A Profiling Study of Physical Function and Performance in Inpatient Adults Experiencing Homelessness at St. James’s Hospital

This Thesis is submitted for a Masters in Research to the University of Dublin, Trinity College

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Declaration

I declare that this thesis has not been submitted as an exercise for a degree at this or any other university and it is entirely my own work.

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Sinéad Kiernan, BSc (Physiotherapy)
Summary

Homelessness can often be an exceptionally intransient kind of social exclusion. Excluded individuals who are homeless are especially vulnerable to dramatically poor mental and physical health, including younger onset of chronic disease, multi-morbidity and a reduced life expectancy (Fazel et al. 2014). As highlighted by Hewett (2012), drug or alcohol misuse among people who are homeless often augments existing mental and physical health problems, resulting in a so-called ‘tri-morbidity’. Socially excluded populations have a mortality rate eight times higher than the average for males, and almost 12 times higher for females (Aldridge 2017). Ivers et al. (2019) investigated deaths among people who were homeless in Dublin between 2011 and 2015 and found that out of 201 deaths, the median age at death was 41 years (males 44 years and females 36 years).

Despite the acknowledged poor health profile of people who are homeless and their frequent hospital presentation, the overall physical status and performance of patients who are homeless is not well known. The purpose of the present study was to assess the physical health and performance variables of people who are experiencing homelessness and admitted to an acute hospital setting for any reason. Due to the heterogeneity of this population it was important to include both males and females and evaluate potential gender-based differences. It was also considered beneficial to explore the physical status of homeless individuals closely according to age. The study also aimed to provide any recommendations on a suitable test battery for this cohort that may help to inform future studies.

Ethical approval was granted. The number of participants who took part in the study and the level of participation with each of the various outcome measures were used to assess the feasibility of the study among this cohort. The test battery measured the following variables: functional exercise capacity (six minute walk test), stair-climbing ability (stair climb test), quality of life (EQ5D5L), pain (visual analogue scale), frailty (clinical frailty scale), muscle strength (handgrip dynamometry), loss of skeletal muscle function/sarcopenia (calf circumference), physical performance (short physical performance battery), falls risk (timed up and go), perceptions of physical activity and physiotherapy (open-ended questionnaire). A number of open-ended questions were also asked to ascertain participants’ perspective on their physical ability.
A total of sixty-five participants consented to participate and took park in some or all of the outlined test battery. The majority of participants (n=44, 67.7%) were male. The mean (±SD) age was 47 (+/- 13.2) years with a range of 23 to 80 years. Most participants (n= 41, 64%) utilized hostel accommodation or were rough sleepers (n=11, 17%). More than one third of participants (n= 24, 36.9%) used a mobility aid. Adherence rates were highest with the subjective outcome measures, while adherence rates were lowest with the 6MWT and the SCT. High adherence rates to the test battery overall and good levels of engagement with the subjective questionnaire demonstrated the feasibility of conducting a study with this cohort. Overall, this study demonstrated poor physical status among this cohort of homeless inpatients. Of note, participants had globally poor physical status, irrespective of age or gender. Low physical fitness and function was noted in the younger participants aged between 20 and 30 and was broadly consistent throughout the various age groups. The normal age-related decrements in mobility and physical status did not occur but rather widespread substandard levels of physical fitness and function were observed.

In conclusion, this study gathered a comprehensive physical profile of inpatients of a large acute hospital experiencing homelessness. This study also trialed a physical test battery with this cohort and offered recommendations for future studies. It was found that falls are prevalent among this cohort. In general, widespread poor mobility and functional ability was identified irrespective of gender or age. Low physical activity levels were consistently reported. Prolonged mobility aid use was noted, which underlines an unmet rehabilitation need among this population. The 6MWT and SCT were deemed unsuitable measures for this cohort as less than half of participants were able to attempt these measures. Future studies should elucidate suitable strategies to bridge the rehabilitation gap observed in this vulnerable cohort.
Acknowledgements

This study was funded by Trinity College Dublin and St. James’s Hospital Dublin.

This thesis would not have been completed without the help and encouragement of a number of individuals to whom I am very grateful.

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A huge thank you is due to my manager at St. James’s Niamh Murphy for providing me with the opportunity to undertake this Research Masters while working. A thank you also to all of my physiotherapy friends and colleagues at St. James’s Hospital for their interest and support in this study.

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Abstract

**Background:** Homelessness is a particularly intransient form of social exclusion, which is associated with markedly poor health outcomes. Research has shown that adults who are homeless suffer higher levels of premature mortality and age-related medical conditions compared to the general population. Despite the effect of homelessness on physical health, information on physical function and performance in adults who are homeless is largely unexplored.

**Methods:** This cross-sectional study assessed inpatients of St. James’s Hospital who were registered as homeless from November 2018 to May 2019. The following physical performance variables were assessed; functional exercise capacity (six minute walk test), stair-climbing ability (stair climb test), quality of life (EQ5D5L), pain (visual analogue scale), frailty (clinical frailty scale), muscle strength (handgrip dynamometry), loss of skeletal muscle function/sarcopenia (calf circumference), physical performance (short physical performance battery), falls risk (timed up and go), perceptions of physical activity and physiotherapy (open-ended questionnaire). A number of open-ended questions were also asked to ascertain participants’ perspective on their physical ability.

**Results:** A total of 65 participants completed some or all of the test battery. Participants were predominately male (n=44, 67.7%) and most used hostel accommodation or were rough sleepers (n=52, 80%). The mean (+/- SD) age was 47 (13.2) years with a range of 23 to 80 years. 24 participants (36.9%) required the use of a mobility aid. Pain reporting was high among participants with over 63% (n=41) reporting at least one area of pain. Falls were common with 53.8% (n=35) reporting at least one fall in the last 6 months. Only 31% (n=20) of participants were able to climb one flight of stairs and 38% (n=25) were able to walk for 6 minutes. The majority (68.3%, n=X) of participants were classified as frail or pre-frail. Participants provided valuable insights highlighting their low physical capacity and their desire to walk.

**Conclusion:** It was found that this sample of individuals who are homeless had complex health needs and extremely low levels of physical fitness and performance. This study proved that carrying out research with this population is feasible as the study participants were both receptive and engaging. Follow on studies should explore suitable rehabilitation interventions for this vulnerable group.
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<td>Clinical Frailty Scale</td>
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Chapter 1: Introduction
1.0 Introduction

1.1 Background

Good health is an integral part of a well functioning life. Health is not just a lack of illness, but rather it includes wellbeing, physical, mental and social components of life (WHO, 2004). Good health can be an unrealistic expectation for some populations, especially for those who are socially excluded. Socially excluded populations are often considered to consist of people who are homeless, people with substance disorders, sex workers and people who are incarcerated. These populations have common adverse life experiences and risk factors such as poverty and childhood trauma that lead to social exclusion (Fitzpatrick, 2012). Inclusion health is a developing approach that strives to address extreme health and social inequalities (Luchenski et al. 2017).

Homelessness can often be an exceptionally intransient kind of social exclusion. Luchenski et al. (2017) carried out a systematic review of effective interventions for marginalised and excluded populations. A number of barriers to inclusion have been identified. Patient related barriers include fear, poor awareness and judgment of services, restrictive requirements for services (e.g. proof of address), health illiteracy. System related barriers include negative stereotyping by the media and stigma. Excluded individuals who are homeless are especially vulnerable to dramatically poor mental and physical health, including younger onset of chronic disease, multi-morbidity and a reduced life expectancy (Fazel et al. 2014). As highlighted by Hewett (2012), drug or alcohol misuse among people who are homeless often augments existing mental and physical health problems, resulting in a so-called ‘tri-morbidity’.

Socially excluded populations have a mortality rate eight times higher than the average for males, and almost 12 times higher for females (Aldridge 2017). People who are homeless have higher rates of premature mortality largely due to suicide, unintentional injuries, an increased prevalence of infectious diseases, mental disorders and substance misuse (Fazel et al. 2014). Ivers et al. (2019) carried out a retrospective record study of deaths among people who were homeless in Dublin between 2011 and 2015. Out of 201 deaths, the median age at death was 41 years (males 44 years and females 36 years). Drug and alcohol were the leading cause of death for this cohort and was responsible for
38.4% of all verified deaths. Furthermore, in 58.7% (118/195) of all verified cases of death, drugs and alcohol were indicated. These figures highlight the high percentage of potentially avoidable deaths among this population. It is clear that individuals who are homeless in Dublin are an extremely vulnerable cohort and require health intervention where possible.

People who are homeless are considered to be a vastly heterogeneous group (Dawes et al, 2003). A 2014 study by Fazel et al. explored the causes of homelessness. Fazel et al. (2014) proposed that the causes of homelessness are an interaction between individual and structural factors. Individual factors may include poverty, family issues, mental health, and alcohol and substance misuse problems. The shortage of low-cost housing is regarded as the most important structural determinant for homelessness.

Reports by Focus Ireland (September 2019) have highlighted the growing problem of homelessness in Dublin at present. The Focus Ireland Annual Report (September 2019) showed that it helped a record number of over 15,500 people in 2018. This was a rise of over 7% from the 14,500 helped by Focus Ireland in 2017 and a 14% increase since 2016 when it helped over 13,500 people. According to a 2019 report (Department of Housing, Planning and Local Government Homelessness Report April 2019), a total of 4,401 adults were registered as homeless in Dublin.

Further, the Focus Ireland report highlights the growing number of young families and children becoming homeless. It reports that nearly 4,000 children in Ireland are homeless and the number of children homeless has increased dramatically by 365% in 5 years. The growing number of people who are homeless and the increasing numbers of young homeless are causes for concern. For this reason the health of people who are homeless is gaining greater prominence.

An inevitable consequence of the previously mentioned poor health, younger onset of chronic disease and multi-morbidity among individuals who are homeless is an increased usage of unscheduled health care. A 2017 study by Ní Cheallaigh et al. demonstrated that homelessness is associated with a 20-fold increased use of the emergency department and over 10-fold increased use of unscheduled medical inpatient beds compared to the general population. Additionally, a recent UK based study by Bowen et al. (2019) explored emergency department use among people who are homeless. Results showed that this
cohort had an emergency department visit rate 60 times that compared to the general population. St. James’s Hospital is a centrally located hospital in Dublin that has a large number of patients who are homeless admitted and readmitted frequently. According to Ní Cheallaigh et al. (2017), individuals who are homeless account for almost 10% of emergency department attendances and inpatient stays at St. James’s Hospital Dublin despite only representing 0.4% of the catchment population.

Despite the acknowledged poor health profile of people who are homeless and their frequent hospital presentation, the overall physical status and performance of patients who are homeless is not well known. Some research has suggested that an earlier onset of frailty and other geriatric syndromes usually observed in older adults occurs in adults who are homeless (Adams et al 2007, Gelberg et al 1990, Brown et al 2012, Brown et al 2016). A pattern of premature aging is therefore suspected among individuals who are homeless, with physical functioning declining at an accelerated rate in comparison to that of age-matched housed individuals. This may be due to several reasons including physical and mental health conditions, poor access to and uptake of health care, and addictions, which may lead to physiologic and functional impairments. Kushel et al. (2012) underlined that people who are homeless often have great difficulty modifying their environment, which may prolong or exacerbate an existing functional impairment. Therefore, frequent falls and other injurious traumas among this cohort might initiate a decline in functional status. People who are socially excluded might find it harder to recover from injury and illness. This may lead to a pattern of progressive decline in functional status with repeated episodes of acute injury.

The assessment of functional limitations and performance may be important in evaluating the overall health and physical abilities of individuals who are homeless. Verbrugge and Jette (1994) proposed that assessment of functional limitations might offer a useful insight into the risk of progression in the disablement pathway. A functional assessment may help to risk stratify more vulnerable patients and identify who need targeted rehabilitative treatments (Dawes et al. 2003, Dawes et al. 2017). This is important, as it seems that individuals who are homeless have unique needs that may not be fulfilled by mainstream physiotherapy and other available physical health resources.

Along with the aforementioned premature aging, previous studies have also highlighted the high prevalence of physical inactivity in this population (Gregg and Bedard, 2016,
Morrison, 2009, Kendzor et al, 2017). Regular participation in physical activity is not only associated with healthy ageing but can also help delay, prevent or manage diseases including those relating to physical (e.g. cardiorespiratory) and mental health (e.g. depression and anxiety)(Li & Siegrist 2012, Schuch et al. 2017). Conversely, excessive sedentary time negatively impacts both physical and mental health irrespective of physical activity levels (de Rezende et al. 2014). Despite this, information on physical activity levels among people who are homeless is largely unexplored.

While the literature appears to broadly suggest that individuals who are homeless may have low physical activity levels and demonstrate impaired physical function, there seems to be a lack of research into specific variables that may account for these findings. It would appear that the overall physical profile of homeless individuals is relatively unexplored. For this reason, a systematic review investigating the physical function and physical activity levels of homeless individuals was carried out. The review aimed to profile physical performance variables such as physical activity levels, cardiovascular fitness, and muscle strength among homeless individuals.
1.2 Systematic Review:
Functional status and exercise in homeless individuals

Systematic Review Introduction

The objective of this systematic review was to examine and summarize the literature regarding physical activity levels, cardiovascular fitness and functional status among homeless persons. While exercise and functional status are intrinsically linked, this review will explore functional status and physical activity separately before gathering an overall physical profile of this population. The review is systematic in nature and aims to gain a comprehensive physical profile of this population.

Methods of Systematic Review

Study design
This systematic review was conducted to explore functional status and exercise among homeless individuals. The “Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)” (Moher et al. (2009)) and the criteria outlined in “A Measurement Tool to Assess Systematic Reviews (AMSTAR) checklist” (Shea et al. (2017)) guidelines were followed in drafting this review (appendix I). The protocol outlining the planned search strategy and method of analysis for this review was registered online and is available on PROSPERO (appendix II), a register of systematic reviews (CRD42019124306).

Eligibility criteria
This review included studies with a quantitative and/or qualitative study design: controlled trials and observational studies (e.g. cross-sectional, longitudinal, cohort, case-control). Only baseline data from Intervention studies was included. Inclusion criteria were both quantitative and qualitative studies that examined physical function, exercise and/or performance among homeless adults (with/without co-occurring mental illness, infectious disease, substance use disorder), as a primary or secondary outcome measure. It was required that at least 80% of study participants were homeless adults > 18 years. In the case of heterogeneous populations, if information pertaining to homeless people could be
separated and extracted, such studies could be included. Case reports, abstracts with no full text available, commentaries or expert opinion and review articles were excluded.

Search Strategy
A skilled medical librarian was consulted and a comprehensive search strategy was developed with all keywords and subject headings included. The following electronic databases were searched: MEDLINE/PubMed, EMBASE, PEDro, AMED, CINAHL, PsycINFO, SCOPUS, Web of Science and the Cochrane Library. The search terms were adapted for each bibliographic database. The search terms related to three categories: 1) The population (e.g. ‘homeless individuals’, ‘homeless adult’, and ‘homeless person’. 2) Function (e.g. ‘functional status’, ‘functional assessment’, ‘performance’ and ‘limitation’ and 3) Physical activity (e.g. ‘cardiovascular fitness’, ‘physical fitness’, and ‘sedentary behaviour’). The search was divided into two strands: (i) functional status and (ii) physical activity. Due to the relatively small number of studies deemed eligible for inclusion in the systematic review, along with an overlap between the two strands, studies yielded from the two separate search strands were integrated into one systematic review. There was no limit placed on the year, as it was believed that the search strategy would detect articles published within the last thirty years, due to the relatively novel nature of this literature. The bibliographies of all of the included studies were examined to identify further studies. The search strategy is available in appendix III.

Selection criteria
Two researchers independently screened titles and abstracts to identify studies that met the eligibility criteria. Any disagreements between researchers were discussed and if a consensus could not be reached a third party was consulted. All full-texts were obtained and examined in detail to assess for inclusion in this review (Figures 1 & 2).
Figure 1: PRISMA 2009 Flow Diagram 1 Functional Status Search

Records identified through database searching (n = 430)

Records after duplicates removed (n=170)

Records screened (n = 170)  Records excluded (n =120)

Full-text articles assessed for eligibility (n = 50)  Full-text articles excluded, with reasons (n = 44)

Studies included (n = 6)
- Qualitative studies (n = 1)
- Quantitative studies (n = 5)

Reasons for exclusion:
1. Outcome measure did not report on variables relevant to this review (n=37)
2. The study included formerly homeless population (n=7)
Records identified through database searching (n = 2402)

Records after duplicates removed (n = 1644)

Records screened (n = 1644)

Records excluded (n = 1566)

Full-text articles assessed for eligibility (n = 78)

Full-text articles excluded, with reasons (n = 70)

Studies included (n = 8)
- Qualitative studies (n = 2)
- Quantitative studies (n = 5)
- Mixed methods (n = 1)

Reasons for exclusion:
1. Outcome measure did not report on variables relevant to this review (n = 57)
2. <50% of participants were homeless (n = 6)
3. No baseline data (n = 3)
4. A lack of physical outcome measure (n = 4)
Risk of bias and classification of intervention type within studies

Two researchers independently appraised the risk of bias of included studies; any disagreements were resolved through consultation. The Downs and Black (Downs & Black (1998)) checklist was used to assess the risk of bias of all included observational studies. This checklist consists of 27 ‘yes’ or ‘no’ questions across five sections, and can assess the methodological quality of randomised and non-randomised studies (Downs & Black, 1998). The final score is variable as some items of the checklist may not be relevant and can be excluded. In addition, the Cochrane Collaboration’s tool (Higgins et al. (2016)) was also used to assess risk of bias for each RCT, where bias is assessed as a judgment (high, low or unclear) for five domains (selection, performance, attrition, reporting and other).

Data extraction & analysis

Two researchers (SK, JB) extracted data from the studies onto standardized data abstraction forms. Any disagreements were discussed, if a consensus could not be reached, a third party would have been consulted (CNC). Data was extracted using the following headings: methods, allocation, blinding, duration, design, setting, participants, diagnosis, age, sex, inclusion criteria, exclusion criteria, intervention, control group, primary outcomes, secondary outcomes, results in primary outcomes, results in secondary outcomes. Covidence software was used to support a more efficient production of this systematic review.

A quantitative synthesis of included data was planned, but was deemed inappropriate due to the heterogeneity of study design, interventions and outcomes. Therefore, a qualitative synthesis of study interventions and results was completed.

Results of Systematic Review

As indicated by the PRISMA diagrams (Figures 1 and 2), a total of 14 studies were included in the systematic review. There was overlap between the studies obtained from the ‘functional status’ search and the ‘physical activity’ search. Studies included in the systematic review and participant characteristics are presented in Tables 1 and 2.
respectively. Two studies (Bazari et al. 2016 and Quine et al. 2004) were qualitative studies, while Ballard (2009) was both qualitative and quantitative, and the remaining studies were quantitative. The studies measured on a range of physical variables (Table 3).

