>
<td>72</td>
<td>63</td>
<td>57</td>
<td>55</td>
</tr>
<tr>
<td>Q9 I do moderate intensity physical activity for at least 30 minutes on five days per week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>0.288*</td>
<td>-0.308*</td>
<td>1.000</td>
<td>0.435**</td>
<td>0.264</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.023</td>
<td>0.014</td>
<td></td>
<td>0.001</td>
<td>0.062</td>
</tr>
<tr>
<td>N</td>
<td>62</td>
<td>63</td>
<td>65</td>
<td>54</td>
<td>51</td>
</tr>
<tr>
<td>Q10 I do low intensity physical activity every day</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>0.331*</td>
<td>-0.402**</td>
<td>0.435**</td>
<td>1.000</td>
<td>0.044</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.014</td>
<td>0.002</td>
<td>0.001</td>
<td></td>
<td>0.763</td>
</tr>
<tr>
<td>N</td>
<td>54</td>
<td>57</td>
<td>54</td>
<td>58</td>
<td>49</td>
</tr>
<tr>
<td>Q11 I do high intensity physical activity for 20 minutes three times per week</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Correlation Coefficient</td>
<td>0.062</td>
<td>-0.130</td>
<td>0.264</td>
<td>0.044</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.659</td>
<td>0.344</td>
<td>0.062</td>
<td>0.763</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>54</td>
<td>55</td>
<td>51</td>
<td>49</td>
<td>56</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
* . Correlation is significant at the 0.05 level (2-tailed)
<table>
<thead>
<tr>
<th></th>
<th>Q9 I do moderate intensity physical activity for at least 30 minutes on five days per week</th>
<th>Q10 I do low intensity physical activity every day</th>
<th>Q11 I do high intensity physical activity for 20 minutes three times per week</th>
<th>Q2 Before my stroke, I was an active person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spearman's Rho</td>
<td>Correlation Coefficient</td>
<td>Correlation Coefficient</td>
<td>Correlation Coefficient</td>
<td>Correlation Coefficient</td>
</tr>
<tr>
<td>Q9 I do moderate intensity physical activity for at least 30 minutes on five days per week</td>
<td>1.000</td>
<td>.435**</td>
<td>.264</td>
<td>.213</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.001</td>
<td>.062</td>
<td>.096</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>65</td>
<td>54</td>
<td>51</td>
<td>62</td>
</tr>
<tr>
<td>Q10 I do low intensity physical activity every day</td>
<td>.435**</td>
<td>1.000</td>
<td>.044</td>
<td>.415**</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.001</td>
<td>.763</td>
<td>.002</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>54</td>
<td>58</td>
<td>49</td>
<td>54</td>
</tr>
<tr>
<td>Q11 I do high intensity physical activity for 20 minutes three times per week</td>
<td>.264</td>
<td>.044</td>
<td>1.000</td>
<td>.078</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.062</td>
<td>.763</td>
<td>.</td>
<td>.574</td>
</tr>
<tr>
<td>N</td>
<td>51</td>
<td>49</td>
<td>56</td>
<td>54</td>
</tr>
<tr>
<td>Q2 Before my stroke, I was an active person</td>
<td>.213</td>
<td>.415**</td>
<td>.078</td>
<td>1.000</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>.096</td>
<td>.002</td>
<td>.574</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>62</td>
<td>54</td>
<td>54</td>
<td>71</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
<table>
<thead>
<tr>
<th>Question</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
<th>Question</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
<th>Question</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
<th>Question</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
<th>Question</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q9 I do moderate intensity physical activity for at least 30 minutes on five days per week</td>
<td>1.000</td>
<td>.</td>
<td></td>
<td>Q11 I do high intensity physical activity for 20 minutes three times per week</td>
<td>-1.27</td>
<td>.001</td>
<td>63</td>
<td>Q14 Increasing my physical activity levels will not improve my health</td>
<td>-1.98</td>
<td>.119</td>
<td>63</td>
<td>Q15 I would be happy to do physical activities with others who have had a stroke</td>
<td>1.000</td>
<td>.777</td>
<td>63</td>
<td>Q16 I would like to increase my physical activity levels</td>
<td>1.000</td>
<td>.546</td>
<td>63</td>
</tr>
<tr>
<td>Q10 I do low intensity physical activity every day</td>
<td>.435**</td>
<td>.001</td>
<td>65</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q11 I do high intensity physical activity for 20 minutes three times per week</td>
<td>.044</td>
<td>.763</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q14 Increasing my physical activity levels will not improve my health</td>
<td>-1.98</td>
<td>.714</td>
<td>63</td>
</tr>
<tr>
<td>Q11 I do high intensity physical activity for 20 minutes three times per week</td>
<td>.264</td>
<td>.013</td>
<td>51</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q14 Increasing my physical activity levels will not improve my health</td>
<td>-1.09</td>
<td>.519</td>
<td>53</td>
<td>Q15 I would be happy to do physical activities with others who have had a stroke</td>
<td>-1.09</td>
<td>.482</td>
<td>55</td>
<td>Q16 I would like to increase my physical activity levels</td>
<td>-1.402</td>
<td>.024</td>
<td>46</td>
</tr>
<tr>
<td>Q14 Increasing my physical activity levels will not improve my health</td>
<td>-1.09</td>
<td>.519</td>
<td>53</td>
<td>Q15 I would be happy to do physical activities with others who have had a stroke</td>
<td>1.000</td>
<td>.013</td>
<td>70</td>
<td>Q16 I would like to increase my physical activity levels</td>
<td>1.000</td>
<td>.024</td>
<td>69</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q17 Too much physical activity could bring on another stroke</td>
<td>-1.98</td>
<td>.777</td>
<td>61</td>
</tr>
<tr>
<td>Q15 I would be happy to do physical activities with others who have had a stroke</td>
<td>1.000</td>
<td>.777</td>
<td>55</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q16 I would like to increase my physical activity levels</td>
<td>.198</td>
<td>.743</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q17 Too much physical activity could bring on another stroke</td>
<td>.072</td>
<td>.743</td>
<td>63</td>
</tr>
<tr>
<td>Q16 I would like to increase my physical activity levels</td>
<td>.198</td>
<td>.743</td>
<td>63</td>
<td>Q17 Too much physical activity could bring on another stroke</td>
<td>.072</td>
<td>.743</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q17 Too much physical activity could bring on another stroke</td>
<td>.072</td>
<td>.743</td>
<td>63</td>
</tr>
<tr>
<td>Q17 Too much physical activity could bring on another stroke</td>
<td>.072</td>
<td>.743</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q17 Too much physical activity could bring on another stroke</td>
<td>.072</td>
<td>.743</td>
<td>63</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Q17 Too much physical activity could bring on another stroke</td>
<td>.072</td>
<td>.743</td>
<td>63</td>
</tr>
</tbody>
</table>