### Table 1: Studies included in the systematic review

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<th>Country</th>
<th>Design</th>
<th>Inclusion criteria</th>
<th>Living arrangement</th>
<th>Outcomes</th>
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| Ballard, 2009          | US      | Cross sectional                                                       | 1. Homeless women  
2. Age >18 years  
3. Understood and spoke English | Homeless shelters in Wake and Mecklenburg Counties | -HPLII to measure physical activity levels.  
-Qualitatively explored barriers to physical activity |
| Bazari et al. 2018     | US      | Longitudinal Qualitative study including semi-structured interviews    | 1. Age >50 years  
2. Able to give consent  
3. English speaking  
4. Homeless | Unsheltered adults stay in Oakland, California | -Evaluated symptom burden using semi-structured interviews |
| Brown et al. 2012      | US      | Mixed-interview and physical examination                               | 1. Age >50 years  
2. Able to communicate in English  
3. Able to give consent | Emergency, transitional and day centers in Boston | -Fried frailty criteria  
-Self-reported falls and mobility impairments. |
| Brown et al. 2016      | US      | Prospective cohort study                                               | 1. Age >50 years  
2. Able to give consent  
3. English speaking Homeless | Overnight shelters, a recycling center, and places where unsheltered people stayed overnight. | -Functional status  
-Self-reported falls and mobility impairments |
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<tr>
<th>Study</th>
<th>Country</th>
<th>Design</th>
<th>Participants</th>
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<td>Šaderman et al. 2014</td>
<td>Canada</td>
<td>Cross-sectional</td>
<td>Age &gt;18 years</td>
<td>Homeless shelters, meal programs, rooming houses, and a supervised injection site</td>
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<td></td>
<td>-Physical and mental health conditions</td>
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<td>-SF12</td>
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<td>Gregg and Bedard 2016</td>
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<td>Not specified</td>
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<td>US</td>
<td>Pilot study</td>
<td>1. &gt;6th grade English literacy, 2. Willingness to quit smoking, 3. Age &gt;18 years, 4. Willingness to attend smoking cessation treatment</td>
<td>Homeless shelter</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-7 items from the Behavioral Risk Factor Surveillance System Questionnaire: Physical Activity</td>
</tr>
<tr>
<td>Jarmolejo et al. 2018</td>
<td>US</td>
<td>Two group cross-sectional comparative study</td>
<td>Ability to give consent</td>
<td>Homeless young adults attending a drop-in centre, Los Angeles County</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Sit and reach test</td>
</tr>
<tr>
<td>Patanwal et al. 2017</td>
<td>US</td>
<td>Cross-sectional analysis within longitudinal cohort study</td>
<td>1. Age &gt;50 years, 2. English speaking, 3. Able to give informed consent</td>
<td>Overnight homeless shelters, low-cost meal programs, a recycling center, and places where unsheltered homeless adults stayed</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>-Prevalence of symptoms and symptom burden among older homeless-experienced adults</td>
</tr>
<tr>
<td>Reference</td>
<td>Country</td>
<td>Type</td>
<td>Criteria</td>
<td>Location</td>
</tr>
<tr>
<td>--------------------</td>
<td>------------</td>
<td>---------------------------</td>
<td>--------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Quine et al 2004</td>
<td>Australia</td>
<td>Qualitative study</td>
<td>1. Older men ≥ 50 years, 2. In receipt of a pension or benefit, 3. Effectively single, 4. Non-homeowners, 5. Living alone</td>
<td>Non-homeowners in Sydney</td>
</tr>
<tr>
<td>Randers et al 2010</td>
<td>Denmark</td>
<td>Cross sectional</td>
<td>Not specified</td>
<td>Shelters and unemployment offices in Copenhagen, Denmark</td>
</tr>
<tr>
<td>Randers et al 2012</td>
<td>Denmark</td>
<td>Controlled training study</td>
<td>Not specified</td>
<td>Shelters and unemployment offices in Copenhagen, Denmark</td>
</tr>
<tr>
<td>Raven et al. 2017</td>
<td>US</td>
<td>Cross sectional study</td>
<td>1. English speaking, 2. Age &gt; 50 years</td>
<td>Homeless encampments, recycling center, all overnight homeless shelters, and all free and low-cost meal programs</td>
</tr>
<tr>
<td>Wilson, 2004</td>
<td>US</td>
<td>Descriptive, cross-sectional, non-experimental study</td>
<td>1. Homeless women, 2. Registered residents of the shelters, 3. Could read and understand the</td>
<td>Homeless shelters</td>
</tr>
</tbody>
</table>
Table 2: Systematic review participant characteristics

<table>
<thead>
<tr>
<th>Citation</th>
<th>Number of participants</th>
<th>Age mean (SD)</th>
<th>Gender</th>
<th>Race/Ethnicity</th>
<th>&lt; High school education</th>
<th>Comorbid conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballard, 2009</td>
<td>126</td>
<td>41.99 ± 9.42 years</td>
<td>Female = 100%</td>
<td>African American (54%) White (32.5%) American Indian (4.8%) Mixed race (4.8%) Asian (1.6%) Other/unsure (4.4%)</td>
<td>31.8%</td>
<td>High blood pressure: 41.1% Asthma: 26.8% Arthritis: 25% STDs: 22.4%</td>
</tr>
<tr>
<td>Bazari et al. 2018</td>
<td>20</td>
<td>62 years (Range 52-78)</td>
<td>Male = 65%</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Not stated</td>
</tr>
<tr>
<td>Brown et al. 2012</td>
<td>247</td>
<td>56 years</td>
<td>Female = 8%</td>
<td>39.7% white</td>
<td>26.1%</td>
<td>Hypertension (59%), arthritis (44.9%), depression (59.6%)</td>
</tr>
<tr>
<td>Brown et al. 2016</td>
<td>350</td>
<td>58 years</td>
<td>Male = 77.1%</td>
<td>African American (79.7%), White (10.9%) Latino (4.6%), Other (4.9%)</td>
<td>25.7%</td>
<td>Mental health problems (71.3%), smoked tobacco (65.4%), &gt;50% alcohol and/or drug problem</td>
</tr>
<tr>
<td>Gadermahan et al. 2014</td>
<td>100</td>
<td>43.3 +/- 11.9 years</td>
<td>Male = 69%</td>
<td>White (55%), Aboriginal (30%) Other (15%)</td>
<td>27.2%</td>
<td>43.9% arthritis, rheumatism, joint problems, Hepatitis C (31.6%), migraines (28.6%), mental health conditions (52.5%), substance abuse (40.2%), depression (34%), substance dependence</td>
</tr>
<tr>
<td>Study</td>
<td>Sample Size</td>
<td>Age</td>
<td>Gender</td>
<td>Race/Ethnicity</td>
<td>Prevalence</td>
<td>Mortality</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>-------------</td>
<td>--------------</td>
<td>------------</td>
<td>---------------------------------------------------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>Gregg and Bedard 2016</td>
<td>18</td>
<td>41.05 ± 11.32 years</td>
<td>Male 100%</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Not stated</td>
</tr>
<tr>
<td>Kendzor et al. 2015</td>
<td>57</td>
<td>49.4 +/- 7.7 years</td>
<td>Male 66.6%</td>
<td>Predominantly non-White; Black (54.4%) Latino (3.5%) More than one race (5.3%)</td>
<td>Not stated</td>
<td>69.4% were overweight or obese (29.8%)</td>
</tr>
<tr>
<td>Marmolejo et al 2018</td>
<td>40</td>
<td>21.4 ± 2.3 years</td>
<td>Male 67.5%</td>
<td>White 12 (30%) Hispanic 11 (27.5%) Black/African American 8 (20%) American Indian/Alaska Native 3 (7.5%) Native Hawaiian/Pacific Islander 1 (2.5%) Missing 5 (12.5%)</td>
<td>6 (15%)</td>
<td>Not stated</td>
</tr>
<tr>
<td>Pantalawa et al. 2017</td>
<td>283</td>
<td>59 years</td>
<td>Male 75.6%</td>
<td>African American (82.4%)</td>
<td>Not stated</td>
<td>50% suffered from two or more chronic diseases, of which arthritis and pulmonary diseases were most prevalent</td>
</tr>
<tr>
<td>Quine et al 2004</td>
<td>32</td>
<td>Range 50 – 89 years</td>
<td>Male 100%</td>
<td>Not stated</td>
<td>Not stated</td>
<td>21.9% reported arthritis, respiratory problems and/or poor eyesight 66.6% reported conditions such as recent cardiovascular problems (angina, high blood pressure, diabetes)</td>
</tr>
</tbody>
</table>
pressure, heart attack, stroke), arthritis, pneumonia and earlier bouts of cancer, many had dental and eyesight difficulties

<table>
<thead>
<tr>
<th>Randers et al 2010</th>
<th>15</th>
<th>29 ± 2 years</th>
<th>Male = 100%</th>
<th>Not stated</th>
<th>Not stated</th>
<th>Not stated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randers et al 2012</td>
<td>33</td>
<td>37 ± 10 years</td>
<td>Male = 100%</td>
<td>Not stated</td>
<td>Not stated</td>
<td>Regular use of cigarettes, alcohol and cannabis was reported for 73, 36 and 64% of group</td>
</tr>
<tr>
<td>Raven et al. 2017</td>
<td>350</td>
<td>&lt;60 years</td>
<td>Majority male (% not specified)</td>
<td>Majority African American</td>
<td>74.3%</td>
<td>Chronic illness (23.9%), acute illness (21.6%), pain (19.2%), (32.6%) PTSD, 53.3% depression</td>
</tr>
<tr>
<td>Wilson, 2004</td>
<td>137</td>
<td>36 years (range 18-60)</td>
<td>Female = 100%</td>
<td>White (53%)</td>
<td>African American (43.8%)</td>
<td>22%</td>
</tr>
</tbody>
</table>

**Functional status**

**Mobility**

Three studies reported on variables related to mobility: two using self-report and one using the Short physical performance battery (SPPB) (Table 3). Results from the two studies indicated that homeless individuals have difficulty mobilizing. In two studies (Brown et al. 2012 and Brown et al. 2016), mobility was measured by self-reported difficulty walking and by self-reported balance problems. Brown et al. (2012) sampled 247 homeless adults, and found that 102 (41.3%) self-reported difficulty walking (Brown et al. 2012). Furthermore, they found that homeless adults had more difficulty walking compared to population-based cohorts.
Similarly, a later study by Brown et al. (2016) found mobility impairments among participants. A total of 350 participants were included in the study. Mobility impairment was defined as self-reported difficulty walking across a room. It was found that participants who became homeless before the age of 50 had greater problems with their mobility. Overall, 58 adults (29.3%) who were homeless before the age of 50 reported mobility impairment versus 36 adults (23.7%) homeless aged 50 or over. Thus, more mobility impairments were found in those under the age of 50, compared to those over the age of 50.

Raven et al. 2017 found that over half (58.4, n=204) of participants had limitations in lower extremity function measured by the SPPB.

<table>
<thead>
<tr>
<th>Physical Variable</th>
<th>Type of Measure</th>
<th>Total number of studies</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mobility</td>
<td>Self-reported difficulty walking</td>
<td>3</td>
<td>Brown et al. (2012)</td>
</tr>
<tr>
<td></td>
<td>SPPB</td>
<td></td>
<td>Brown et al. (2016)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Raven et al. (2017)</td>
</tr>
<tr>
<td>Frailty</td>
<td>Fried criteria</td>
<td>1</td>
<td>Brown et al. (2012)</td>
</tr>
<tr>
<td>Falls</td>
<td>Self-report</td>
<td>1</td>
<td>Brown et al. (2012)</td>
</tr>
<tr>
<td>Geriatric Syndromes</td>
<td>Physical symptom burden (self-report)</td>
<td>4</td>
<td>Pantanwala et al. (2017)</td>
</tr>
<tr>
<td></td>
<td>SF-12</td>
<td></td>
<td>Bazari et al. (2018)</td>
</tr>
<tr>
<td></td>
<td>Frailty</td>
<td></td>
<td>Gaderman et al. (2014)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Brown et al. (2012)</td>
</tr>
<tr>
<td>Physical Activity levels</td>
<td>Questionnaire</td>
<td>5</td>
<td>Kendzor et al. (2015)</td>
</tr>
<tr>
<td></td>
<td>Self-report</td>
<td></td>
<td>Marmolejo et al. (2018)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Quine et al. (2004)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Greg &amp; Bedard</td>
</tr>
<tr>
<td>-------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Flexibility</td>
<td>Sit and reach test</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Heart Rate (HR)</td>
<td>Mean HR</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Time &gt;90% of HR max</td>
<td>Randers et al. (2010) Randers et al. (2018)</td>
<td></td>
</tr>
</tbody>
</table>

**Frailty**

Just one study included in the systematic review examined frailty. Frailty is a distinctive health state related to the ageing process in which multiple body systems gradually lose their in-built reserves (Turner 2014). A principal feature of physical frailty, as defined by the phenotype model is loss of skeletal muscle function (sarcopenia) (Turner 2014).

**Falls**

Firstly, in relation to balance, Brown et al. (2012) found that out of a sample of 247 homeless adults, 90 participants (36.6%) self-reported difficulty with balance. This predisposes a high proportion of this cohort to falling. In addition, reported falls were high among this population with a total of 131 (53.2%) recalling a fall in the prior year (Brown et al. 2012).

**Geriatric Syndromes**

As previously mentioned, there is an indication that homeless adults suffer ‘premature aging’. It is thought that due to certain lifestyle factors and living conditions, homeless adults may have an earlier onset of geriatric syndromes.
A total of four studies in this review commented on geriatric syndromes. Two studies noted symptom burden such as shortness of breath as an indication of geriatric syndromes. The two other studies used the SF-12 and functional impairment (measured by frailty and mobility) to identify presence of geriatric syndromes.

Patanwala et al. (2017) looked at physical symptoms in people who were homeless aged 50 and older. They found that over one-third (34%, n= 96) had moderate-high physical symptom burden. The most common physical symptoms were joint pain, fatigue, back pain and sleep disturbance. Similarly, Gaderman et al. (2014) used the SF-12 and found that 87.9% (n=53) reported having at least one physical health condition. The mean age was 43.3 years (SD= 11.9 years, range 22-74). The most common physical complaints included arthritis, rheumatism or joint problems (43.9%), along with problems walking or loss of a limb (23.2%). Gaderman et al. (2014) concluded that physical conditions are highly prevalent among homeless individuals and that they rate their functional physical health status substantially lower compared to general population norms.

Brown et al. (2012) evaluated functional impairment, frailty and a number of other declines associated with aging. Based on their results, they concluded that geriatric syndromes are common in older homeless adults and are experienced at higher rates than in the general older population.

These findings correlate with information gathered from the qualitative studies. Bazari et al. (2018) found that physical symptoms experienced by homeless adults interfere with daily functioning. They included 20 participants aged between 52 and 78 (median age 62). It was found that daily hassles and physical conditions of homelessness caused and exacerbated symptoms.

“I can’t be active anymore like playing sports because I used to like to go play basketball or lift weights… but I can’t do nothing anymore… because it’s too much stress and strain” (M, 63)

Some participants cited premature aging as the reason for their physical symptoms and decreased functional ability.
“It’s the arthritis…. Sometimes I feel I am carrying all my weight on my legs. Going up and down the bus, most of the time the bus drivers lower the platform so I can get up but – I just feel like I’ve aged so quickly in my life”

(F, 58)

Physical Activity Levels

Insufficient physical activity levels

Insufficient physical activity levels among homeless adults were reported across the literature. A total of six studies reported on physical activity levels (Table 4). Physical activity levels were quantified through various self-report methods and questionnaires. Kendzor et al. (2015) examined modifiable health risk factors among homeless smokers (n= 57). The results showed that insufficient physical activity was prevalent. Physical activity was measured using 7 items from the Behavioural Risk Factor Surveillance System Questionnaire: Physical activity. This tool measured the frequency of moderate and vigorous leisure activity over the previous week. During the previous week, it was reported that 26.3% (n= 15) failed to meet the recommended guidelines. In total, 69.4% (n= 40) were overweight or obese (29.8% n=17) with a mean BMI of 28.1 (SD= 5.5)

In a similar way, Wilson (2005) explored health-promoting behaviours of sheltered homeless women (n= 137). The study employed the Health-Promoting Lifestyle Profile II (HPLPII), which asks participants to indicate the frequency in which they engage in various health promoting behaviours. The HPLPII consists of six subscales: interpersonal relations, stress management, nutrition, self-actualization, health responsibility and physical activity. The questionnaire is scored as follows: never (N) = 1, sometimes (S) = 2, often (O) = 3, and routinely (R) = 4. It was found that participants scored lowest in the physical activity subscale (mean 1.97, SD = .56, range 1.00-3.63)(Table 4). A 2012 study by Wei et al. investigated the HPLPII in Japanese University students. Students obtained a score of 2.23 (+/- 0.59) in the physical activity scale. While it is not suitable to compare a homeless population to a student population, it is worth noting the low physical activity levels among the individuals experiencing homelessness.

Greg & Bedard (2016) measured physical activity levels using self-report. Less than half (n= 8, 44%) of participants reported partaking in regular physical activity. Marmolejo et al
(2018) also used a self-report questionnaire to measure physical activity. In total, 14 participants (36.8%) reported engaging in low frequency (0-2 times per week) physical activity and 24 (63.2%) in high frequency (3+ times per week) physical activity. However, it was not clear how physical activity was measured. It should also be noted that the mean age of participants in the study was 21.4 years (+/- 2.3).

Quine et al. (2004) found that some participants were until recently physically active. However, deterioration in their health had reduced their activity levels.

“I used to walk about a quarter of a mile up and around the block” (M, 86)

Ballard (2009) explored the reasons why homeless women were achieving insufficient levels of physical activity. Some (n = 13, 10%) reported environmental barriers (e.g. “lack of safe place to exercise”, “no recreational center like a club house or gathering place to exercise”, “can not afford the gym”, “not aware of where and what to do on exercising”).

Table 4: Physical activity/sedentary behaviour

<table>
<thead>
<tr>
<th>Author</th>
<th>Type of measure</th>
<th>Questionnaire</th>
<th>Subscale (if relevant)</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ballard, 2009</td>
<td>Questionnaire</td>
<td>Health Promotion Model Measures</td>
<td>Physical activity subscale [Health-promoting Lifestyle Profile II (HPLP II)]</td>
<td>2.08 (0.66) Range: 1.00-3.88</td>
</tr>
<tr>
<td>Gregg &amp; Bedard, 2016</td>
<td>Reporting of frequency of exercise</td>
<td>Exercise defined as ‘at least three times per week, for at least 20-30 min</td>
<td></td>
<td>8 (44%) participants reported exercising regularly</td>
</tr>
</tbody>
</table>
in duration, and at least moderate-to-vigorous intensity” (as per Courneya & Bobick, 2000)

<table>
<thead>
<tr>
<th>Kendzor et al, 2015</th>
<th>Questionnaire Behavioural Risk factor Surveillance System Questionnaire</th>
<th>Insufficient physical activity defined as &lt;150 minutes of moderate physical activity or &lt;75 minutes of vigorous physical activity (or less than an equivalent combination of the two)</th>
<th>During the previous week, 26.3% did not meet recommended physical activity guidelines</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marmolejo et al 2018</td>
<td>Self-report paper questionnaire but unclear exactly how physical activity measured</td>
<td>‘Low frequency’ physical activity 0-2 times per week</td>
<td>N=14, 36.8%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>‘High frequency’ Physical activity 3+ times/week</td>
<td>N=24, 63.2%</td>
</tr>
</tbody>
</table>
Table 5: Health-Promoting Lifestyle Profile - Physical activity subscale

<table>
<thead>
<tr>
<th>Health-Promoting Lifestyle Profile - Physical activity subscale (From Wilson, 2004)</th>
<th>Mean (SD)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Follow a planned exercise program</td>
<td>1.78 (0.77)</td>
</tr>
<tr>
<td>Exercise vigorously for 20 or more minutes at least three times a week (such as brisk walking, bicycling, aerobic dancing, using a stair climber)</td>
<td>2.05 (0.98)</td>
</tr>
<tr>
<td>Take part in light to moderate physical activity (such as sustained walking 30-40 minutes 5 or more times a week)</td>
<td>2.28 (0.93)</td>
</tr>
<tr>
<td>Take part in leisure-time (recreational) physical activities (such as swimming, dancing, bicycling)</td>
<td>2.02 (0.76)</td>
</tr>
<tr>
<td>Do stretching exercises at least 3 times per week</td>
<td>1.90 (0.89)</td>
</tr>
<tr>
<td>Get exercise during usual daily activities (such as walking during lunch, using stairs instead of elevators, parking away from destination and walking)</td>
<td>2.59 (0.94)</td>
</tr>
<tr>
<td>Check my pulse when exercising</td>
<td>1.53 (0.80)</td>
</tr>
<tr>
<td>Teach my target heart rate when exercising</td>
<td>1.61 (0.76)</td>
</tr>
</tbody>
</table>
The HPLP II consists of a 52-item scale that encompasses a total score and 6 subscales (8 to 9 items each). See the above physical activity subscale. The HPLP II is scored with a 4 point response format: never = 1, sometimes = 2, often = 3; and routinely = 4. Scores are calculated for the total score and 6 subscale scores by calculation of a mean of the individual’s responses. (Wilson 2005)

**Flexibility**

Flexibility is critical to musculoskeletal health and wellness by reducing risk of injury (Marmolejo et al. 2018). Two studies explored flexibility. Gregg & Bedard (2016) used the sit and reach test and found that participants (n= 18) scored far below the acceptable range of flexibility (24.32cm +/- 8.07).

Marmolejo et al. (2018) employed a number of flexibility assessments (sit and reach, butterfly, right shoulder and left trunk twist tests). The study findings suggested that among young adults, the musculoskeletal systems, in particular the groin, shoulder and back are negatively affected by experiencing homelessness.

**Heart Rate**

Randers et al. (2010) studied activity profile and psychological response to football training for untrained males and females, elderly, youths and homeless. The study found that the mean heart rate during small-sided football games was 80% of the maximum heart rate for the entire sessions irrespective of the level of training, sex, social background and age. Thus, despite the previously described low levels of physical activity among this population, it appears that homeless adults have the potential to create physiological adaptations and improve performance with regular training.

Furthermore, Randers et al. (2012) investigated heart rate and movement pattern in street soccer for homeless men. During one hour of soccer training the mean heart rate was 154 +/- 12 beats per minute. The study concluded that males experiencing homelessness had very poor aerobic fitness and cardiovascular health profile. However, while physical activity levels are low among this population, there is evidence to suggest that activity levels and physical fitness could be improved with an appropriate intervention.
Systematic Review Discussion

This review examined functional status and physical activity levels among homeless adults. The included studies evaluated a range of outcomes including mobility, frailty, falls, geriatric syndromes, physical activity levels, flexibility and heart rate. The majority of the studies were quantitative, while two were qualitative [Bazari et al. (2018), Quine et al. (2004), and one was mixed methods Ballard (2009)]. Overall, the studies indicated higher levels of functional impairment and lower levels of physical activity among homeless adults compared to age matched norms. Some barriers to exercise were explored.

Firstly, it should be noted that, while a large number of studies were yielded from the two separate searches (n= 2832), relatively few studies (n= 14) met inclusion criteria. A number of studies were excluded as they reported on formerly homeless populations or fewer than half of the study participants were homeless. This finding indicates that functional status and exercise levels among homeless adults are under-researched. The systematic review included a total of 1,808 participants across all studies, of which 65.6% (n=956) were male, 34.4% (n=502) were female, while gender was not specified for 350 participants.

Variables reported in studies included within this review were as follows; frailty, falls, HR, flexibility, mobility impairment, frailty and falls.

Mobility impairments were reported in three studies (Brown et al. 2012, Brown et al. 2016, Raven et al. (2017)). Geriatric syndromes in adults experiencing homelessness were explored in a number of studies (Patanwala et al. (2017), Gaderman et al. (2014), Brown et al. (2011), Bazari et al. (2018)). Additionally, activity levels were examined in four studies (Kendzor et al. (2015), Wilson (2005), Quine et al. (2004), Ballard (2009)). Different questionnaires were used to qualitatively measure physical activity. While Ballard (2009) and Wilson (2005) used the health-promoting lifestyle profile, Kendzor et al. (2015) used the Behavioural Factor Surveillance System Questionnaire: Physical Activity and Quine et al. (2004) qualitatively explored activity levels. In six studies physical activity was explored using self-report rather than objective measures. Two studies examined flexibility (Marmolejo et al. (2018), Greg & Bedard (2016)), while Randers et al. (2010), Randers et al. (2018) examined heart rate.
Frailty was reported among a cohort of adults experiencing homelessness in a 2012 study by Brown et al. Frailty was measured using the Fried criteria in which more than 3 of 5 characteristics were present: unintentional weight loss, low physical activity, exhaustion, slow walking speed and weak handgrip. In total, 40 participants (16%) met frailty criteria, bearing in mind that participants were aged between 50 and 69.

Brown et al. (2012) was the only study in the systematic review to report on falls. Falls are the leading cause of injury in adults aged 65 years or older (Jin 2018). A major fall can result in decreased functional independence and quality of life. The risk of falling increases with age for a number of reasons, including overall weakness and frailty, balance problems, cognitive problems, vision problems, medications, acute illness, and other environmental hazards (Jin 2018). The above risk factors are pertinent to the homeless population due to the aforementioned weakness, frailty and illness among this cohort.

The majority of studies (n=11) employed self-report methods of evaluating physical variables. While self-report is valuable for measuring exercise and fitness, objective measures such as VO2 max for cardiorespiratory fitness, and accelerometers for physical activity are considered more robust methods of evaluation. Consistency and the use of standardized outcome measures can aid comparison of results across studies.

As the studies measured a range of physical variables and used different outcome measures, it is difficult to draw conclusions on homeless adult’s functional status and exercise habits. A lack of consistency across the studies makes it hard to compare the studies. It is clear that there are no current guidelines or suggestions to measure functional status or exercise in this cohort. Due to the heterogeneous nature of the studies and diversity of outcome measures employed, (e.g. HPLP II, behavioural risk factor surveillance system questionnaire and self-report questionnaires to measure physical activity) it was not possible to pool results.

As seen from Table 2, the research predominantly studied male homeless adults. Four studies (Gregg and Bedard (2016), Quine et al. (2004), Randers et al. (2010), Randers et al. (2012)) included only male participants. Furthermore, eight of the remaining studies were majority male, meaning that only two studies examined females exclusively (Ballard (2000), Wilson (2004). The reason for this may be that there were more men available to
take part in the study. Alternatively, it is possible that there was higher compliance among men compared to women.

A total of nine studies (64.3%) were carried out in the USA, two in Canada (14.3%), two in Denmark (14.3%) and one in Australia (7.1%). Only two studies were carried out in Europe (Randers et al. (2010), Randers et al. (2012)). This may indicate that research relating to functional status and physical activity among individuals who are homeless is largely unexplored, particularly in Europe. Furthermore, all of the studies in the systematic review focused on participants outside of the hospital setting. As previously mentioned, adults experiencing homelessness often experience poor health. Thus, there appears to be a need to investigate inpatients who are homeless. Additionally, more is known about male adults experiencing homelessness than females, as this review included 956 males and only 502 females.

From Table 2, it can be seen that 6 studies (42.9%) only included homeless adults over the age of 50. The mean age of participants in the study by Marmolejo et al. (2018) was 21.4 (+/- 2.3), while Bazari et al. (2018) had a mean age of 62 (range 52-78). The wide age range between studies and the lack of in-depth analysis by age made it hard to draw conclusions regarding the physical profile of homeless adults from this systematic review. Variances in race/ethnicity were noted in Table 2 also. This suggests that the homeless populations in the studies are heterogeneous.

While a number of limitations to the studies have been discussed, there was an overall consistent finding. Across all of the studies it was found that in general there were poor levels of physical activity, fitness and function. While different variables and measures were used, participants scored below age-matched norms across the board. This finding suggests a global decline or substandard level of physical fitness and function among homeless adults.

In conclusion, this review shows that homeless adults have poor functional status and physical fitness. While the studies are useful in gathering an overall physical picture of this population, further examination of specific variables (e.g. falls, frailty, exercise tolerance) is needed. More objective measures should be used to examine exercise in this cohort. In addition, there is a need to develop guidelines or suggestions on physical performance and exercise testing among homeless adults.
1.3 Justification for this topic of research

Homeless individuals are a heterogeneous group. Upon reviewing the literature it was noted that studies focused on sheltered or unsheltered individuals outside of the hospital setting (see Table 1). Thus, no studies included hospitalized homeless individuals. Hospitalized homeless may represent the most vulnerable and debilitated of the homeless cohort. This highlights the evident lack of research into the physical profile of homeless inpatients and underlines the need to explore this area.

Further exploration into this area of research is required to determine a suitable physical test battery for this population. Recommendations on appropriate measures to examine balance, cardiovascular fitness, functional ability, and perceived exercise tolerance are needed. Furthermore, there appears to be less known about the physical profile of homeless females compared to males, due to a greater number of male participants taking part in the studies. In addition, some studies placed an age restriction on participation.

For the above reasons, there is a clear need to investigate the physical health and performance variables of people who are homeless and hospitalized. Due to the heterogeneity of this population it is important to include both males and females and evaluate potential gender-based differences. It would also be beneficial to explore the physical status of homeless individuals closely according to age. Any recommendations on a suitable test battery for this cohort would be beneficial for future studies.
1.4 Aims and objectives of the study

Overall aim:
The overall aim of this study is to profile the physical functioning and performance in long-term inpatients experiencing homelessness at St. James’s Hospital.

Objectives:

1. To measure the following variables; Muscle strength, muscle mass, physical performance, dynamic balance, cardiovascular fitness, frailty, physical activity and quality of life in long-term homeless adults admitted to St. James’s Hospital

2. To assess the feasibility of using the battery of measures for this population proposed in this project

3. To profile the physiotherapy referral patterns of participants during their inpatient stay

4. To ascertain the study populations’ perception of their own unmet physical health needs, exercise habits and preferences
Chapter 2: Methods
Methods

Study design

This study was cross-sectional in design. Participants were assessed at a single time point during an inpatient hospital stay in St. James’s Hospital.

Setting

The study took place in a ward-based inpatient setting at St. James’s Hospital, Dublin 8. The Tallaght Hospital/St. James’s Hospital Research Ethics Committee granted ethical approval for the study (appendix V). Due to its inner city location, St. James’s Hospital has a large proportion of homeless people within its catchment area. In this setting, it has been shown previously that people registered as homeless accounted for 459 (6.5%) of all unscheduled admissions in 2015 related to 261 people who were homeless (Ní Cheallaigh et al. 2017). The Power BI software system provides a live daily update of the number of inpatients registered as homeless in St. James’s Hospital.

Dr. Clíona Ní Cheallaigh is a consultant in general medicine and infectious diseases at St James’s Hospital. Dr. Ní Cheallaigh is one of the world’s first consultants working in inclusion health. This inclusion health service is a dedicated service to tackle health and social inequities among the most vulnerable and socially excluded populations: the homeless, people with substance use disorders, sex workers and prisoners. (URL: https://www.irishtimes.com/life-and-style/health-family/dr-homelessness-caring-for-dublin-s-most-vulnerable-patients-1.3247190)
Subject Recruitment

Recruitment took place from November 2018 to May 2019. Demographic data, participant information and medical details were gathered from the electronic database at St. James’s Hospital.

The study employed consecutive admissions and considered all participants registered as homeless (within the study time frame) for inclusion in the study. If a study participant was re-admitted during the study time-period, the readmission was noted but data pertaining to the first admission during the study time period only was included in the study.

Study Procedure

1. Via a process of consecutive admissions, all patients registered as homeless were eligibility screened for study participation by Dr. Cliona Ní Cheallaigh as part of her consultant liaison service.
2. The study investigator checked the EPR (Electronic patient record) and Power-BI (computerised system in St. James’s Hospital which generates live, interactive reports of admissions) daily and tracked number and location of inpatients registered as homeless on the EPR (which feeds into Power-BI).
3. The research physiotherapist (SK) then approached potential participants on the ward. The study was explained to the patient and the opportunity was given to participants to ask any study-related questions. An information leaflet and consent form (appendix IV) was given to the patient. If they were agreeable to participate, consent was gained. Participants were given up to 2-3 days to consider if they wanted to take part or not.
4. The test battery was conducted. Where possible it was conducted in one session, but where necessary it was completed over >1 session, as long as this was within one inpatient admission
Inclusion Criteria

• All inpatients registered as homeless who are at least 18 years of age

Exclusion Criteria

• Insufficient level of English to follow instructions required for study participation (unless translator present).
• Cognitive impairment, delirium, agitated state or other reasons to a degree that precludes assessment. Medical or orthopaedic reasons that would preclude ability to complete test battery (the patient may be assessed when these have resolved).
• Confirmed pregnancy (tests outlined in this study are not deleterious to people who are pregnant but as people with an advanced pregnancy may score differently on physical functioning/performance tests, people with a confirmed pregnancy were excluded from study participation to limit bias).
Data Handling

Newly implemented GDPR regulations were followed throughout the study. In compliance with principles of data minimisation, only data needed for the purposes of this study was collected. The EPR, medical chart and physiotherapy notes were assessed to obtain the following information; age, gender, BMI, long term living arrangement, usage of unscheduled health care over previous year, co-morbidities, drug/alcohol/smoking habits, number of falls over previous year, malnutrition, pre-admission mobility status, length of current admission, referral destination and accessibility of referral destination. If the patient underwent physiotherapy treatment the following variables were collected from the physiotherapy notes; reason for referral, presenting complaint, physiotherapy intervention and number of physiotherapy sessions while an inpatient.

Hard copies of the data collected during the study were filed and stored in a locked cabinet for the minimal time period possible. The electronic data was stored in a data drive (memory stick) and back-up data drive in the shared computer within the post-graduate room of the Trinity Centre. A hard disk encryption device provided by IT services, Trinity College Dublin (TCD) fully integrated with operating systems was utilized.

In compliance with local regulations, data will be retained for a maximum of five years with the Discipline of Physiotherapy, TCD in a password protected data drive for the purpose of final thesis submission for an academic qualification and subsequent dissemination in a peer reviewer journal. The data may also be used to inform future studies in this area. The key to the cabinet was available only by the project supervisor and lead contact person. All documents and files were encrypted and protected with a password. This was accessed by username and password of authorized researchers only. Every available step was taken to ensure GDPR compliance by also ensuring computing devices used for this study were safe and secure.
### Table 6: Study test battery of outcome measures

<table>
<thead>
<tr>
<th>Name</th>
<th>Category</th>
<th>Equipment</th>
<th>Scoring System</th>
</tr>
</thead>
<tbody>
<tr>
<td>EQ5D5L</td>
<td>Quality of Life</td>
<td>EQ5D5L score sheet</td>
<td>1-5 scale</td>
</tr>
<tr>
<td>VAS</td>
<td>Pain</td>
<td>VAS print out</td>
<td>0-10 scale</td>
</tr>
<tr>
<td>Handgrip dynamometry</td>
<td>Strength</td>
<td>Hand held grip dynamometer</td>
<td>Numerical value</td>
</tr>
<tr>
<td>Calf Circumference</td>
<td>Sarcopenia</td>
<td>Measuring tape</td>
<td>Calf circumference &lt;31cm has been associated with disability (Rolland et al, 2003).</td>
</tr>
<tr>
<td>SPPB</td>
<td>Physical performance</td>
<td>Stopwatch, chair</td>
<td>The tests are scored between 0 and 4 and summed (maximum score, 12)</td>
</tr>
<tr>
<td>TUG</td>
<td>Dynamic balance</td>
<td>Stopwatch, chair</td>
<td>Time in seconds</td>
</tr>
<tr>
<td>6MWT</td>
<td>Physical Performance</td>
<td>Marked 30m course, stopwatch, pulse oximeter</td>
<td>Distance in m</td>
</tr>
<tr>
<td>SCT</td>
<td>Physical performance</td>
<td>Stopwatch</td>
<td>Time in seconds compared to standard norms</td>
</tr>
<tr>
<td>CFS</td>
<td>Frailty</td>
<td>CFS score sheet</td>
<td>Rating scale 1-9</td>
</tr>
<tr>
<td>PA and open ended Qs</td>
<td>Physical activity levels</td>
<td>Questionnaire print out</td>
<td>Analysis</td>
</tr>
</tbody>
</table>

### Study Outcomes and Testing Procedures

The assessment tools listed in the above Table 6 focus on physical performance, strength, frailty and balance. These tools were selected as this study aimed to gather a physical profile of a homeless inpatient population. In the event that an assessment had to be prematurely terminated, the remaining untested measures could be tested at a later date provided it was on the same hospital admission.
The systematic review helped to inform the choice of tests in the present study. Studies from the systematic review (Brown et al. (2012), Brown et al. (2016) and Raven et al. (2017)) reported on mobility, in particular difficulty with mobilizing among this cohort. Therefore, this study utilized both quantitative measures (SPPB) and self-report (EQ5D5L) to measure difficulty mobilizing. Similarly, several of the systematic review studies reported on frailty and falls. Therefore this study employed measures such as the CFS, the TUG and self-reported falls. Finally, similar to the systematic review, this study used questionnaires and self-report to measure physical activity levels.

**Short Physical Performance Battery (SPPB)**

The SPPB (appendix VI) measures a number of aspects of physical performance. It comprises three tasks: a balance task, five timed sit-to-stand, and a short timed walk (see appendix I). The three tasks are scored and a higher total score indicates better lower-body function. Reliability of the SPPB has been shown to be remarkably high in the U.S. populations, with intraclass correlation coefficient (ICC) values ranging between .88 and .92 (Ostir et al. 2002). A study by Vasunilashorn et al. (2009) showed that participants with SPPB scores <10 at baseline had a significantly higher chance of mobility disability at 3 year follow up. In addition, a review by Cooper et al. (2010) concluded that walking speed, chair rises and standing balance (all of which are included in the SPPB) are associated with mortality.

**Timed up and GO (TUG)**

The timed up and go (TUG) is a test commonly used to screen for falls risk in the community and inpatient setting (Barry et al. 2014) (Figure 3). The TUG is a modified version of the Get up and Go test (Mathias et al. 1986, Podsiadlo et al. 1991) and was developed in 1991. The TUG measures the time it takes a person to stand up from an armchair; walk three meters and turn back to return to the chair (Steffen et al. 2002). Podsiadlo et al. (1991) reported high intratester and intertester reliability for the TUG in elderly populations (ICC= .99). In addition, Shumway-Cook et al. (2000) found that the TUG had a sensitivity and specificity of 87% for identifying people who fall. Construct
validity has been shown through correlation of TUG results with measurements collected for gait speed (pearson r= -.74), Barthel Index (pearson r= -.79), and functional stair test (r=.59) (Mathias et al. 1986, Hughes et al. 1998).

Figure 3: Timed Up and Go protocol
(URL:https://www.sciencedirect.com/science/article/abs/pii/S000399931600139)

Six-Minute Walk Test (6MWT)

The 6MWT (see appendix VII), first described by Guyatt et al. (1985) is a measure of functional capacity in which a patient ambulates as far as possible over the course of six minutes. Communication with the patient is kept to a minimum and distance covered; rest breaks, oxygen saturation levels, heart rate and dyspnoea levels are recorded (see appendix II). Good test-retest reliability (.88<R< .94) has been shown for the 6MWT in a population of older adults (Rikli et al. 1998). Acceptable validity levels of the 6MWT have also been demonstrated (Rikli et al. 1998).
The SCT (appendix VIII) is a measure of functional strength, balance and agility through ascending and descending a set number of steps (Bennell et al. 2011). It is recommended that stairs with 8-14 steps and two handrails be used (Dobson et al. 2013). The tester uses a stopwatch and the total time taken to ascend and descend the steps is recorded to score the test (see appendix III). The SCT has demonstrated excellent inter-rater reliability (r = .94) in patients following total knee arthroplasty (Almeida et al. 2010). The SCT also demonstrated good construct validity, negatively correlating with lower limb strength in knee osteoarthritis (Bennell et al. 2011). The SCT has also showed responsiveness to detecting initial deterioration and subsequent improvement post total joint arthroplasty (Kennedy et al. 2005)
**Handgrip dynamometry**

Isometric handgrip strength is strongly linked with lower extremity muscle power, knee extension torque and calf cross-sectional muscle area (Cruz-Jentoft et al. 2010) (Figure 4). While a systematic review by Mijnarends et al. (2013) highlighted handheld dynamometry as a valid and reliable tool to measure muscle strength in community dwelling older people, the need for a standardized protocol was underlined. Samuel et al. (2012) argued that handgrip strength may not be an accurate predictor of overall strength and that lower extremity strength may be more relevant and important for functional activities. Thus, for this reason a combination of measures was used in this study investigating homeless inpatients.

![CAMRY Handgrip Dynamometer](https://www.climbing.com)

**Figure 4: CAMRY Handgrip Dynamometer**

(URL: [https://www.climbing.com](https://www.climbing.com))

**Calf circumference**

Sarcopenia has been defined as the loss of skeletal muscle mass and strength that occurs with advancing age (Morley, 2001). Given the risk factors for sarcopenia include early life development influences, a sub-optimal diet, chronic diseases and a number of drug treatments as well as the effect of chronological ageing, homeless populations are highly susceptible to sarcopenia detrimentally affecting strength (Paddon-Jones et al
2008, Sayer et al 2008, Thompson 2007). The European Working Group on Sarcopenia in Older People (EWGSOP) recommends using the presence of both low muscle mass and low muscle function (strength or performance) for the diagnosis of sarcopenia (Cruz-Jentoft et al, 2010).

CT and MRI are the gold standards for estimating muscle mass in research. BIA (bioimpedence analysis) might be a good alternative to dual energy X-ray absorptiometry (DXA). Alternatively, calf circumference (Figure 5) correlates positively with muscle mass; calf circumference <31cm has been associated with disability (Rolland et al, 2003).

Figure 5: Calf circumference measurement
(URL: https://www.compression-socks.com/how_to_measure.php)
Subjective Measures:

Clinical Frailty Scale (CFS)

Frailty is a ‘widely used term to denote a multidimensional syndrome of loss of energy reserves (energy, physical ability, cognition, health) that gives rise to vulnerability’ (Rockwood, 2005). The CFS is scored on a scale from 1 (very fit) to 9 (terminally ill) and is based on clinical judgment (Rockwood et al. 2005). Each point on the scale is correlated with a description of frailty along with a visual chart to aid the tester in classifying frailty (appendix IX). According to Rockwood et al. (2005) a score >5 indicates frailty. The CFS has been validated as an adverse outcome predictor of older inpatients (Basic et al. 2014).

EQ5D5L

The EuroQol-5 Dimension (EQ-5D) is a widely used tool to measure health related quality of life (Hernandez et al. 2019)(appendix X). The Number of responses of the original EQ-5D was increased from 3 to 5 levels (EQ-5D-5L). A comparison study by Conner-Spady et al. (2015) concluded that the EQ5D5L provided stronger validity evidence than the EQ5D3L, particularly in relation to mobility, usual activities and pain/discomfort in patients with osteoarthritis. Intraclass correlation coefficients were 0.61-0.77 for the 5L dimensions and 0.87 for the 5L index (Conner-Spady et al. 2015).