Spearman's Rho
<table>
<thead>
<tr>
<th>Q17 Too much physical activity could bring on another stroke</th>
<th>Correlation Coefficient</th>
<th>Sig. (2-tailed)</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>-.083</td>
<td>.546</td>
<td>55</td>
</tr>
<tr>
<td></td>
<td>-.305</td>
<td>.035</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>.037</td>
<td>.807</td>
<td>46</td>
</tr>
<tr>
<td></td>
<td>.310*</td>
<td>.015</td>
<td>61</td>
</tr>
<tr>
<td></td>
<td>-.243</td>
<td>.057</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>-.226</td>
<td>.077</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>1.000</td>
<td>.</td>
<td>63</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).
Title of Project: An investigation of factors influencing physical activity levels in community-dwelling chronic stroke survivors.

Name of Researcher: Shae Jackson

Please initial all boxes

1. I confirm that I have read and understand the information sheet dated 06/01/14 (version 1.1) for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my medical care or legal rights being affected.

3. I understand that all the information that I provide will be confidential and that the principal investigator will not share the information that I provide with anyone else, such as my GP or other health workers. However, in the unlikely event of any participant disclosing information that could potentially have a harmful effect on themselves or others, the principal investigator is duty-bound by professional conduct guidelines to report this to the appropriate authorities who can help.

4. I understand that the group forum will be recorded so that comments made by participants can be written down later, and grouped together in themes. In any publications or reports from this research, the information provided by individuals will be anonymous.

5. I understand that direct quotations taken from the group forum discussion may be used in publications or reports from this research. Pseudonyms will be used for any direct quotations.

6. I agree to take part in the above study.

7. I would like to be informed of the results of this research.

Name of Participant   Date    Signature

Name of Person   Date    Signature taking consent.