Visual Analogue Scale (VAS)

The VAS is a simple and commonly used tool for the assessment of pain intensity (Carlsson, 1983). The VAS is a continuous scale comprised of a horizontal line with verbal descriptors whereby the patient is asked to rate their pain (Figure 6). A 2018 study by Alghadir et al. showed that the VAS was the most reliable and accurate in measuring OA knee pain compared to numerical rating and verbal rating scales. It was shown to have an intraclass correlation coefficient of 0.97.
A physical activity and open-ended questionnaire was devised to be included in the study (Table 7). The questionnaire asked questions relating to the intensity and frequency of exercise participation, perceptions of exercise and attitudes towards physiotherapy. The questionnaire also focused on what matters to the participant and what their ideal exercise programme would consist of.
Table 7: Physical activity and Open-ended Questionnaire

<table>
<thead>
<tr>
<th>Physical Activity Questions</th>
<th>1. On average how many <strong>days</strong> per week do you engage in moderate-strenuous exercises (like a brisk walk)?</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2. On average how many <strong>minutes</strong> do you engage in exercise at this level?</td>
</tr>
<tr>
<td>Open-ended Questions</td>
<td>1. Do you feel you have any concerns with your physical health (your strength, how fit you feel) at the moment?</td>
</tr>
<tr>
<td></td>
<td>2. Is there anything we could do better to address these concerns?</td>
</tr>
<tr>
<td></td>
<td>3. What matters most to you at the moment?</td>
</tr>
<tr>
<td></td>
<td>4. What are you not able to do that you would like to be able to do?</td>
</tr>
<tr>
<td></td>
<td>5. If we were to design an exercise service what would it look like to you?</td>
</tr>
</tbody>
</table>
Statistical Analysis

Descriptive analysis was undertaken to quantify physical functioning and performance of participants within this study. Statistical analysis was employed to (i) compare study variables between genders, (ii) evaluate differences in study variables according to decade of presentation. Data was visually examined and plotted to evaluate for normal distribution and the presence of outliers. A 1-sample Kolmogorov-Smirnov test was applied to assess for normality of distribution. If data were normally distributed independent t tests were carried out to evaluate gender-based differences between variables and a Mann Whitney test was applied if data were non-normally distributed. To evaluate age-based differences for different decades of presentation, an ANOVA test was applied if data were normally distributed and a Kruskal Wallis test for non-normally distributed data. Due to small numbers of participants over 80 years, the 7th and 8th decades were collapsed for comparison of variables across decades. No adjustment was made for multiple testing. Data was assessed using IBM SPSS V24 and p<0.05 was considered significant.

Thematic analysis using the methodology from Braun and Clarke (2006) was used to identify patterns/themes in data generated from open-ended questions. According to Braun and Clarke (2006) thematic analysis is a method for identifying, analysing and reporting themes within data, as well as interpreting aspects of the research topics. The six-phase framework for thematic analysis was applied. This includes: becoming familiar with the data, generating initial codes, searching for themes, reviewing themes, defining themes and writing the data up. A theme as described by Braun and Clarke (2006) captures something important about the data in relation to the research topic and illustrates a level of pattern within the data field. In this study, two reviewers became familiar with the data, generated codes and searched for themes independently. The two reviewers then came together to review the themes, define the themes and write up the data.
Chapter 3: Results
Results

In total, 122 homeless inpatients were eligibility screened between November 2018 and May 2019. The total number of participants who completed all or some of the assessment was 65. Figure 7 shows that 57 participants were excluded for a number of different reasons. The most common reasons were that the patient was off the ward (n= 23), not feeling up to it (n= 17) or required a translator to comply with the study test battery (n= 6).

Figure 7: Flow diagram of participants through the study

-Participant off ward/"gone for smoke" (n=23)
-Not interested/not feeling up to it (n=17)
-Absconded (n=3)
-Too drowsy (n=3)
-Behavioural/aggressive (n=2)
-Required translator/no translator present (n=6)
-Patient died on the ward due to overdose (n=1)
-Receiving end of life care (n=1)
-Too medically unwell (n=1)
Participant demographics

Participant demographics are presented in Table 8. The majority of participants (n=44, 67.7%) were male. The mean (+/- SD) age was 47 (+/- 13.2) years with a range of 23 to 80 years (Figure 8). The majority of participants (n=57, 87.7%) were born in Ireland, with five participants (7.7%) from other parts of Europe, two participants (3.1%) from Africa and one from Asia (1.5%). Most participants (n= 41, 64%) utilized hostel accommodation while others lived in sheltered accommodation (n=3, 4.6%), with family/friends (n=5, 7.7%), hotel (n=3, 4.6%) or were rough sleepers (n=11, 17%). BMI was only recorded for 40% of participants (n=26). Of those who had a BMI measurement, only ten participants (38.5%) were classified as being a normal weight. In total, two participants (7.7%) were classified as underweight, ten (38.5%) were overweight and 4 (15.3%) were obese.

Of note, more than half of the participants (n=34, 52%) reported consuming excess alcohol (Table 9. A smaller percent (n= 23, 35.4%) admitted to actively using heroin or Intravenous drugs. The majority (n= 52, 80%) were current smokers. In relation to physical health, 53.8% (n=35) reported at least one fall over the last 6 months, while 63% (n=41) reported at least one are of pain. Many participants had multiple comorbidities (Figure 2), with mental health issues, Hepatitis C, alcoholic liver disease and epilepsy/seizure disorders among the most common.

More than one third of participants (n= 24, 36.9%) used a mobility aid (Table 10). Sixteen males (36.4%) used a mobility aid while 8 females (38.1%) used a mobility aid. Females used crutches (n= 5) or a frame (n= 3), while males used a walking stick (n= 3), crutches (n= 6), a frame (n= 3) or a wheelchair (n= 4) (see Figures 9 and 10).

Among the females, the mean age of those using a frame was 57.6 years (+/- 9.5)(range 47-70) and a crutch/crutches was 39 years (+/- 6.5)(range 29-41). In comparison, the mean age of males using a frame was 73.3 years (+/- 5.3) (range 67-80) and a crutch/crutches was 44.3 (+/- 6) (range 35-53). The mean age of male wheelchair users was 36.8 (+/- 5.4) years (range 28-42) and walking-stick users was 62.6 (+/- 9.5) years (range 50-73). Out of those who used a mobility aid, only 4 (16.7%) were previously independent without an aid prior to hospital admission. Reasons for now requiring a mobility aid included a recent leg amputation (n=1) and pain (n=3)
Table 8: Demographics of study participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
</table>
## Demographics

### Gender

<table>
<thead>
<tr>
<th>Gender</th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>44</td>
<td>21</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Age, years mean (SD)</th>
<th>Age, years range</th>
<th>Median age</th>
<th>Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>47.4 +/- 13.2</td>
<td>23-80</td>
<td>45</td>
<td>40</td>
</tr>
</tbody>
</table>

### BMI (Kg/m2)

<table>
<thead>
<tr>
<th>BMI Category</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight (&lt;18.5)</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Normal weight (18.5-24.9)</td>
<td>10</td>
<td>15.4</td>
</tr>
<tr>
<td>Overweight (25-29.9)</td>
<td>10</td>
<td>15.4</td>
</tr>
<tr>
<td>Obese (&gt;30)</td>
<td>4</td>
<td>6.2</td>
</tr>
<tr>
<td>Not recorded</td>
<td>39</td>
<td>60</td>
</tr>
</tbody>
</table>

### Race/ethnicity

<table>
<thead>
<tr>
<th>Race/ethnicity</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Irish</td>
<td>57</td>
<td>87.7</td>
</tr>
<tr>
<td>Other European (Polish, German, Lithuanian, Turkish)</td>
<td>5</td>
<td>7.7</td>
</tr>
<tr>
<td>African</td>
<td>2</td>
<td>3.1</td>
</tr>
<tr>
<td>Asia</td>
<td>1</td>
<td>1.5</td>
</tr>
</tbody>
</table>

### Current living arrangement

<table>
<thead>
<tr>
<th>Current living arrangement</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hostel accommodation</td>
<td>41</td>
<td>64.1</td>
</tr>
<tr>
<td>Rough Sleeping</td>
<td>11</td>
<td>16.9</td>
</tr>
<tr>
<td>Residing with friends/family</td>
<td>5</td>
<td>7.7</td>
</tr>
<tr>
<td>Sheltered accommodation</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Count</td>
<td>Value</td>
</tr>
<tr>
<td>--------------------------</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Hotel</td>
<td>3</td>
<td>4.6</td>
</tr>
<tr>
<td>Rehabilitation facility</td>
<td>3</td>
<td>4.6</td>
</tr>
<tr>
<td>Unknown</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td>Repeat admission during 7 month data collection</td>
<td>11</td>
<td>16.9</td>
</tr>
</tbody>
</table>
Table 9: Alcohol, drug and smoking habits of study participants

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reported alcohol consumption</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Excess alcohol</td>
<td>34</td>
<td>52.3</td>
</tr>
<tr>
<td>Ex-alcohol abuse</td>
<td>4</td>
<td>6.2</td>
</tr>
<tr>
<td>Non drinker/drugs</td>
<td>6</td>
<td>9.2</td>
</tr>
<tr>
<td>Undocumented</td>
<td>21</td>
<td>32.3</td>
</tr>
<tr>
<td>Documented alcohol related liver damage</td>
<td>12</td>
<td>18.5</td>
</tr>
<tr>
<td><strong>Reported drug habits</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current substance misuse</td>
<td>23</td>
<td>35.4</td>
</tr>
<tr>
<td>Intravenous drug use (IVDU)</td>
<td>19</td>
<td>29.2</td>
</tr>
<tr>
<td>Cocaine</td>
<td>2</td>
<td>3.1</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>2</td>
<td>3.1</td>
</tr>
<tr>
<td>Former IVDU/drug abuse</td>
<td>12</td>
<td>18.5</td>
</tr>
<tr>
<td><strong>Current smoker</strong></td>
<td>52</td>
<td>80</td>
</tr>
<tr>
<td>Ex smoker</td>
<td>5</td>
<td>7.7</td>
</tr>
<tr>
<td>Non smoker</td>
<td>11</td>
<td>16.9</td>
</tr>
<tr>
<td>Unsure</td>
<td>3</td>
<td>4.6</td>
</tr>
</tbody>
</table>
Table 10: Physical variables of study participants

<table>
<thead>
<tr>
<th>Physical Variable</th>
<th>N</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pre-admission mobility status</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Independent no aid</td>
<td>40</td>
<td>61.5</td>
</tr>
<tr>
<td>Uses an aid</td>
<td>24</td>
<td>36.9</td>
</tr>
<tr>
<td>Undocumented</td>
<td>1</td>
<td>1.5</td>
</tr>
<tr>
<td><strong>Type of aid:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Walking stick</td>
<td>3</td>
<td>4.6</td>
</tr>
<tr>
<td>Crutches</td>
<td>11</td>
<td>16.9</td>
</tr>
<tr>
<td>Walking frame</td>
<td>6</td>
<td>9.2</td>
</tr>
<tr>
<td>Wheelchair</td>
<td>4</td>
<td>6.2</td>
</tr>
<tr>
<td><strong>Decline in mobility status as inpatient</strong></td>
<td></td>
<td>9.2</td>
</tr>
<tr>
<td><strong>Falls over last 6 months</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>35</td>
<td>53.8</td>
</tr>
<tr>
<td>No</td>
<td>6</td>
<td>9.2</td>
</tr>
<tr>
<td>3 Falls</td>
<td>3</td>
<td>4.6</td>
</tr>
<tr>
<td>&gt;5 falls</td>
<td>18</td>
<td>27.7</td>
</tr>
<tr>
<td>Undocumented</td>
<td>24</td>
<td>36.92</td>
</tr>
<tr>
<td><strong>Presence of pain</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>No pain areas</td>
<td>6</td>
<td>9.2</td>
</tr>
<tr>
<td>One area of pain</td>
<td>41</td>
<td>63.1</td>
</tr>
<tr>
<td>------------------</td>
<td>----</td>
<td>------</td>
</tr>
<tr>
<td>More than one area of pain</td>
<td>12</td>
<td>18.4</td>
</tr>
<tr>
<td>Not tested</td>
<td>5</td>
<td>7.7</td>
</tr>
</tbody>
</table>

**Areas of pain**

<table>
<thead>
<tr>
<th>Area</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Back</td>
<td>9</td>
<td>13.8</td>
</tr>
<tr>
<td>Head</td>
<td>3</td>
<td>4.6</td>
</tr>
<tr>
<td>Upper Limb</td>
<td>10</td>
<td>15.4</td>
</tr>
<tr>
<td>Lower Limb</td>
<td>29</td>
<td>44.6</td>
</tr>
<tr>
<td>Trunk</td>
<td>11</td>
<td>16.9</td>
</tr>
<tr>
<td>Phantom limb</td>
<td>2</td>
<td>3.1</td>
</tr>
<tr>
<td>Whole body</td>
<td>2</td>
<td>3.1</td>
</tr>
</tbody>
</table>

**Physiotherapy referral during current admission**

<table>
<thead>
<tr>
<th>Referral</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30</td>
<td>35</td>
</tr>
</tbody>
</table>
Figure 8: Bar chart of age profile of participants
Figure 9: Pie chart of number of female participants who used a mobility aid

Figure 10: Pie chart of number of male participants who used a mobility aid
Figure 11: Bar chart of comorbidities experienced by participants
Most Common Documented Co-morbidities

Outcome Measures
Participants completed some or all of the outcome measures outlined in the test battery. Participants’ responses to the self-reported measures were handwritten by the investigator, coded and transferred onto a password-protected datasheet. Reasons for not completing certain measures are noted later in the results study. Table 11 displays participation numbers according to the various outcome measures. The highest level of compliance was recorded for the EQ5D5L, Open-ended questionnaire and the Clinical Frailty Scale. Compliance was lowest with the SCT (31%, n=20) and the 6MWT (38%, n=25).

Table 11: Outcome Measures: Order of Test and Participation Numbers

<table>
<thead>
<tr>
<th>Measure (In Order)</th>
<th>Number of Participants</th>
<th>Percentage of Compliance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Open-ended questionnaire</td>
<td>65</td>
<td>100</td>
</tr>
<tr>
<td>2. VAS</td>
<td>58</td>
<td>89</td>
</tr>
<tr>
<td>3. EQ5D5L</td>
<td>65</td>
<td>100</td>
</tr>
<tr>
<td>4. Hand grip dynamometry</td>
<td>49</td>
<td>75</td>
</tr>
<tr>
<td>5. Calf circumference</td>
<td>48</td>
<td>74</td>
</tr>
<tr>
<td>6. TUG</td>
<td>36</td>
<td>55</td>
</tr>
<tr>
<td>7. SPPB</td>
<td>42</td>
<td>65</td>
</tr>
<tr>
<td>8. CFS</td>
<td>63</td>
<td>97</td>
</tr>
<tr>
<td>9. 6MWT</td>
<td>25</td>
<td>38</td>
</tr>
<tr>
<td>10. SCT</td>
<td>20</td>
<td>31</td>
</tr>
</tbody>
</table>

It was found that starting with the 3 self-report measures helped to build a rapport with the participant. Handgrip dynamometry and calf circumference were the least strenuous physical tests and therefore were selected to follow the self-report measures. The TUG, SPPB and CFS followed and allowed the study investigator to gauge the participants’ level of safety to perform the higher-level 6MWT and SCT. The test battery in general took 20-40 minutes to complete, depending on the participants’ compliance with the measures.

**Timed up and go (TUG)**
In total, 55% of participants (n= 36) completed the TUG. The reasons for not testing the TUG in 45% (n= 29) of participants varied. Some declined (n= 7) some were in too much pain (n=10), two did not have appropriate footwear, 5 were not well enough and two were non-weight bearing.

The mean (+/- SD) time to complete the TUG was 22.39 seconds (+/- 20.2) (range 6.3 sec- 1min 29 seconds). In this study, only 44% (n=16) completed the TUG in >13.5 seconds meaning that 56% (n=20) were at a risk of falling. The mean (SD) age of those at risk of falling was 51 (+/-15.2) (range 27-80 years). Of those at risk of falling, 65% were male (n=13) and 35% were female (n=7). As data were non-normally distributed, non-parametric statistics were applied. A Wilcoxin signed-rank test showed that there was no statistically significant difference in TUG scores between males and female participants (Z = - 1.041, p= 0.298). A Kruskal-Wallis H test showed that there was no statistically significant difference in TUG scores between decades of presentation, $X^2(5) = 7.453, p= 0.189$.

6 Minute Walk Test (6MWT)
A minority of participants (n=25, 38%) completed the 6MWT, 2 participants terminated the test early and 38 (58%) did not complete the test as they were unable or declined. Reasons for not completing the 6MWT included not feeling up to it (n= 8), unable for various reasons (n= 8), pain (n=10), suicidal ideation (n= 2), not well enough (n= 5), no appropriate footwear (n= 2) or non weight bearing (n=3).

The mean 6MWT distance was 289.9 meters (+/-111.3) (range 30-505 meters). A total of 18 males (72%) completed the 6MWT compared to 7 females (28%). The mean 6MWT distance among the male group was 293.2 meters (+/-106.5) (range 35-505 meters) versus 281.6 meters (+/-131.6) (range 30-410 meters) among the female group (Figure 12).¹

Figure 12: Scatterplot of 6MWT distance: Male v Female

¹A 2006 study by Camarri et al. showed that the average 6MWT distance in healthy subjects aged 55-75 years was 659 +/- 62m (range 484-820m).
The 6MWT distance also varied according to age (Figures 13 and 14). Only 3 of the 5 participants (60%) aged between 20 and 29 completed the 6MWT, with a mean distance of 288m (+/-75.4) (range 201-333m) (Figure 5). Half (n=6) of those aged between 30 and 39 completed the 6MWT with a mean distance of 328m (+/- 106.5m) (range 200-505m). While only 29% (n= 6) of participants aged between 40 and 49 completed the 6MWT, their mean walking distance of 336m (+/- 51.3) (range 255-410m) was greater than both those in the 20 and 30 age groups. The largest variability was seen among the 50-59 year old group where the furthest distance walked was 435m and the shortest distance was 35m (mean 278m +/- 131.9). None of the 60-69 year olds (n= 5) completed the test. In comparison, 66% (n= 2) of those aged 70-79 and one participant aged 80 completed it.

The further distance walked was 505m and was achieved by a 36-year-old male. As data for the 6-minute walk test was normally distributed, parametric tests were used to explore differences between gender and age. An independent t-test did not reveal any differences in 6MWT distance covered between male and female participants t(25) = -1.161, p=0.257. An ANOVA test revealed no difference in 6MWT result between decades of presentation F(5,21) = 0.992, p= 0.446.

**Figure 13: Scatterplot of 6MWT Distance v Age**
Figure 14: Bar chart of Average 6MWT Distance by age

Average 6MWT Distance by Age

<table>
<thead>
<tr>
<th>Age (Years)</th>
<th>Distance (Meters)</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>288</td>
</tr>
<tr>
<td>30-39</td>
<td>328.4</td>
</tr>
<tr>
<td>40-49</td>
<td>336.3</td>
</tr>
<tr>
<td>50-59</td>
<td>278</td>
</tr>
<tr>
<td>70-79</td>
<td>110</td>
</tr>
<tr>
<td>80-89</td>
<td>330</td>
</tr>
</tbody>
</table>
**Stair Climb Test (SCT)**

In total, 20 participants (31%) completed the SCT (11 steps). Approximately 69% (n=45) did not carry out the SCT. In the majority of cases, patients did not perform the SCT, as they were unable/unsafe to do so (n=41). Other reasons included feeling dizzy (n=1), pain (n=2) and afraid of stairs (n=1). The mean time taken was 22.7 seconds (+/-10.5) (range 11.35-49.8 seconds)\(^2\). Of those who completed the SCT, 15 were male (75%) while only five were female (25%). A 41-year-old female took the shortest time to complete the SCT (11.35 seconds), while a 29-year-old man took the longest (49.8 seconds)(Figure 15). As data were non-normally distributed, non-parametric statistics were applied. A Wilcoxin signed-rank test showed that there was no statistically significant difference in SCT scores between males and female participants (Z = -0.131, p = 0.933). A Kruskal-Wallis H test showed that there was no statistically significant difference in SCT scores between decades of presentation, \(X^2(4) = 1.391\), p = 0.846.

\(^2\) A 2011 study by Bennell et al. recorded that a sample of 106 elderly people with symptomatic hip or knee OA completed the 11-step SCT with a time of 1.14 seconds per step.
Figure 15: Scatterplot of time taken to complete SCT

![Scatterplot of time taken to complete SCT](image)
Short Physical Performance Battery (SPPB)

A total of 42 participants (65%) carried out the SPPB. The reasons for not carrying out the SPPB included pain (n=8); participant declined (n=5), not well enough (n=5), non-weight bearing status (n=3), no appropriate footwear (n=2). Overall, 83% (n=58) scored a total score of less than 10 in the test, indicating one or more mobility limitations\(^3\). Half of participants (n=21, 50%) were unable to sit to stand without using their hands for assistance. In addition, 26% (n=11) of participants scored zero in the balance subset of the SPPB, meaning they could not hold a side-by-side stance for 10 seconds.

More males (n=33, 79%) than females (n=9, 21%) completed the SPPB. Both males and females scored lowest in the chair stand test (see Figure 16), meaning they were unable to or had difficulty standing up from a chair without using their hands to assist them. Total scores were similar between both groups with the females averaging at a total score of 5.1 and males at 5.3. As data were non-normally distributed, non-parametric statistics were applied. A Wilcoxin signed-rank test showed that there was no statistically significant difference in SPPB scores between males and female participants ($Z = -0.123$, $p = 0.902$). A Kruskal-Wallis H test showed that there was no statistically significant difference in SPPB scores between decades of presentation, $X^2(5) = 4.758$, $p=0.446$.

---

\(^3\) Pavasini et al. (2016) investigated the relationship between SPPB score and all-cause mortality and found that a total score lower than 10 is predictive of all-cause mortality.
In total, 49 participants (75%) carried out handgrip dynamometry. The reasons for not carrying out handgrip dynamometry included decline due to fatigue (n= 3), not feeling well (n= 5), suicidal (n= 1), broken wrist (n= 2), pain (n=5). Of the 49 participants, 16 (33%) were female and 33 (67%) were male. Out of the 16 females in this study the average handgrip strength was 13.17kg, with the range being 5.01kg to 28.9 kg (Figure 17). The average handgrip strength for males in this study was 25.29kg with the range being 7.2kg to 41.35kg. Data for handgrip were normally distributed so parametric statistics were applied. An independent t-test showed that handgrip strength for male participants was significantly higher than for female participants t(47)= - 4.471, p < 0.001. There was no difference in handgrip strength according to decade of presentation [ANOVA, F(5,43)=0.413, p=0.837]).

According to Steiber et al (2016) average handgrip strength for men aged 30-49 is 54kg and women is 34.5kg (see figure 4). At 65-69 years of age, average handgrip strength is 44kg for males and 28kg for women (Steiber et al. 2016)
Figure 17: Bar chart of average recorded handgrip strength v normative values

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study average age 30-49</td>
<td>25.9</td>
<td>11.8</td>
</tr>
<tr>
<td>Normative values age 30-49</td>
<td>54</td>
<td>34.5</td>
</tr>
</tbody>
</table>

Power in Kgs
Calf circumference

Calf circumference measurements were obtained for 48 participants (74%). For two of these participants, calf circumference for only one leg could be measured due to a splint being in place (n=1) and an air cast boot (n=1). Calf circumference for the remaining 17 participants (26%) was not obtained. Reasons for this included extreme pain (n= 5), patient declined (n= 6), not feeling well (n= 5), suicidal (n= 1). Of the 48 calf circumference measurements obtained, 14 (29%) were women and 34 (71%) were male participants. The mean calf circumference of females in the study was 38.8cm (+/- 6.2) (range 29.25cm – 51.5cm). The percentage of females with calf circumference measurement below that of the 33cm cut off point was 7% (n=1). The average calf circumference of male participants in the study was 35.9cm (+/- 4.4) (range 23.5cm – 45cm). The percentage of males with calf circumference measurement below that of the 34cm cut off point was 32.4% (n=11). Thus, according to results from this test, more males than females had a decrease in muscle mass. Data for calf circumference was normally distributed so parametric statistics were applied. An independent t-test showed that there were no differences in calf circumference measurements between male and female participants [t(46)=1.841, p = 0.072]. An ANOVA test showed that there was no difference in calf circumference according to decade of presentation F(5,42)=1.850, p=0.124.

5 According to Pagotto et al. (2017), cutoff points of 33cm in females and 34cm in males indicate predictive capacity of decreased muscle mass.
Visual Analogue Scale (VAS)

Of the 65 participants, 58 (89%) gave a subjective pain rating using the VAS (Figure 18). Pain levels ranged from 0-10 and the mean pain rating was 5.96 (+/- 3.16). In total, 17 females and 41 males reported their pain using the VAS. Females rated their pain higher than males with a mean rating of 6.9 (+/- 2.15, range 2-10), compared to 5.5 (+/- 3.25, range 0-10). Data for VAS was non-normally distributed so non-parametric statistics were applied. A Wilcoxon signed-rank test showed that there was no statistically significant difference in VAS scores between males and female participants ($Z = -1.395, p = 0.163$). A Kruskal-Wallis H test showed that there was no statistically significant difference in VAS scores between decades of presentation, $X^2(5) = 3.241$, $p=0.663$ (Figure 19).

Approximately 63% of participants (n=41) reported at least one area of pain, with the lower limb (n= 29) being the most common area of pain, followed by the trunk (n= 11)(see Figure 18).

**Figure 18: Bar chart of reported pain areas**
Clinical Frailty Scale (CFS)

A CFS score was obtained for 63 participants (97%). In 2 cases (3%), a CFS score was not obtained, as the lead investigator did not have enough subjective and objective information about the participant to make a judgment. In both cases, the participant declined to partake in the physical battery tests. Therefore, it was unclear whether the participant declined but would be fit for tests or whether the participant would be unable to carry out the tests in any case.

The CFS ranges from 1 (very fit) to 9 (terminally ill). The CFS scores in this study varied widely. The highest proportion of participants (n=18, 28.6%) scored 4 meaning they were vulnerable and while they did not depend on others for daily help, their symptoms often limited them (Figure 20). Only one participant obtained a score of 1 (very fit) and this
participant was 80 years of age. In total 7 participants (11.1%) obtained a score of 2 indicating they were well, while 12 participants (19%) scored 3 meaning they were not regularly active but were managing well.

A greater proportion of participants scored at the higher end of the scale with 39.7% (n=25) being classified as frail. Upon further analysis of frailty, a total of twelve (19%) were classified as 5 (mildly frail) and ten (15.9%) as 6 (moderately frail). In total, three participants (4.8%) scored 7 indicating they were severely frail and completely dependent for personal care. Overall, only 20 participants (31.7%) were classified as being robust or non-frail. Conversely, 68.3% (n=43) were either pre-frail (vulnerable) or frail. As data were non-normally distributed, non-parametric statistics were used to compare CFS scores. A Wilcoxin signed-rank test showed that there was a statistically significant difference in CFS scores between males and female participants ($Z = -2.277, p = 0.023$) (Figure 21). A Kruskal-Wallis H test showed that there was no statistically significant difference in CFS scores between decades of presentation, $X^2(5)= 5.771, p= 0.329$ (Figure 22).

Figure 20: Bar chart of Clinical Frailty Scale Scores

![Bar chart of Clinical Frailty Scale Scores](image-url)
Figure 21: Bar chart of Male v Female CFS scores

Number of Participants

Male, blue
Female, red
Figure 22: Bar chart of CFS age breakdown

<table>
<thead>
<tr>
<th>Age</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-69</th>
<th>70-79</th>
<th>80</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 (very fit)</td>
<td>0</td>
<td>3</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>2 (Well)</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3 (managing well)</td>
<td>1</td>
<td>1</td>
<td>7</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>4 (vulnerable)</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>5 (mildly frail)</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>6 (moderately frail)</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>7 (Severely frail)</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>
All participants (n=65, 100%) completed the EQ5D5L. Participants scored best in the ‘self-care’ and ‘usual activity’ subscales of the EQ5D5L. The majority of participants (n=47, 72%) reported no problem (n=30, 46%) or slight problems (n=17, 26%) with their self-care. Similarly, 29% (n=19) reported no problem and 31% (n=20) reported slight problems with their usual activities.

In agreement with objective findings, 80% (n=52) reported some level of difficulty with their mobility ranging from slight problem (n=16, 25%), moderate problem (n=18, 28%), and severe problem (n=14, 22%) or unable to walk at all (n=4, 6%)(Figure 23). Similarly, high pain levels were reported among participants with 31% (n=20) reporting severe pain or discomfort and 15% (n=10) reporting extreme levels of pain or discomfort.

The majority of participants (n=53, 84%) reported some level of anxiety and/or depression. Two participants were unable to rate their anxiety/depression. The most frequently reported level of anxiety and depression was an ‘extreme’ level as reported by 19 participants (29%, male (n=9), female (n=10)). A total of 22% (n=14) rated their anxiety/depression as ‘severe’, 18.5% as moderate (n=12), 9% (n=6) as slight, with only 18.5% (n=12) reporting no anxiety/depression, and 3% (n=2) unable to give a rating. As data were non-normally distributed, non-parametric tests were applied to the analysis of the EQ5D. A Wilcoxin signed rank test showed that females scored significantly higher on the anxiety subscale of the EQ5D compared to males (Z= -2.413, p=0.016). A Kruskal-Wallis H test did not show any difference in anxiety scores between decades of presentation, $X^2(5)=7.003$, $p=0.220$. The average self-reported health rating score (scale 0-100) was 45. Two participants were unable to answer. In total 32% (n=20) rated their health as below 30 on the scale.
As shown in Figure 24, more male participants (n= 12) reported no problem with their mobility compared to females (n=1). However, at the more extreme end of the scale, more males (n=3) than females (n=1) reported being unable to mobilise. The same number of males (n= 7) and females (n= 7) reported severe problems with their mobility. A Wilcoxin signed-rank test showed that the mobility subscale of the EQ5D was
significantly lower in female compared to male participants ($Z = -2.088, p = 0.037$). A Kruskal-Wallis H test showed that there was a statistically significant difference in mobility scores between decades of presentation, $X^2(5) = 12.421, p = 0.029$. A visual inspection of the data appeared to poor mobility levels for the 2nd, 6, and 7/8th decades.

There was no difference between male and female participants for the subscales of activity ($Z = -1.109, p = 0.267$) or self-care ($Z = -1.546, p = 0.122$). There was no difference in levels of the self-care subscale comparing decades of presentation ($Z = 2.070, p = 0.839$). There was a difference between decades for the subscale of activity [$X^2(5) = 14.556, p = 0.012$], with a visual examination indicating lower scores for the 2nd, 6th and 7th/8th decades.

Figure 24: EQ5D5L: Mobility Male v Female participants

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
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<tbody>
<tr>
<td>Unable</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Severe problem</td>
<td></td>
<td></td>
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<tr>
<td>Moderate problem</td>
<td></td>
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</tr>
<tr>
<td>Slight problem</td>
<td>5</td>
<td>11</td>
</tr>
<tr>
<td>No problem</td>
<td>1</td>
<td>12</td>
</tr>
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</table>
Regarding pain reporting, more males (n= 8) reported 'no pain' compared to females (n= 1) (Figure 25). However, more males (n= 6) than females (n= 4) reported 'extreme' levels of pain. Most participants (male (n= 9) and female (n=10)) reported ‘extreme’ levels of anxiety and depression (Figure 26). A Wilcoxin signed rank test revealed there was no significant differences in EQ5D pain scores between male and female participants (Z = - 0.929, p= 0.353). A Kruskal Wallis test revealed no differences in pain across the different decades of presentation [$X^2(5)= 7.756$, p= 0.170]. Only 3 female and 9 male participants reported ‘no problem’ in relation to anxiety and depression. This means that in total, only 12 participants (18.5%) report suffering from anxiety and/or depression.

**Figure 25: EQ5D5L: Pain Male v Female Participants**
Regarding age, Figure 27 shows that the highest proportion of those ‘unable’ to mobilise were aged in between 40-49 years (n= 2). Similarly, those reporting ‘severe problems’ with mobilizing were predominately aged between 40-49 years (n=6). The largest proportion of participants (n= 6) reporting 'no problem' with their mobility was aged between 50-59. No participants aged between 20-29 reported 'no problem' with mobility, instead reporting slight (n=1), moderate (n=2) or severe (n= 2) problems. The 2 participants aged 80 reported 'no problem' with their mobility.
Figure 27: EQ5D5L Mobility: age breakdown of participants
PA and open-ended questionnaire

All of the participants (n=65, 100%) answered the physical activity and open-ended questionnaire. Regarding physical activity, only 3 participants (4.6%) reported doing exercise other than routine walking as part of their normal daily routine. Such exercise included cycling (n=1), playing football with a local team (n=1) and going to the gym (n=1). Two participants stated they were more active when they were in prison as they could use the gym that was available.

Summary of main themes

Six main themes emerged from the physical activity and open-ended questionnaire. The data was analysed guided by the Braun and Clarke (2006) six-phase framework. The six main themes were: past exercise habits, feeling weak/unfit/lethargic, perception of physiotherapy, the value of family and recovery, desire to be able to walk and exercise service suggestions.

Table 12: Overview of main themes

<table>
<thead>
<tr>
<th>Theme</th>
<th>Key points</th>
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</thead>
<tbody>
<tr>
<td>1. Past exercise habits</td>
<td>• Contrast between current level of exercise and former exercise habits</td>
</tr>
<tr>
<td>2. Feeling weak/unfit/lethargic</td>
<td>• Concerns expressed with physical health</td>
</tr>
<tr>
<td>3. Perception of physiotherapy</td>
<td>• Uncertainty</td>
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<tr>
<td></td>
<td>• Unmet expectations</td>
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<td></td>
<td>• A desire for more physiotherapy</td>
</tr>
<tr>
<td>4. The value of family and recovery</td>
<td>• Family, recovery and health mattered to participants</td>
</tr>
<tr>
<td>5. Desire to be able to walk</td>
<td>• Poor walking ability limited everyday life/tasks</td>
</tr>
<tr>
<td>6. Exercise service suggestions</td>
<td>• Multimodal</td>
</tr>
<tr>
<td></td>
<td>• Achievable</td>
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<tr>
<td></td>
<td>• Gradual</td>
</tr>
</tbody>
</table>
Theme 1: Past exercise habits

As mentioned above, only three participants (4.6%) reported doing exercise other than routine walking as part of their normal daily regime. However, a large proportion of participants commented on their past exercise habits. There was a trend toward exercising less now than they had in previous years.

For some participants, their current level of engagement in exercise greatly contrasted with their former exercise habits. Interestingly, some participants who no longer exercised previously exercised at a high or even elite level.

“I used to play football for Ireland underage” I40 (M, 41)

“In the last 6 months no (exercise), but before that – gym, kickboxing, football” I50 (M, 29)

It also emerged that a few participants had qualifications relating to health and fitness. Two participants who held such qualifications no longer exercised for different reasons. The first participant quoted being in jail and depression for no longer using their qualification.

“In jail I locked myself away, didn’t even walk in the yard, didn’t use the gym. I am a qualified fitness instructor but I don’t exercise anymore. I can’t be bothered doing anything I feel so depressed.” I15 (M, 37)

The other participant reported their fractured foot as a barrier to exercise.

“I do some walking but I find it hard to exercise with the boot. I’m usually very active, I previously used the gym and I did my QQ1 course in nutrition and one in health and fitness from Ushers Ireland Simon” I25 (F, 45)

A number of participants gave reasons for their withdrawal from exercise. The main reasons were due to depression, alcohol dependence and pain.

For several participants, depression acted as a barrier to exercise.
“I used to go hill walking but I haven’t got the nerves anymore. I’m depressed.” 122 (M, 42)

Another participant reported that their exercise habits fluctuate according to their drinking habits.

“When I drink I don’t exercise. When I’m not drinking I go to the gym every second day” 116 (M, 36)

Lastly, pain hindered a number of participants’ ability to exercise.

“I like walking but I’m limited by my arthritis” 141 (M, 80)

Finally, there was a trend toward exercise as a necessity rather than for enjoyment. Several participants reported that they exercised, in the form of walking simply to get somewhere.

“I used to exercise, now only if I have to run to a clinic or something” 110 (M, 33)

A large proportion of other participants cited that that while they do not formally exercise, they walk as means to get somewhere. One participant reported that their only form of exercise was going for cigarette breaks.

“… Hopping around going out for a smoke.” 143 (F, 29)

**Theme 2: Feeling weak/unfit/lethargic**

The majority of participants expressed some level of concern with their physical health. Feeling weak, unfit and lethargic were among the most common complaints. Participants reported a variety of reasons to explain their poor physical health. Illness, sedentary behaviour, trauma, weight gain and living conditions were cited as reasons for poor health.
One participant reported that their illness prevented them from exercising.

“I keep saying I’ll go back to the gym but being ill has made me short of breath. Coughing is preventing me from exercising. Up until June I used to go running and do 3 kilometers.” I24 (F, 41)

Another participant also indicated that their fitness was suffering as a result of their poor physical health.

“I get very breathless. I get back pain due to carrying stuff all the time, my feet are sore.” I33 (F, 27)

In contrast, one of the participants reported that inactivity and sedentary behaviour was making them unfit.

“…Sitting around all day in focus Ireland. I’m not as active as I was previously” I07 (F, 70)

The youngest participant in the study expressed that weight gain and living conditions contributed to a decline in her physical fitness.

“…Added weight makes me sluggish, out of breath, tired… I find it hard to exercise when living in hotels and getting takeaway meals” I14 (F, 23)

Lastly, trauma appeared to be another contributor to poor physical health.

“Damage is paying its toll and I’m getting damaged more easily physically… my feet are bad… I think I have a broken toe and a broken collar bone” I32 (M, 59)

While many participants expressed feelings of weakness and tiredness, it was indicated that this was a result of decline overtime.

“I let myself go physically… had a mental breakdown… I was put in prison and 2 years in there everything went downhill” I15 (M, 37)
Another participant expressed feeling low as a result of their decline in fitness.

"I'm not fit at all. I used to be running around after 6 kinds, worked 3 jobs... now I feel worthless." I31 (F, 47)

While some participants recognised that their fitness was once good and had since declined, there was a lack of hope that they would ever regain their fitness. There appeared to be a sense among participants that their fitness was gone and they would never get it back.

"I'm p*****d off because my fitness is gone to hell. It makes me depressed, it makes me suicidal that I've lost my fitness completely." I28 (M, 43)

Finally, lethargy, weakness and feeling unfit had a severe and negative impact on the lives of participants. Many cited that these physical symptoms interfered with their daily lives.

"I don't have the physical capacity to carry on a normal life. I can't do a 9-5 schedule without getting exhausted" I18 (F, 60)

One young participant cited that his poor physical health was even impacting on his relationship.

"I am only able to walk 5-6 steps and have to stop cos I'm out of breath and legs aren't able. It's affecting me relationship... I'm in a wheelchair and I'm only 37" I46 (M, 37)
Theme 3: Perception of physiotherapy

When participants were asked if they thought there was anything more physiotherapists could do for them, an insight into their perception of physiotherapy became clear. Five main issues arose. These included an uncertainty or lack of understanding of what physiotherapy is, a lack of confidence in the benefits of physiotherapy and prioritizing other matters ahead of physiotherapy. However, it also became clear that several participants expressed a desire to do more exercise and physiotherapy, while others expressed unmet expectations.

Firstly, a number of participants demonstrated a lack of understanding of what physiotherapy is and how physiotherapy could be of benefit to them. Further, some participants had never engaged in physiotherapy and did no know where or how it was offered.

“I’ve never had physio… I don’t know how to approach it… I feel like a doctor would have to ask for physio” I01 (F, 34)

Secondly, it was clear that a proportion of the participants did not believe that physiotherapy could improve their situation in any way. In some cases, participants believed that medication was the only solution for their musculoskeletal problems.

“I am grateful for meds. I don’t think physio will help with my hands or hips” I06 (M, 73)

Another participant expressed uncertainty over the benefit of physiotherapy for their breathing and shoulder problems.

“…My weakness is coming from my breathlessness… breathlessness is not something physio can fix… (physio) possibly could help with my frozen shoulder” I18 (F, 60)

In contrast, a number of participants expressed a desire to do more exercise with the physiotherapist.
“... I'd like more exercise. Somebody to come around everyday” I03 (M, 43)

“... I would love a bike to use in hospital... give me the feeling I could do something to get better... other ways of moving instead of walking” I07 (F, 70)

Another participant indicated the value of advice from a qualified physiotherapist.

“... Giving out the best exercise. Sometimes when you go to the gym you don't know what exercises to do. I want the best exercise and meals to help me to lose weight.” I14 (F, 23)

While the above participants viewed physiotherapy and exercise as important, other participants outlined that they had greater priorities.

“... They're trying to get me accommodation and that's my main worry” I23 (F, 41)

Another participant expressed that the stigma associated with being homeless was more important than anything else.

“... Teach people more about us and the lives we live... there are no rights for us... this is why homeless people die, they cannot break back into normal life” I32 (M, 59)

Finally, a few of the participants indicated that their needs from physiotherapy were unmet. Participants described that their needs were not met both as an inpatient and in the outpatient setting.

“I could do with more physio but I know you don't have the resources. Physio has been fantastic and so kind” I55 (M, 67)

“I'd like a cardio kind of thing once per week while in hospital and a follow up when I'm out of hospital- I thought they would have done this” I24 (M, 52)
Theme 4: The value of family and recovery

Participants were asked the question “what matters the most to you?” The vast majority of participants reported that family; recovery and getting their health back mattered the most to them.

“… Putting my life back together – back to work and family” I16 (M, 36)

“To get off the streets, get clean” I27 (F, 35)

“To be alive and not have me children burying me at 50 years of age. I know I can be a better person without the drink” I04 (M, 51)

“My family, daughters, sisters and nephews… they were all I had when I was in prison” I19 (F, 46)

“My two boys and that I’m healthy and alright” I40 (M, 41)

Theme 5: Desire to be able to walk

Participants were asked the question “what are you not able to do that you would like to be able to do?” The majority of participants answered that they would simply like to be able to walk.

“Walk without crutches” I01 (F, 34)

“Walk properly” I26 (M, 45)

“Walk freely” I60 (M, 40)

Some participants even reported that their walking was so bad that it limited them in everyday life. Participants described their walking ability as something that was abnormal.
“... I want to walk like a normal human being at a normal pace... I have to sit down on me walker cos of tightness in the chest” I06 (M, 73)

“...Run for a bus, catch the luas. I can’t even walk fast. (To be able to) do normal things” I04 (M, 51)

While the majority of participants expressed a desire to simply be able to walk, others indicated that they would like to be able to run, jog or lift weights in the gym.

Theme 6: Exercise service suggestions

The participants were asked to design an exercise service they would like to attend. From the answers given, it was clear that most of the participants expressed a fondness towards exercise. However, the participants typically spoke about exercise as something they did in the past or something they would like to get back to. Not many of the participants were involved in current exercise programmes or services. Weight training, walking, running and the bike were all suggested as modes of exercise for the potential exercise service. It was clear that participants would like this exercise service to be achievable and have a gradual build up.

“I’d have to be able to do it... I don’t want to fail” I31 (F, 47)

“... Legwork, walking up and down with crutches and then eventually no crutches” I08 (M, 28)

One participant described a multimodal exercise service.

“Exercises to keep fit... mental well-being... keep the weight down... fit into part of a lifestyle that is going to be long-term... motivation to carry on” I24 (M, 52)

However, while numerous good ideas for a potential exercise service were proposed, many of the participants expressed doubt in their own ability to exercise.
“... I’d try to do what I could which isn’t much” I06 (M, 73)

“... I don’t know... I’m not sure what I’d be able to do. Can’t see at the moment what I’d be able to do.” I04 (M, 51)
Chapter 4: Discussion
Discussion

This thesis primarily explored the physical function and performance of an inpatient population at St. James’s Hospital who were registered as homeless. It also examined the suitability of the outlined physical test battery and explored the perception of unmet physical needs, exercise habits and preferences.

Main Findings

Overall, this study demonstrated poor physical status among this cohort of homeless inpatients. Of note, participants had globally poor physical status, irrespective of age or gender. Low physical fitness and function was noted in the younger participants aged between 20 and 30 years and was broadly consistent throughout the various age groups. The normal age-related decrements in mobility and physical status did not occur but rather widespread substandard levels of physical fitness and function were observed.

Secondly, it was difficult to initiate a physical test battery as so little is known about physical performance variables in this population. This is reflected in the systematic review, described in the introduction section of this thesis, where a diversity of outcome measures were employed. This study piloted an experimental test battery. The test battery comprised both subjective and objective measures. Recommendations for future studies will be discussed in detail in a subsequent section of this chapter.

Lastly, there may be a pre-conceived idea that this population would be particularly challenging to work with. However, based on the experience of the current study, the participants proved to be very receptive to the study. Once recruited, there were no dropouts. In addition, the open-ended questionnaire revealed that, in general this cohort were very insightful and had a good awareness of their physical needs.

Participant recruitment and characteristics

Participants enrolled in the current study were homeless individuals admitted to St. James’s Hospital between November 2018 and May 2019. Notably, a number of potentially eligible participants (n= 23) had to be excluded from the study as they were off the ward for long periods (typically gone outside for a cigarette). Often, several attempts
were required to make contact with potentially eligible participants on the ward, so flexibility and additional time to allow for recruitment would be important considerations for future studies in this population.

Participants were predominately male (n= 44, 67.7%). The mean age of participants was 47 (+/- 13.2, range 23-80) years. This is consistent with a report from April 2019 on housing and homeless figures (Department of Housing, Planning & Local Government Homeless Report 2019). It reported that out of 4401 homeless individuals in Dublin and most were male (n= 2538, 57.7%). This finding is also consistent with gender statistics from the systematic review outlined in the introduction section. The review studies consisted predominantly of male participants who were homeless. Specifically, out of the 1,808 participants included in the review, 65.6% (n=956) were male and 34.4% (n=502) were female.

Most participants in the current study were aged between 40 and 59 years (n= 38, 58%). This may be a somewhat older age profile than report, which identified that most individuals experiencing homelessness in Dublin (n= 2647, 60.1%) were aged between 25 and 44 years (Department of Housing, Planning & Local Government Homeless Report 2019). This may indicate that an older than average proportion of adults experiencing homelessness present to hospital. However, this does not necessarily mean that this age group has poorer physical health. As observed in this study, physical function and status were poor across all ages.

In the current study, most participants were Irish nationals (n= 57, 87.7%) and most lived in hostel accommodation (n= 41, 64.1%) or were rough sleepers (n= 11, 16.9%). A number of poor health behaviours were documented. Over 80% (n= 52) of participants were smokers. This finding correlated with a study by Baggett et al. (2010), which reported that approximately three quarters of adults experiencing homelessness are cigarette smokers. Excess alcohol was documented for 34 participants (52.3%). A total of 16 (24.6%) participants had documented drug habits. In total, 9 participants (13.8%) had documented dual addiction of alcohol and drugs. While almost 25% (n= 16) had documented current substance misuse and 12 (18.5%) had formerly abused drugs, it is possible that the level of drug use was under-reported both in the medical charts and from self-report. Studies by Gaderman et al. (2013) and Brown et al. (2016) reported higher
levels of drug and alcohol use among homeless adults. Gaderman et al. (2013) recruited 100 participants and found substance abuse among 40.2% and substance dependence among 26.6% of participants. Similarly, Brown et al. (2011) found that over 50% of participants had alcohol or drug problems. Figures from homeless research in Ireland have reported similar figures. The aforementioned 2019 study by Ivers et al. reported that drug and alcohol were among the leading cause of death for individuals who were homeless in Dublin. Between 2011-2015, 58.7% (118/195) of homeless deaths in Dublin were associated with drugs and/or alcohol.

**Primary outcomes**

A profile of physical function and performance was gathered using a combination of subjective and objective measures. As mentioned above it was found that this cohort of inpatients registered as homeless cohort had very low levels of physical fitness and high levels of mobility impairments.

**Mobility**

From the study results, it was clear that participants had significant difficulties mobilising. Over one-third (n= 24, 36.9%) required a mobility aid. Most participants who required a mobility aid were aged 50 or under (n=16, 66%). Notably, the four participants who used a wheelchair were all male and aged 42 or under. None of the female participants used a wheelchair. There was no pattern to mobility aid use across age or gender. This is reflected in the wide age range of participants using mobility aids. For example, three men aged between 50 and 73 used a walking stick, while three women aged between 47 and 70 used a walking frame. It appeared that mobility aids are used at a younger age and for prolonged use among this population. While it was not documented whether the walking aid was for temporary or long-term use, a pattern appeared to emerge regarding mobility aid use in this cohort. For a number of participants, they were initially given a temporary mobility aid post injury/amputation/fracture/fall etc. Following a prolonged period of mobility aid use and a lack of follow up, these participants reported using the mobility aid on a permanent basis. Thus, post injury they had failed to regain their baseline mobility resulting in a new and declined mobility baseline. This highlights the need for suitable physiotherapy follow up post hospital admission to help re-gain confidence and
independence to mobilise without an aid. Different models of care such as outreach physiotherapy service in accessible locations such as hostel accommodation may result in better engagement with people experiencing homelessness. Future studies should explore the incidence and cause of prolonged mobility aid use among this population. It would seem that these participants suffer physically from a lack of rehabilitation from previous injuries. There is an unmet need for rehabilitation for homeless patients, which will be discussed later in this chapter.

A total of 58 participants (83%) had one or more mobility limitations as indicated by the SPPB. While more males (n= 33, 79%) than females (n= 9, 21%) completed the SPPB, the average total scores were similar between both groups. Corresponding results from the EQ5D5L reveal that participants had a very good insight into their mobility limitations, which was backed up by qualitative findings. Many of the participants expressed a simple desire to be able to walk. Similarly, 52 participants (80%) reported some level of difficulty with their mobility ranging from a slight/moderate/severe problem to being unable to walk. The aforementioned mobility impairments links with self-reported incidental exercise habits. It is possible that due to mobility impairments and difficulty getting around, this population might only exercise when necessary for specific tasks.

It should be noted that while two studies from the systematic review (Brown et al. (2011) and Brown et al. (2016)) reported mobility impairments in homeless individuals, mobility was measured through self-report. The current study used a combination of objective measures (SPPB, TUG, 6MWT) along with self-report measures (EQ5D5L) to ascertain mobility impairments. A high level of agreement between the SPPB and the EQ5D5L strengthens the finding that a large proportion (~80%) of homeless adults had difficulty mobilising.

Falls

This study indicated that falls were common in this population with more than half (n= 35, 53.8%) of participants reporting at least one fall over the last 6 months. This self-reported finding correlated strongly with results from the TUG. While just over half (n= 36, 55%) of participants completed the TUG, 20 (56%) were at risk of falling. In addition, participants scored poorly in the balance subset of the SPPB. A total of 11 (26%) could not hold a
side-by-side balance for 10 seconds. Brown et al. (2011) measured falls through self-report alone. This study strengthened its findings through identifying corresponding results from the TUG and SPPB with self-reported falls.

These findings concur with Brown et al. (2011) who found that 90 homeless individuals (36.6%) self-reported difficulty with balance. In addition, falls were high among this cohort with a total of 131 (53.2%) recalling a fall in the prior year. It should be noted that participants in the current study were inpatients, of whom some were admitted to hospital due to a fall. Thus, it might be expected that self-reported falls may be higher in this study compared to the systematic review. While both the current study and Brown et al. (2011) reported just over half of participants reporting a fall, this study investigated falls in the last 6 months whereas Brown et al. (2011) commented on falls in the prior year.

In addition, recurrent falls were an issue among this cohort with almost 28% (n= 18) reporting more than 5 falls in the last 6 months. An accumulation of trauma due to recurrent falls may have accounted for some of the participants who were hospitalised due to a fall. The reasons for reported falls varied. Some falls were alcohol or drug related. Others were epilepsy of seizure related. The aforementioned poor mobility and balance problems accounted for some of the falls.

**Functional mobility/physical performance**

Functional mobility and physical performance were measured primarily using the 6MWT and SCT. A minority of participants completed the 6MWT (n=25, 38%) and SCT (n= 20, 31%). Of those who completed the 6MWT, the mean distance was 289.9 meters (+/- 111.3) (range 30-505 meters). A 2006 study by Camarri et al. showed that the average 6MWT distance in healthy subjects aged 55-75 years was 659 +/- 62m (range 484-820m). This shows that the walking distance among this homeless inpatient cohort is drastically less than a normal healthy population. This indicates poor functional ability and likely poor fitness.

A similar proportion of males (n= 17, 38.6%) to females (n= 7, 33.3%) completed the 6MWT. Mean distances of 293.2 meters (+/- 106.5 meters) for males and 281.6 meters (+/- 131.6) for females showed little difference between the two groups. The most interesting finding was the lack of pattern with results according to age. Participants aged
40-49 years achieved better results than those aged 20-39 years. An 80-year-old participant achieved the same walking distance as some participants in the 20-year-old age group. The furthest distance walked (505m) was still below established age and gender normative values (Camarri et al. 2006).

A greater proportion of males (n= 15, 34.1%) completed the SCT compared to females (n= 5, 23.8%). This may suggest that the males in the study were physically more able than females. Most participants (n= 45, 64%) declined or were deemed unsafe to carry out the SCT. This measure demonstrated poor functional mobility among this cohort as stair climbing could be considered a basic everyday physical skill. Furthermore, this may have an implication for discharge destination for participants who are not guaranteed accommodation in hostels with a working elevator.

**Feasibility**

This research showed that a profiling study of physical functioning and performance in homeless inpatients at St. James's Hospital was feasible. There were large recruitment numbers and high levels of engagement with the battery of tests. Over half of the patients (n=65, 53%) who were assessed for eligibility were included in the study. Once recruited in the study, there was high engagement with the battery of tests.

Four main factors contributed to the feasibility of the study. Firstly having the involvement of the consultant in inclusion health at St. James’s – an engaged and committed consultant who has pioneered this area- was of great benefit. Secondly, the location and catchment area of the hospital played a significant role. St. James’s Hospital has a large catchment area of homeless individuals and this greatly increased the numbers of eligible participants for the study. In addition, the study was carried out in close proximity to a supportive inclusion health team. The fact that the assessment was once off and could be completed at one time point also contributed to the study’s feasibility. Lastly, employing a diversity of both subjective and objective outcome measures as well as gaining lived experience of this cohort ensured at least some data was gained for each participant (see Table 13).
Physiotherapy use

This study demonstrated that a high number of participants (n= 30, 46.2%) were referred to physiotherapy. These participants were referred to physiotherapy for general mobility, falls or respiratory assessments. Such assessments on the ward in the acute setting may be relatively brief in order to assess the patient’s acute needs for safe discharge. There are a number of potential barriers or challenges to physiotherapy among this population. As demonstrated by the study results, falls were a significant problem. However, a number of falls were alcohol or epilepsy related falls. Thus, the reason for falls may not have been amenable to physiotherapy treatment and rehabilitation.

Another challenge to physiotherapy is the complex needs of participants. The physical activity and open-ended questionnaire provided an insight into the participants’ perception of physiotherapy. Some participants reported that physiotherapy was not a priority for them as they were pre-occupied with accommodation or other concerns. This finding is understandable and consistent with the literature. A study by Rae & Rees (2015) recognised that individuals who are homeless are often aware of their health problems but do not always prioritise intervention or leading a healthy lifestyle. Other studies have found that persons experiencing homelessness might prioritise two main things: survival–finding shelter, food and stability (Morrell-Bellai et al.2000, Bigelow & Stepka 2012) and escapism from the reality of their lives through alcoholism and drug addiction (Martins 2008, Williams & Stickley 2010). Another challenge to physiotherapy among those experiencing homelessness might be due to poor health literacy and ability to navigate the health care system.

As a result of the above challenges to physiotherapy and time constraints of the acute ward setting, the aforementioned functional status, prolonged mobility aid use and balance issues may not be comprehensively addressed as part of a routine clinical practice. Therefore, while a high percentage (46%, n= 30) required acute physiotherapy on the ward, an even greater percent have chronic problems that may be overlooked due to other priorities. This underlines the need for physiotherapy input among this cohort. It also highlights an unmet rehabilitation need.
Unmet Rehabilitation Need

As previously mentioned, this study has demonstrated that recurrent falls, prolonged mobility aid use, poor exercise tolerance and chronic musculoskeletal problems are an issue due to the complex needs of this cohort. It appears that a lack of follow up and rehabilitation post hospital admission might result in a failure to regain baseline mobility. Due to the frequent hospital usage among this cohort, even small reductions in physical function upon each hospital admission could result in a progressive and dramatic decline in overall physical status over time. Based on the evidence of this study and results of the systematic review, there certainly is an unmet rehabilitation need among homeless individuals. There appears to be a need for inpatient physiotherapy service and an outpatient rehabilitation physiotherapy service and a link between the two.

Perception of unmet physical needs, physical activity levels and preferences

All of the participants answered the physical activity and open-ended questionnaire. Participants described how their physical activity levels have declined compared to previous years. Interestingly, some had qualifications relating to health and fitness that they no longer made use of. Another pattern among participants relating to current physical activity levels was highlighted; it was discovered that most participants’ main form of physical activity was incidental exercise needed for fulfilling normal daily tasks, e.g. going outside for a smoke. This corresponds with findings from Quine et al. (2004), who found that, due to the chaotic lifestyle of those experiencing homelessness, exercise was not a priority and thus incidental exercise was the participants’ main form of physical activity.

The majority of participants in the present study reported that they felt weak, unfit and/or lethargic. This subjective feedback correlates with findings of poor mobility and performance in the physical outcome measures. Participants expressed the simple desire to be able to walk. Similarly, this links with finding from the physical outcome measures that 40 (61.5%) and 45 (69.2%) were unable or declined carrying out the 6MWT and SCT. It is obvious that this cohort lacked the basic and fundamental components of physical fitness and that included being able to walk properly.
Results from both the present study and the systematic review (Kendzor et al. (2015), Wilson (2005), Quine et al. (2004) and Ballard (2009)) showed insufficient activity levels among adults who are homeless. The present study and studies in the systematic review both relied on self-report measures of physical activity levels. Ideally, physical activity levels might be measured objectively (e.g. using actigraphy). However, the feasibility of using such an objective measure in a study among this cohort is yet to be explored.

Results from the open-ended questionnaire in the present study correspond with findings from Quine et al. (2004), where a decline in physical activity was identified. For example, in the present study a large proportion of participants commented on past activity levels and there was a trend toward being less active now than they had been in previous years. Similarly, Quine et al. (2004) found that some participants were (until recently) physically active and deterioration in their health had reduced their activity levels. This indicates that people who are homeless may experience a decline in their health status, which can lead to a reduction in physical activity levels. This depicts a vicious cycle of a decline in health and physical activity levels. For this reason, it is essential that more research be carried out into the physical function and status of adults experiencing homelessness. It should be noted that the population in the present study were inpatients and potentially quite unwell prior to admission. Thus, this population might have lower levels of physical activity compared to non-hospitalised homeless individuals. Further, this also indicates the need to investigate physical activity levels among people who are homeless and not hospitalized.

Ballard (2009) explored the reasons why homeless women were not achieving sufficient levels of physical activity. Notably, some of the responses from participants correlated with findings from the current study. In both this study and Ballard (2009) participants reported struggling to find a location to exercise. In addition, participants in both studies reported they would like guidance with exercise.

Despite low activity levels at present, participants were very open to the idea of an exercise service or programme. Weight training, walking, running and the bike were all suggested as modes of physical activity for a potential exercise service. It appears that this population lacks the resources to access or design their own exercise programmes. There seems to be a strong need for physical activity promotion and education among
this population. However, the correct type of intervention is not known and requires further evaluation.

**Exploratory outcomes**

**Premature Aging**

Results from this study showed that normal age-related decrements in mobility/functional status as a result of aging did not apply to this population. The use of a mobility aid was noted across all ages from a 28-year-old male using a wheelchair to an 80-year-old male using a walking frame. Results from the physical test battery were haphazard in nature, showing no age-related patterns or trends. As mentioned previously, an 80-year-old participant achieved the same or a better distance in the 6MWT compared to some participants in the 20 year-old age group. In addition, this participant was the only participant to score 1 (very fit) on the clinical frailty scale. While this participant is a potential outlier he had been homeless for several years and was a hostel resident. There are a number of reasons why his physical performance might be better than other younger participants. This participant reported not consuming alcohol in over three years. It is also possible that the younger participants scored so drastically low in some of the measures making this particular participant look exceptionally fit. It should also be noted that this cohort is a heterogeneous population. There are many different reasons why a person might become homeless, how long they have been homeless for, living arrangements and other lifestyle factors, which all uniquely influence physical variables measured in this study.

Variables associated with premature aging were consistent in both the present study and the systematic review. Brown et al. (2011) investigated functional impairment and frailty among homeless individuals using the Fried criteria (Drey et al. 2011). It was found that 40 participants (16%) aged between 50 and 69 years met frailty criteria. In the current study, 68.3% (n= 43) participants aged between 23 and 80 years were classified as either frail or pre-frail using the clinical frailty scale. While a larger proportion of participants in the present study were classified as frail compared to the systematic review, it should be considered that the current study observed an inpatient population. The high level of frailty and pre-fraility among younger participants in the present study should be noted. The largest proportion of participants classified as frail/pre-frail was in fact aged between
30 and 59 years. This finding may be associated with the aforementioned premature aging among individuals who are homeless.

Some research has explored premature aging among homeless individuals. In Dublin, the mean age at death for rough sleepers is 38 for women and 42 for men (Barry et al. 2016). According to studies by Baggett et al. (2013) and Adams et al. (2007), hospitalisation and death from age related conditions such as cancer and cardiovascular disease occurs 10-15 years earlier in individuals who are homeless in the United States. Other studies (Gelberg et al. (1990), Brown et al. (2012), Brown et al. (2014)) have reported an earlier onset of frailty and other geriatric syndromes typically seen in older adults, among those experiencing homelessness. This might explain some of the age-related findings in the present study.

A study by DePaul (a provider for support and care for homeless persons), carried out by Ní Cheallaigh et al. (2018) and Trinity College Dublin (TCD) assessed physical and cognitive health of some of its residents who are homeless. They used a number of outcome measures consistent with the present study: handgrip dynamometry, TUG, Clinical frailty scale. The study recruited 31 participants and similar to the present study most were male (n= 27, 87%). The study compared their finding to the Irish Longitudinal Study on Aging (TILDA report 2018) and found that there is increased frailty in the cohort of their service users.

**Length of time spent homeless**

Future studies should take into account the length of time a person has been homeless. Due to the heterogeneity of this population and different living arrangements this is a hard variable to measure. However, according to Kneebone et al. (2015), the more time spent homeless the more likely a person will suffer from a medical condition, and people who experience chronic homelessness are more likely to experience higher rates of chronic disease, mental health issues and addiction.

Furthermore, the average age of death among homeless individuals should be considered. As previously mentioned, Ivers et al. (2019), found that the average age of death among adults experiencing homelessness in Dublin was 42 years. In the present study 27 (41.5%) participants were aged 50 years or older. As these participants have
exceeded the average age of death of adults experiencing homelessness in Dublin, it is reasonable to suggest that some of these participants may be more recently homeless. In particular, it is possible that the 10 participants (15.4%) who were aged 60 or above became homeless in their latter years. Conversely, it may just mean that the older participants in this study were healthier than their younger counterparts.

**Male v female**

A statistical difference in anxiety levels measured by the EQ5D5L was recorded (p=0.016), with females reporting higher levels of anxiety. Additionally, there was a statistically significant difference (p=0.023) in frailty between males and females, with a higher prevalence of frailty among females. This is an important finding as it highlights the potential additional vulnerability associated with females who are homeless. Furthermore, it should be noted that more males than females completed the outcome measures in the study. For example, out of the 20 participants who completed the SCT, 15 (75%) were male while only 5 (25%) were female. This finding along with the above statistical differences might suggest that females in this study have lower levels of functional ability or are at risk of having lower levels of functional ability compared to males. The above findings are consistent with a 2018 study by Luchenski et al., which reported that due to the finding that socially excluded women experience high levels of anxiety, health interventions may need to be tailored specifically to their individual needs.

**Working with this cohort**

While there were a few challenges associated with working with this population, it should be noted that despite their difficult circumstances, overall the cohort was extremely engaging, receptive and co-operative. The challenges included a high self-discharge rate and patients being off the ward frequently which often led to needing to visit the patient two to three times to recruit and carry out the test battery. For some participants, even though the lead researcher visited the ward up to three times, they were never available and therefore we were unable to recruit this cohort. However, for those that were recruited there were no dropouts, evidence of the receptivity of this group to the study. Furthermore, the open-ended questions yielded rich and unique insights of the lived
experience of homeless inpatients, which may help to inform future studies. A 2018 study by Luchenski et al. highlighted that intervention among people who are socially excluded is possible. Luchenski et al. (2018) reported that accessibility; fairness, equality, education, trust and acceptance need to be considered in order to promote inclusion and engagement in various health interventions.

**Future direction: recommended outcome measures**

While 65 participants took part in the study, not all of the study outcome measures were feasible for every participant. Some measures were more appropriate than others. For example, the subjective measures proved feasible among this population with 100% of participants completing the EQ5D5L and PA and open-ended questionnaire. In most cases, the EQ5D5L and the open-ended questionnaire were read aloud to participants to overcome any potential functional literacy issues, which may have been relevant to the cohort. The CFS was also easy to use in this study and a CFS score was obtained for 97% (n= 63) of participants. Similarly, the VAS was successfully carried out with this cohort. In total, 89% (n= 58) were able to rate their pain using this measure. In general, handgrip dynamometry and calf circumference were successful measures with 75% (n= 49) and 74% (n= 48) of participants engaging respectively.

Some of the remaining objective measures proved more difficult. Overall, the SPPB was the best objective measure of physical performance with 65% (n=42) of participants completing it. According to Westman et al. 2019, the SPPB may not be able to distinguish performance in high functioning patients. Based on the results of this study, it would appear that this cohort is an extremely low functioning group and thus the SPPB is a suitable measure of performance. The TUG measure also proved feasible with over half (n= 36, 55%) completing the test. A minority of participants (n= 25, 38%) completed the 6MWT suggesting it is not feasible among this cohort, although results gained from the cohort who completed the test are still informative in terms of estimating functional capacity. Lastly, the SCT was the least feasible test with only 31% (n=20) completing it. Furthermore, those who did complete it were the higher-level participants and thus the results did not differ greatly/highlight anything. However, the ability to climb stairs is an important determinant of discharge destination. Thus it is still a potentially important test to complete with the caveat that a large proportion may not even be able to attempt it.
The order of the tests could potentially have played a role in the results. However, while it could be suggested that fatigue could have played a role in participants not completing the 6MWT and SCT, the test battery leading up to these final tests was not overly physical demanding. Furthermore, while this was the general order of the testing, the order was flexible based on the participants’ wishes. In general, it became apparent that poor physical functioning rather than the order of the outcome measures was the reason for non-compliance with the more physical challenging measures. Based on the results of this study, table 13 presents recommended outcome measures for future studies in this field.

<table>
<thead>
<tr>
<th>Recommended Outcome Measure</th>
<th>Strengths</th>
<th>To consider</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Subjective Measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>EQ5D5L</td>
<td>Good measure of ADLS, mobility, pain, anxiety/depression</td>
<td>All were able to complete this. It was read out to participants by the study investigator</td>
</tr>
<tr>
<td>Clinical Frailty Scale</td>
<td>Quick, easy</td>
<td></td>
</tr>
<tr>
<td>Visual Analogue Scale</td>
<td>Quick, easy</td>
<td>Most understood the concept immediately. Others needed further instruction</td>
</tr>
<tr>
<td><strong>Objective measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Handgrip Dynamometry</td>
<td>Quick, easy</td>
<td>Standardised protocol</td>
</tr>
<tr>
<td>Calf circumference</td>
<td>Quick, easy</td>
<td>Does not account for lower limb swelling- take upper limb circumference into consideration</td>
</tr>
<tr>
<td>Short Physical Performance Battery</td>
<td>Encompasses gait speed, balance and lower limb strength in a quick and</td>
<td></td>
</tr>
</tbody>
</table>
Study Strengths

A major strength of this study is the contribution to the body of knowledge in a relatively unexplored area. The area of ‘inclusion health’ is in itself a ‘newer’ area of focus in medicine, which considers the health of very vulnerable people such as those who are homeless. To the investigators’ best knowledge, this is the first profiling study to be carried out on an inpatient population experiencing homelessness. In the acute hospital setting, people who are homeless are referred to physiotherapy due to general mobility, specific musculoskeletal or respiratory problems. Due to time pressures of clinical practice routine assessment does not allow for the detailed assessment of all aspects of physical functioning and performance. The overall physical status and performance of patients who are homeless therefore is not well known. In a novel way, this study gathered a profile of physical function and performance of inpatients of St. James’s Hospital, registered as homeless, in a comprehensive physiotherapy-led assessment.

Furthermore, the majority of existing literature has examined homeless individuals in the community setting whereas this study focused solely on the inpatient setting. It is also the first study to monitor inpatient physiotherapy referrals among inpatients experiencing homelessness. Additionally, a devised test battery of physical performance outcome measures was trialed in this population.

A further strength of this study was that it employed a once off assessment, which helped to avoid a potentially large drop out rate. Furthermore, having the involvement of the consultant in this area aided the recruitment process. For the investigator, the recruitment process was relatively straightforward. A combination of subjective and objective outcome measures meant that if a participant was unable to complete all of the test battery they could at least complete a component which was useful for generating data on all participants regardless of ability.
Study Limitations

Data was presented descriptively. Since this study evaluates data at a single time period only, difficulty of deriving causal relationships or associations from cross-sectional analysis was acknowledged. Descriptive analysis was undertaken to quantify physical functioning and performance of participants within this study.

While a once off assessment was also a strongpoint of the study, it is possible that the patients’ physical ability on admission and closer to discharge might be different. However, as gained from the subjective questions and medical history, the vast majority of participants had an extremely poor baseline. Therefore, different time points may not have made much difference. Additional information such as length of stay and details of physiotherapy assessment and treatment may have been beneficial. Further, the length of time-spent homeless might have been worthwhile information. Following this cohort in a longitudinal study would be insightful.

It is possible that the small sample size, in particular small numbers in some age/gender categories may have had an effect on some of the statistical tests. For example, there were only 5 participants aged 20-29 and 5 participants aged 60-69. Similarly, there were only 3 participants aged 70-79. However as this population may be a hard to reach cohort, this study included all adults experiencing homelessness over the age of 18.

It is also possible that the participants’ reason for admission may have had an influence on their physical functioning. For example, a participant who had a fracture and was non-weight bearing at the time of the study may present differently at a later date. However, due to time constraints of the study, only the mobility status of the participant at the time of the study was captured. Future studies should record the reason for admission.
Conclusion

In conclusion, this study gathered a physical profile of homeless inpatients. This study also trialed a physical test battery with this cohort and offered recommendations for future studies. More males than females participated in the study with the average age being 44 years old. It was found that falls are prevalent among this cohort. In general, widespread poor mobility and functional ability was identified irrespective of gender or age. Low physical activity levels were consistently reported. Prolonged mobility aid use was noted, which underlines an unmet rehabilitation need among this population. The 6MWT and SCT were deemed unsuitable measures for this cohort as less than half of participants were able to attempt these measures. There was a 100% compliance rate with the subjective outcome measures. Findings from this study correlate with other studies from the earlier systematic review, which suggest a potential premature ageing pattern among homeless individuals.

In conclusion, it was found that this sample of homeless inpatients had extremely low levels of physical fitness and performance, indicative of their complex health needs. The unmet rehabilitation need highlighted their need for physiotherapy for both acute and chronic issues. This study proved that carrying out research with this population is feasible as the study participants were both receptive and engaged. Future research should focus on the design of suitable interventions to target physical performance variables in this vulnerable group.
References


Bennell, K., Dobson, F. and Hinman, R., 2011. Measures of physical performance assessments: Self-Paced Walk Test (SPWT), Stair Climb Test (SCT), Six-Minute Walk Test (6MWT), Chair Stand Test (CST), Timed Up & Go (TUG), Sock Test, Lift and Carry Test (LCT), and Car Task. *Arthritis care & research, 63*(S11), pp.S350-S370.


The Irish Longitudinal Study on Aging 2018, Wellbeing & Health in Ireland’s over 50’s 2009-2016, Chemistry extension building, Trinity College Dublin.


Appendices
Appendix I: AMSTAR

AMSTAR – a measurement tool to assess the methodological quality of systematic reviews.

1. Was an 'a priori' design provided?
The research question and inclusion criteria should be established before the conduct of the review.
Note: Need to refer to a protocol, ethics approval, or pre-determined/a priori published research objectives to score a "yes."

☐ Yes □ No □ Can't answer □ Not applicable

2. Was there duplicate study selection and data extraction?
There should be at least two independent data extractors and a consensus procedure for disagreements should be in place.
Note: 2 people do study selection, 2 people do data extraction, consensus process or one person checks the other's work.

☐ Yes □ No □ Can't answer □ Not applicable

3. Was a comprehensive literature search performed?
At least two electronic sources should be searched. The report must include years and databases used (e.g., Central, EMBASE, and MEDLINE). Key words and/or MESH terms must be stated and where feasible the search strategy should be provided. All searches should be supplemented by consulting current contents, reviews, textbooks, specialized registers, or experts in the particular field of study, and by reviewing the references in the studies found.
Note: If at least 2 sources + one supplementary strategy used, select "yes" (Cochrane register/Central counts as 2 sources; a grey literature search counts as supplementary).

☐ Yes □ No □ Can't answer □ Not applicable

4. Was the status of publication (i.e. grey literature) used as an inclusion criterion?
The authors should state that they searched for reports regardless of their publication type. The authors should state whether or not they excluded any reports (from the systematic review), based on their publication status, language etc.
Note: If review indicates that there was a search for "grey literature" or "unpublished literature," indicate "yes." SIGLE database, dissertations, conference proceedings, and trial registries are all considered grey for this purpose. If searching a source that contains both grey and non-grey, must specify that they were searching for grey/unpublished lit.

☐ Yes □ No □ Can't answer □ Not applicable

5. Was a list of studies (included and excluded) provided?
A list of included and excluded studies should be provided.
Note: Acceptable if the excluded studies are referenced. If there is an electronic link to the list but the link is dead, select "no."

☐ Yes □ No □ Can't answer □ Not applicable

6. Were the characteristics of the included studies provided?
In an aggregated form such as a table, data from the original studies should be provided on the participants, interventions and outcomes. The ranges of characteristics in all the studies analyzed e.g., age, race, sex, relevant socioeconomic data, disease status, duration, severity, or other diseases should be reported.
Note: Acceptable if not in table format as long as they are described as above.

☐ Yes □ No □ Can't answer □ Not applicable
7. Was the scientific quality of the included studies assessed and documented?

'A priori' methods of assessment should be provided (e.g., for effectiveness studies if the author(s) chose to include only randomized, double-blind, placebo controlled studies, or allocation concealment as inclusion criteria); for other types of studies alternative items will be relevant.

*Note:* Can include use of a quality scoring tool or checklist, e.g., Jadad scale, risk of bias, sensitivity analysis, etc., or a description of quality items, with some kind of result for EACH study ("low" or "high" is fine, as long as it is clear which studies scored "low" and which scored "high"; a summary score/range for all studies is not acceptable).

□ Yes □ No □ Can't answer □ Not applicable

8. Was the scientific quality of the included studies used appropriately in formulating conclusions?

The results of the methodological rigor and scientific quality should be considered in the analysis and the conclusions of the review, and explicitly stated in formulating recommendations.

*Note:* Might say something such as "the results should be interpreted with caution due to poor quality of included studies." Cannot score "yes" for this question if scored "no" for question 7.

□ Yes □ No □ Can't answer □ Not applicable

9. Were the methods used to combine the findings of studies appropriate?

For the pooled results, a test should be done to ensure the studies were combinable, to assess their homogeneity (i.e., Chi-squared test for homogeneity, I^2). If heterogeneity exists a random effects model should be used and/or the clinical appropriateness of combining should be taken into consideration (i.e., is it sensible to combine?).

*Note:* Indicate "yes" if they mention or describe heterogeneity, i.e., if they explain that they cannot pool because of heterogeneity/variability between interventions.

□ Yes □ No □ Can't answer □ Not applicable

10. Was the likelihood of publication bias assessed?

An assessment of publication bias should include a combination of graphical aids (e.g., funnel plot, other available tests) and/or statistical tests (e.g., Egger regression test, Hedges-Olken).

*Note:* If no test values or funnel plot included, score "no". Score "yes" if mentions that publication bias could not be assessed because there were fewer than 10 included studies.

□ Yes □ No □ Can't answer □ Not applicable

11. Was the conflict of interest included?

Potential sources of support should be clearly acknowledged in both the systematic review and the included studies.

*Note:* To get a "yes," must indicate source of funding or support for the systematic review AND for each of the included studies.

□ Yes □ No □ Can't answer □ Not applicable
Appendix II: Systematic Review Registered with PROSPERO

PROSPERO
International prospective register of systematic reviews

UNIVERSITY of York
Centre for Reviews and Dissemination

Systematic review

Give the working title of the review, for example the one used for obtaining funding. Ideally the title should state succinctly the interventions or exposures being reviewed and the associated health or social problems. Where appropriate, the title should use the PI(E)COS structure to contain information on the Participants, Intervention (or Exposure) and Comparison groups, the Outcomes to be measured and Study designs to be included.

A systematic review profiling physical status among homeless people

2. Original language title.
For reviews in languages other than English, this field should be used to enter the title in the language of the review. This will be displayed together with the English language title.

3. * Anticipated or actual start date.
Give the date when the systematic review commenced, or is expected to commence.
30/01/2019

4. * Anticipated completion date.
Give the date by which the review is expected to be completed.
08/04/2019

5. * Stage of review at time of this submission.
Indicate the stage of progress of the review by ticking the relevant Started and Completed boxes. Additional information may be added in the free text box provided.

The review has not yet started: No

Page: 1 / 10
Appendix III: Systematic Review Search Strategy

EMBASE
1. 'homelessness'/exp OR 'homeless person'/exp
2. homeless*:ti,ab
3. #1 OR #2
4. 'exercise'/exp OR 'kinesiotherapy'/exp OR 'physical activity'/exp OR 'physical activity, capacity and performance'/de OR 'training'/de OR 'endurance'/de OR 'exercise tolerance'/de OR 'physical capacity'/de OR 'sport'/exp
5. (isometric* or isotonic* or isokinetic*):ti,ab
6. (resistance OR strength*) NEAR/3 (train* OR exercis*):ti,ab
7. ((physical* or motion* or cardiopulmonary or cardiorespiratory) NEAR/3 (fit* or therap*)):ti,ab
8. (treadmill* or cross-train* or rowing or sport* OR exercis* OR 'physical activit* OR aerobic* OR run or jog* or running OR walk or walks or walking OR gym* OR yoga OR pilates OR 'recreation* activit* OR zumba or salsa* OR cycling or bicycle or bike or swim* or dance or dancer* or dances or dancing or HIIT):ti,ab
9. (circuit* NEAR/1 train*):ti,ab
10. (keep* NEAR/2 (active or fit)):ti,ab
11. #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10
12. #3 AND #11

Medline
1. exp Homeless Persons/
2. homeless*,ti,ab.
3. or/1-2
4. exp Exercise/ OR exp Exercise Therapy/ OR exp Physical Fitness/ OR exp "physical education and training"/ OR exp "Exercise Movement Techniques"/ or physical endurance/ or exercise tolerance/ OR Physical Exertion/ or exp Sports/ or Dancing/
5. (isometric* or isotonic* or isokinetic*):ti,ab.
6. ((resistance OR strength*) adj3 (train* OR exercis*)):ti,ab.
7. ((physical* or motion* or cardiopulmonary or cardiorespiratory) adj3 (fit* or therap* or activit*)):ti,ab.
8. (treadmill* or cross-train* or rowing or sport* or exercise* or physical* activit* or aerobic* or run or jog* or running or walk or walks or walking or gym* or yoga or pilates or "recreation* activit*" or zumba or salsa* or cycling or bicycle or bike or swim* or dance or dancer* or dances or dancing or physiotherapy* or physical therap*):ti,ab.
9. (circuit* adj1 train*):ti,ab.
10. (keep* adj1 (active or fit)).ti,ab
11. or/4-10
12. and/3,11

CINAHL (for each copy/paste untick the “Suggest subject terms box”)
1. (MH "Homeless Persons")
2. TI (homeless*) OR AB (homeless*)
3. S1 OR S2
4. (MH "Exercise+") OR (MH "Physical Fitness+") OR (MH "Therapeutic Exercise+") OR (MH "Physical Therapy")
5. TI (isometric* or isotonic* or isokinetic*) OR AB (isometric* or isotonic* or isokinetic*)
6. TI ((resistance OR strength*) N3 (train* OR exercis*)) OR AB ((resistance OR strength*) N3 (train* OR exercis*))
7. TI ((physical* or motion* or cardiopulmonary or cardiopulmonary or cardiopulmonary) cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary) cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary) N3 (fit* or therap*)) OR AB ((physical* or motion* or cardiopulmonary or cardiopulmonary or cardiopulmonary) cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary) cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary or cardiopulmonary) N3 (fit* or therap*))
8. TI (treadmill* or cross-train* or rowing or sport* OR exercis* OR "physical activit**" OR aerobic* OR run or jog* or running OR walk or walks or walking OR gym* OR yoga OR pilates OR "recreation* activit**" OR zumba or salsa* OR cycling or bicycle or bike or swim* or dance or dancer* or dances or dancing or HIIT) OR AB (treadmill* or cross-train* or rowing or sport* OR exercis* OR "physical activit**" OR aerobic* OR run or jog* or running OR walk or walks or walking OR gym* OR yoga OR pilates OR "recreation* activit**" OR zumba or salsa* OR cycling or bicycle or bike or swim* or dance or dancer* or dances or dancing or HIIT)
9. TI (circuit* N1 train*) OR AB (circuit* N1 train*)
10. TI (keep* N2 (active or fit)) OR AB (keep* N2 (active or fit))
11. S4 OR S5 OR S6 OR S7 OR S8 OR S9 OR S10
12. S3 AND S11

WOS (Copy and paste into advanced search)
TS=(homeless* AND ((isometric* or isotonic* or isokinetic*) OR ((resistance OR strength) NEAR/3 (train* OR exercis*)) OR ((physical* or motion* or cardiopulmonary or cardiopulmonary or cardiopulmonary) NEAR/3 (fit* or therap*)) OR (treadmill* or cross-train* or rowing or sport* OR exercis* OR "physical activit**" OR aerobic* OR run or jog* or running OR walk or walks or walking OR gym* OR yoga OR pilates OR "recreation* activit**" OR zumba or salsa* OR cycling or bicycle or bike or swim* or dance or dancer* or dances or dancing or HIIT) OR (circuit* NEAR/1 train*) OR (keep* NEAR/2 (active or fit)))
Appendix IV: Letter of Ethical Approval

SJH/AMNCH Research Ethics Committee Secretariat
researchethics@tuh.ie

Prof Julie Broderick,
Assistant Professor,
Discipline of Physiotherapy,
School of Medicine,
Trinity Centre for Health Sciences,
St James’ Hospital,
James’ Street,
Dublin 8.

30th October 2018

Re: A Profiling Study of Physical Function and Performance in Long-Term Homeless Adults Assessing Services in St James’s Hospital

REC Reference: 2018-10 List 35 (3)
Original REC Reference: 2018-10 Chairman’s Action 10
(Please quote reference on all correspondence)

Date of valid submission to REC: 19.10.2018
Date of Ethical Review: 26.10.2018

Dear Prof Broderick,

Thank you for your correspondence in which you sent in a response to the Committee’s letter which detailed the Committee’s queries and concerns in relation to the submission of the above referenced research study.

The Chairman has reviewed your response on behalf of the Committee, is happy all issues are dealt with satisfactorily and now gives full ethical approval for the study to proceed.

The following document was reviewed:
Letter of Responses dated 19.10.2018

Yours sincerely,

REC Officer – Dr Sadhbh O’Neill - SJH/TUH Research Ethics Committee

The SJH/TUH Joint Research and Ethics Committee operates in compliance with and is constituted in accordance with the European Communities (Clinical Trials on Medicinal Products for Human Use) Regulations 2004 & ICH GCP guidelines.
PARTICIPANT INFORMATION LEAFLET

HOSPITAL: St. James’s Hospital

DEPARTMENTS: Medicine and Physiotherapy

STUDY TITLE: Physical performance in people registered as homeless admitted to St. James’s Hospital

NAME OF PRINCIPAL INVESTIGATORS: Dr. Cliona Ní Cheallaigh, Dr. Julie Broderick

You are being asked to participate in a research study. Thank you for taking the time to read this.

WHAT IS THE PURPOSE OF THE STUDY?

The purpose of this study is to investigate how people registered as homeless are doing in terms of their physical status or ability. Some research shows that people who don’t have a fixed address can suffer additional health problems but the effect on tasks such as walking ability and strength is not well known, which would help design suitable services if needed.

WHY HAVE I BEEN CHOSEN TO PARTICIPATE IN THIS STUDY?

I have been chosen to participate as I have been registered as having no fixed address during this admission to St. James’s Hospital.

WHAT HAPPENS IF I VOLUNTEER TO PARTICIPATE?

If I volunteer to participate, I understand I will undergo a number of simple tests to assess my strength, walking ability and other physical variables. There is also a questionnaire which we will go through with you and a small number of questions relating to how you feel about your physical health.

The whole assessment will take 30-45 minutes and be carried out by a qualified physiotherapist.

ARE THERE ANY RISKS INVOLVED IN PARTICIPATING?

There are minimal risks to participation in this study. There is a slight risk of injury during the physiotherapy assessment as we will be asking you to perform activities such as standing up from a chair and walking a short distance. However, a qualified...
physiotherapist will be performing the tests and he/she won’t ask you to perform any tests which you are not able for and you will be fully supervised at all times so the risks involved are very small.

ARE THERE ANY BENEFITS INVOLVED IN PARTICIPATING?
There may not be any major direct benefits to you from participating, or taking part in this study. But, by participating in this study you will be taking part in an more detailed physical assessment. This may help highlight areas which need more focussed treatment from physiotherapy. This may also make you more aware of your own physical status.

WHAT HAPPENS IF I DO NOT AGREE TO PARTICIPATE?
Participation in this study is on a voluntary basis. If you do not agree to participate this will not have any impact on your routine care.

WILL MY PARTICIPATION OR WITHDRAWAL HAVE ANY IMPACT ON MY ROUTINE CARE?
You may withdraw or quit this study at any time and this will have no impact on your routine care. Participation, or taking part in this study will also have no impact on your routine care.

WILL MY PARTICIPATION BE CONFIDENTIAL?
Your identity will remain confidential. All personal information and data will be kept confidential. Your name will not be published and will not be disclosed to anyone outside the hospital. Only the investigator within the institution will know the identity of the subjects; codes will be used to conceal identities in all external communications.

INDEMNITY
Your doctors are insured by the State Claims Insurance Service.

WHO IS ORGANISING AND FUNDING THIS RESEARCH?
This research is organised and funded by the Departments of Medicine and Physiotherapy, St. James’s Hospital and the Discipline of Physiotherapy, Trinity College Dublin.

HAS THIS STUDY BEEN REVIEWED BY AN ETHICS COMMITTEE?
This study has been approved by the St James’s and AMNCH Research and Ethics board.

CONTACT DETAILS
Name: Sinead Kiernan
Address: Discipline of Physiotherapy, Trinity centre for Health Sciences, St. James’s Hospital, Dublin 8
Phone: (01) 8962119
PATIENT CONSENT FORM

PLEASE TICK YOUR RESPONSE IN THE APPROPRIATE BOX

I have read and understood the Participant Information
□ Yes □ No

I have had the opportunity to ask questions and discuss the study
□ Yes □ No

I have received satisfactory answers to all my questions
□ Yes □ No

I have received enough information about the study
□ Yes □ No

I understand that I am free to withdraw from the study at any time without giving a reason and without this affecting my future medical care
□ Yes □ No

I agree to take part in the study
□ Yes □ No

Participant signature: ______________________________

Date: ______________________________

Participant’s Name in print: ______________________________

Investigator’s Signature: ______________________________

Date: ______________________________

Investigator’s Name in print: ______________________________
APPENDIX VI: SPPB

Short Physical Performance Battery Protocol and Score Sheet

Participant Name: ___________________________ Date: ___________________________

All of the tests should be performed in the same order as they are presented in this protocol. Instructions to the participants are shown in bold italic and should be given exactly as they are written in this script.

1. BALANCE TESTS

The participant must be able to stand unassisted without the use of a cane or walker. You may help the participant to get up.

Now let’s begin the evaluation. I would now like you to try to move your body in different movements. I will first describe and show each movement to you. Then I’d like you to try to do it, tell me and we’ll move on to the next one. Let me emphasize that I do not want you to try to do any exercise that you feel might be unsafe.

Do you have any questions before we begin?

A. Side-by-Side Stand

1. Now I will show you the first movement.

2. (Demonstrate) I want you to try to stand with your feet together, side-by-side, for about 10 seconds.

3. You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position until I tell you to stop.

4. Stand next to the participant to help him/her into the side-by-side position.

5. Supply just enough support to the participant’s arm to prevent loss of balance.

6. When the participant has his/her feet together, ask “Are you ready?”

7. Then let go and begin timing as you say, “Ready, begin.”

8. Stop the stopwatch and say “Stop” after 10 seconds or when the participant steps out of position or grabs your arm.

9. If participant is unable to hold the position for 10 seconds, record result and go to the gait speed test.
B. Semi-Tandem Stand

1. *Now I will show you the second movement.*

2. (Demonstrate) *Now I want you to try to stand with the side of the heel of one foot touching the big toe of the other foot for about 10 seconds. You may put either foot in front, whichever is more comfortable for you.*

3. *You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position until I tell you to stop.*

4. Stand next to the participant to help him/her into the semi-tandem position.

5. Supply just enough support to the participant’s arm to prevent loss of balance.

6. When the participant has his/her feet together, ask "*Are you ready?*"

7. Then let go and begin timing as you say "*Ready, begin.*"

8. Stop the stopwatch and say "*Stop*" after 10 seconds or when the participant steps out of position or grabs your arm.

9. If participant is unable to hold the position for 10 seconds, record result and go to the gait speed test.

C. Tandem Stand

1. *Now I will show you the third movement.*

2. (Demonstrate) *Now I want you to try to stand with the heel of one foot in front of and touching the toes of the other foot for about 10 seconds. You may put either foot in front, whichever is more comfortable for you.*

3. *You may use your arms, bend your knees, or move your body to maintain your balance, but try not to move your feet. Try to hold this position until I tell you to stop.*

4. Stand next to the participant to help him/her into the tandem position.

5. Supply just enough support to the participant’s arm to prevent loss of balance.

6. When the participant has his/her feet together, ask "*Are you ready?*"

7. Then let go and begin timing as you say, "*Ready, begin.*"

8. Stop the stopwatch and say "*Stop*" after 10 seconds or when the participant steps out of position or grabs your arm.
SCORING:

A. Side-by-Side stand

- Held for 10 sec  ☐ 1 point
- Not held for 10 sec ☐ 0 points
- Not attempted ☐ 0 points

If 0 points, end Balance Tests

Number of seconds held if less than 10 sec:
_____.___ Sec

If participant did not attempt test or failed, circle why:
1. Tried but unable
2. Participant could not hold position unassisted
3. Not attempted, you felt unsafe
4. Not attempted, participant felt unsafe
5. Participant unable to understand instructions
6. Other (specify)
7. Participant refused

B. Semi-Tandem Stand

- Held for 10 sec  ☐ 1 point
- Not held for 10 sec ☐ 0 points
- Not attempted ☐ 0 points

(circle reason to the right)

If 0 points, end Balance Tests

Number of seconds held if less than 10 sec:
_____.___ Sec

If participant did not attempt test or failed, circle why:
1. Tried but unable
2. Participant could not hold position unassisted
3. Not attempted, you felt unsafe
4. Not attempted, participant felt unsafe
5. Participant unable to understand instructions
6. Other (specify)
7. Participant refused

C. Tandem Stand

- Held for 10 sec  ☐ 2 point
- Held for 3 to 9.99 sec ☐ 1 points
- Held for < than 3 sec ☐ 0 points
- Not attempted ☐ 0 points

(circle reason above)

Number of seconds held if less than 10 sec:
_____.___ Sec

If participant did not attempt test or failed, circle why:
1. Tried but unable
2. Participant could not hold position unassisted
3. Not attempted, you felt unsafe
4. Not attempted, participant felt unsafe
5. Participant unable to understand instructions
6. Other (specify)
7. Participant refused

D. Total Balance Tests score ___________ (sum points)

Comments:

______________________________

______________________________

______________________________
2. GAIT SPEED TEST

*Now I am going to observe how you normally walk. If you use a cane or other walking aid and you feel you need it to walk a short distance, then you may use it.*

### A. First Gait Speed Test

1. *This is our walking course. I want you to walk to the other end of the course at your usual speed, just as if you were walking down the street to go to the store.*
2. Demonstrate the walk for the participant.
3. *Walk all the way past the other end of the tape before you stop. I will walk with you. Do you feel this would be safe?*
4. Have the participant stand with both feet touching the starting line.
5. *When I want you to start, I will say: “Ready, begin.” When the participant acknowledges this instruction say: “Ready, begin.”*
6. Press the start/stop button to start the stopwatch as the participant begins walking.
7. Walk behind and to the side of the participant.
8. Stop timing when one of the participant’s feet is completely across the end line.

### B. Second Gait Speed Test

1. *Now I want you to repeat the walk. Remember to walk at your usual pace, and go all the way past the other end of the course.*
2. Have the participant stand with both feet touching the starting line.
3. *When I want you to start, I will say: “Ready, begin.” When the participant acknowledges this instruction say: “Ready, begin.”*
4. Press the start/stop button to start the stopwatch as the participant begins walking.
5. Walk behind and to the side of the participant.
6. Stop timing when one of the participant’s feet is completely across the end line.
GAIT SPEED TEST SCORING:

Length of walk test course: Four meters ☐ Three meters ☐

A. Time for First Gait Speed Test (sec)

1. Time for 3 or 4 meters ______ sec

2. If participant did not attempt test or failed, circle why:
   - Tried but unable 1
   - Participant could not walk unassisted 2
   - Not attempted, you felt unsafe 3
   - Not attempted, participant felt unsafe 4
   - Participant unable to understand instructions 5
   - Other (Specify) ______________________ 6
   - Participant refused 7

3. Aids for first walk............ None ☐ Cane ☐ Other ☐

   Comments: __________________________________________________________
   __________________________________________________________

B. Time for Second Gait Speed Test (sec)

1. Time for 3 or 4 meters ______ sec

2. If participant did not attempt test or failed, circle why:
   - Tried but unable 1
   - Participant could not walk unassisted 2
   - Not attempted, you felt unsafe 3
   - Not attempted, participant felt unsafe 4
   - Participant unable to understand instructions 5
   - Other (Specify) ______________________ 6
   - Participant refused 7

3. Aids for second walk............ None ☐ Cane ☐ Other ☐

   What is the time for the faster of the two walks?
   Record the shorter of the two times ______ sec
   [If only 1 walk done, record that time] ______ sec
   If the participant was unable to do the walk: ☐ 0 points
Short Physical Performance Battery Protocol and Score Sheet

For 4-Meter Walk:

<table>
<thead>
<tr>
<th>Time Range</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 8.70 sec</td>
<td>1 point</td>
</tr>
<tr>
<td>6.21 to 8.70 sec</td>
<td>2 points</td>
</tr>
<tr>
<td>4.82 to 6.20 sec</td>
<td>3 points</td>
</tr>
<tr>
<td>Less than 4.82 sec</td>
<td>4 points</td>
</tr>
</tbody>
</table>

For 3-Meter Walk:

<table>
<thead>
<tr>
<th>Time Range</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 6.52 sec</td>
<td>1 point</td>
</tr>
<tr>
<td>4.66 to 6.52 sec</td>
<td>2 points</td>
</tr>
<tr>
<td>3.62 to 4.65 sec</td>
<td>3 points</td>
</tr>
<tr>
<td>Less than 3.62 sec</td>
<td>4 points</td>
</tr>
</tbody>
</table>

3. CHAIR STAND TEST

Single Chair Stand

1. **Let’s do the last movement test. Do you think it would be safe for you to try to stand up from a chair without using your arms?**
2. **The next test measures the strength in your legs.**
3. (Demonstrate and explain the procedure.) **First, fold your arms across your chest and sit so that your feet are on the floor; then stand up keeping your arms folded across your chest.**
4. Please stand up keeping your arms folded across your chest. (Record result).
5. If participant cannot rise without using arms, say “Okay, try to stand up using your arms.” This is the end of their test. Record result and go to the scoring page.

Repeated Chair Stands

1. **Do you think it would be safe for you to try to stand up from a chair five times without using your arms?**
2. (Demonstrate and explain the procedure): **Please stand up straight as QUICKLY as you can five times, without stopping in between. After standing up each time, sit down and then stand up again. Keep your arms folded across your chest. I’ll be timing you with a stopwatch.**
3. When the participant is properly seated, say: “**Ready? Stand**” and begin timing.
4. Count out loud as the participant arises each time, up to five times.
5. Stop if participant becomes tired or short of breath during repeated chair stands.
6. Stop the stopwatch when he/she has straightened up completely for the fifth time.
7. Also stop:
   - If participant uses his/her arms
   - After 1 minute, if participant has not completed rises
   - At your discretion, if concerned for participant’s safety
8. If the participant stops and appears to be fatigued before completing the five stands, confirm this by asking “**Can you continue?**”
9. If participant says “Yes,” continue timing. If participant says “No,” stop and reset the stopwatch.
**SCORING**

**Single Chair Stand Test**

A. Safe to stand without help

B. Results:
   - Participant stood without using arms
   - Participant used arms to stand
   - Test not completed

C. If participant did not attempt test or failed, circle why:
   - Tried but unable
   - Participant could not stand unassisted
   - Not attempted, you felt unsafe
   - Not attempted, participant felt unsafe
   - Participant unable to understand instructions
   - Other (Specify)
   - Participant refused

**Repeated Chair Stand Test**

A. Safe to stand five times

B. If five stands done successfully, record time in seconds.
   - Time to complete five stands ____.____ sec

C. If participant did not attempt test or failed, circle why:
   - Tried but unable
   - Participant could not stand unassisted
   - Not attempted, you felt unsafe
   - Not attempted, participant felt unsafe
   - Participant unable to understand instructions
   - Other (Specify)
   - Participant refused

**Scoring the Repeated Chair Test**

Participant unable to complete 5 chair stands or completes stands in >60 sec: □ 0 points
If chair stand time is 16.70 sec or more: □ 1 points
If chair stand time is 13.70 to 16.69 sec or more: □ 2 points
If chair stand time is 11.20 to 13.69 sec: □ 3 points
If chair stand time is 11.19 sec or less: □ 4 points
<table>
<thead>
<tr>
<th>Test</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Balance Test</td>
<td></td>
</tr>
<tr>
<td>Gait Speed Test</td>
<td></td>
</tr>
<tr>
<td>Chair Stand Test</td>
<td></td>
</tr>
<tr>
<td><strong>Total Score</strong></td>
<td><strong>points</strong> (sum of points above)</td>
</tr>
</tbody>
</table>

**Scoring for Complete Short Physical Performance Battery**

Participant ID: __________________________ Date: ________________ Tester Initials: __________________________
Appendix VII: 6MWT Protocol and scoring

Study I.D: ______________________

Pre-Testing
Resting Heart Rate
Resting heart rate: ................bpm

Resting Blood Pressure
Resting BP (i): ................mm Hg
Resting BP (ii): ................mm Hg
Resting BP (iii): ................mm Hg

BORG Oxygenation Saturation
Resting BORG RPE: .............. SpO₂: ..............%

During Testing

Lap Counter (Note: 1 lap = 60m)

<table>
<thead>
<tr>
<th>Time (mins)</th>
<th>HR</th>
<th>BORG</th>
<th>Rests</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
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<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Recovery

<table>
<thead>
<tr>
<th>Time (mins)</th>
<th>HR</th>
<th>BORG</th>
<th>BP</th>
<th>SpO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total Distance: ............m
Appendix VIII: Stair climb test protocol

**Stair Climb Test**

**Abbreviation:** $x$-step SCT (where $x$ is the number of steps e.g. 9-step SCT)

**Purpose / Domains**
A test of ascending and descending stair activity.
Also a test of lower body strength and balance.
ICF codes\(^{(2-6)}\): d410 Changing basic body position, d455 Moving around, d4551 Climbing.

**Description**
The time (in seconds) it takes to ascend and descend a flight of stairs\(^{(2-6)}\).
The number of stairs will depend on individual environmental situations.
Where possible, the 9-step stair test with 20cm (8 inch) step height and handrail is recommended.

**Equipment**
- Timer/stop watch.
- Flight of stairs.

**Preparation**

**Environment**
- Suitable step heights (between 16-20cm).
- Ensure adequate lighting and free from traffic and external distractions.

**Participant**
- Comfortable walking footwear (e.g. tennis shoes/cross trainers) should be worn.

**Tester**
- If safety is of concern, the tester should guard behind/below the participant going up the stairs and ahead/to the side coming down the stairs.
- If there is no concern for safety, the tester should remain at the start/finish position on the ground landing.

**Practice**
- A practice trial with tester guarding is recommended before testing to assess for safety.

**Procedure**
- Ascend and descend flight of stairs as quickly as possible but in a safe manner.
- Use of a handrail and walking aid is permitted if needed. Use should be recorded.
- Same stairs should be used for re-testing within site.
Appendix IX: Clinical Frailty scale

Clinical Frailty Scale*

1 Very Fit – People who are robust, active, energetic and motivated. These people commonly exercise regularly. They are among the fittest for their age.

2 Well – People who have no active disease symptoms but are less fit than category 1. Often, they exercise or are very active occasionally, e.g. seasonally.

3 Managing Well – People whose medical problems are well controlled, but are not regularly active beyond routine walking.

4 Vulnerable – While not dependent on others for daily help, often symptoms limit activities. A common complaint is being “slow down”, and/or being tired during the day.

5 Mildly Frail – These people often have more evident slowing, and need help in high order IADLs (finances, transportation, heavy housework, medications). Typically, mild frailty progressively impairs shopping and walking outside alone, meal preparation and housework.

6 Moderately Frail – People need help with all outside activities and with keeping house. Inside, they often have problems with stairs and need help with bathing and might need minimal assistance (cuing, standby) with dressing.

7 Severely Frail – Completely dependent for personal care, from whatever cause (physical or cognitive). Even so, they seem stable and not at high risk of dying (within ~ 6 months).

8 Very Severely Frail – Completely dependent, approaching the end of life. Typically, they could not recover even from a minor illness.

9. Terminally III – Approaching the end of life. This category applies to people with a life expectancy <6 months, who are not otherwise evidently frail.

Scoring frailty in people with dementia

The degree of frailty corresponds to the degree of dementia. Common symptoms in mild dementia include forgetting the details of a recent event, though still remembering the event itself, repeating the same question/story and social withdrawal.

In moderate dementia, recent memory is very impaired, even though they seemingly can remember their past life events well. They can do personal care with prompting.

In severe dementia, they cannot do personal care without help.

* I. Canadian Study on Health & Aging. Revised 2008

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Appendix X: EQ5D5L

Under each heading, please tick the ONE box that best describes your health TODAY.

**MOBILITY**
- I have no problems in walking about
- I have slight problems in walking about
- I have moderate problems in walking about
- I have severe problems in walking about
- I am unable to walk about

**SELF-CARE**
- I have no problems washing or dressing myself
- I have slight problems washing or dressing myself
- I have moderate problems washing or dressing myself
- I have severe problems washing or dressing myself
- I am unable to wash or dress myself

**USUAL ACTIVITIES (e.g. work, study, housework, family or leisure activities)**
- I have no problems doing my usual activities
- I have slight problems doing my usual activities
- I have moderate problems doing my usual activities
- I have severe problems doing my usual activities
- I am unable to do my usual activities

**PAIN / DISCOMFORT**
- I have no pain or discomfort
- I have slight pain or discomfort
- I have moderate pain or discomfort
- I have severe pain or discomfort
- I have extreme pain or discomfort

**ANXIETY / DEPRESSION**
- I am not anxious or depressed
- I am slightly anxious or depressed
- I am moderately anxious or depressed
- I am severely anxious or depressed
- I am extremely anxious or depressed
• We would like to know how good or bad your health is TODAY.

• This scale is numbered from 0 to 100.

• 100 means the best health you can imagine.
  0 means the worst health you can imagine.

• Mark an X on the scale to indicate how your health is TODAY.

• Now, please write the number you marked on the scale in the box below.

YOUR HEALTH TODAY =  

The best health you can imagine

The worst health you can imagine