



SYSTEMATIC REVIEW

Physical functioning limitations and physical activity of people experiencing homelessness: A scoping review [version 1; peer review: awaiting peer review]

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Abstract

Background: Adults who are experiencing homelessness suffer higher levels of premature mortality and age-related medical conditions compared to the general population, but little is known about physical factors that influence their health experience. This review aimed to evaluate what is known about physical functional limitations and physical activity levels, and how these constructs are measured in adults experiencing homelessness.

Methods: This review was conducted in accordance with the Joanna Briggs Institute's methodology for scoping reviews. Suitable quantitative and qualitative articles were searched using PubMed, CINAHL, EMBASE, PsychInfo, Web of Science and SCOPUS databases using a combination of keywords and medical subject headings and a grey literature search was also performed. Two reviewers independently screened articles for inclusion. Inclusion criteria were studies that examined physical functional limitations and/or physical activity among homeless adults (with/without co-occurring mental illness, infectious disease, substance use disorder), as a primary or secondary outcome measure.

Results: We identified 15 studies for inclusion including 2,018 participants. Studies were primarily quantitative (n=11) and there were 4 qualitative studies. The following physical focused measures were evaluated across studies; mobility levels (n=2), frailty (n=1), flexibility (n=2), strength (n=1), physical symptom burden (n=3), physical activity levels (n=6) and exercise capacity (n=3). The majority of studies reported high levels of functional limitations among participants and low physical activity levels although a spectrum of abilities was noted.

Conclusion: This review showed that many adults who are homeless appear to show a high burden of physical functional limitations and low physical activity levels but more objective and consistent measures should be applied to examine these factors in future studies. This will help address and plan future care, physical rehabilitation and housing needs for this vulnerable cohort. This scoping review will help direct research and future systematic reviews in this emerging area.

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Any reports and responses or comments on the article can be found at the end of the article.

Keywords

Functional status, physical activity, homeless adults, homelessness

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Introduction

The number of people experiencing homelessness is significant and increasing, with estimates of 307,000 people in the UK¹, 550,000 in the USA² and 235,000 in Canada³ at any one point. A 'person experiencing homelessness' is someone without stable housing who may live on the streets, in a shelter, in temporary accommodation, or in some other unstable or non-permanent situation⁴.

Life expectancy is greatly reduced among people who are homeless. Recent data from the UK reports a mean age of death among people who died homeless of 45 years among men and 43 years among women, which compares with 76 and 81 years respectively, in the general population⁵. In Ireland the median age at death for people experiencing homelessness in Dublin is devastatingly low at 44 years for males and 36 years for females⁶. Contributing factors to lowered mortality levels are complex. People who are homeless people experience a 'tri-morbidity' of mental illness, physical illness, chronic disease and addiction as well as complex interwoven factors related to social exclusion, higher rates of accidental, violent death and poor access to healthcare⁷.

Common chronic diseases such as chronic obstructive pulmonary disease, asthma, epilepsy, heart disease and stroke are substantially more prevalent among people experiencing homelessness compared to housed individuals⁸. External factors as well as chronic diseases have a multi-system effect with reported accelerated ageing⁹ and early onset of geriatric conditions¹⁰. Reflective of disease prevalence and other factors related to extreme socioeconomic deprivation, people who are homeless present for acute hospital care disproportionately compared to housed individuals¹¹.

An abundance of epidemiological highlights physical inactivity as a significant predictor of cardiovascular disease, type 2 diabetes mellitus, obesity, some cancers, poor skeletal health, some aspects of mental health, and overall mortality, as well as poor quality of life¹². Despite this, information on physical activity levels among homeless individuals is largely unexplored¹³.

Physical performance and functional limitation measures may provide an insight into early signs of disability, poor health, hospitalization and increased death risk^{9,12}. These measures give an indication of a person's ability to perform everyday tasks making them good indicators of overall ability to live independently as ageing occurs⁹. To date there has been no prior effort to characterize the overall physical status of people experiencing homelessness. Improved understanding of physical variables is important, as this may guide the development of screening tools to identify, and interventions to attenuate declines in people experiencing homeless. This will also help direct research as well as future systematic reviews in this topic area.

The protocol was developed and peer-reviewed locally and then registered in the PROSPERO database (CRD42019124306). In order to address the breadth of this area however, a scoping review rather than a 'pure' systematic review¹⁴ was conducted.

Although some consider a scoping review a form of systematic review¹⁵, subtle differences are, for example, the breadth of the research question and the lack of risk of bias assessment^{14,15}.

Based upon the PCC (Population, Concept and Context) elements¹⁶, the overall aim of this scoping review was to evaluate the magnitude and scope of physical functioning limitations and physical activity levels of people experiencing homelessness as well as their measurement methods. Due to the anticipated dearth of literature on physical functioning limitations and scoping nature of this review, related secondary outcomes measures which were reported in included studies such as frailty and cardiovascular fitness were also considered for inclusion in this review.

Methods

This review was informed by the Joanna Briggs Institute's (JBI) methodology for scoping reviews¹⁴ and guided by the original framework of Arksey and O' Malley¹⁷, and enhancements proposed by Levac *et al.*¹⁸. This review was checked against the Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist¹⁹ (see reporting guidelines²⁰).

Data sources and searches

A comprehensive search strategy was developed collaboratively with a skilled research librarian (D.M.) and a subject expert (C.N.C.) was consulted. The following electronic databases were searched without date restrictions; MEDLINE/PubMed, EMBASE, PEDro, AMED, CINAHL, PsycINFO, SCOPUS (see extended data²⁰). A grey literature search using Google Scholar and WorldCat search engines was performed; government reports were searched using the Google search engine and a combination of key word text.

Physical focused definitions employed in this review

We employed the definition of functional limitation proposed by Nagi "limitations in performance at the level of the whole organism or person" such as restrictions in mobility²¹. Although not the specific focus of this review, factors that relate to physical functioning limitations such as, but not limited to, frailty, physical symptom burden and cardiovascular fitness were included in this review if reported in studies sourced. Physical activity was defined as any bodily movement produced by skeletal muscles that results in energy expenditure from light physical activity to vigorous levels of physical activity, including incidental movements²².

Inclusion/exclusion criteria

This review included English language studies only. To meet the objective of the scoping review questions in this study, both qualitative and quantitative study designs were included. Studies that examined physical functioning or physical activity (separate searches for each were conducted and later combined) among homeless adults (>18 years) as a primary or secondary outcome measure were included. The following criteria for homeless from the European Typology for Homelessness and Housing Exclusion (ETHOS) criteria²³: roofless, houseless, living in

insecure housing, living in inadequate housing was employed in this review.

Selection of studies

Duplications were removed and relevant studies were imported into Covidence for title and abstract screening which took place independently by two reviewers (J.B. and S.K.). Both authors then conducted a full-text evaluation of selected studies. If necessary, any discrepancies were resolved by consensus by including a third author (C.N.C.).

Data extraction

Two reviewers (S.K. and J.B.) independently extracted data using a specifically designed data extraction sheet. Any differences were resolved by consensus discussion. A third author (C.N.C) was available if disparities emerged between reviewers.

Data analysis

Descriptive analysis was performed for all demographic data and data was grouped according to outcome evaluated. Due to the heterogeneity of study design, interventions and outcomes, a narrative synthesis was conducted.

Results

Studies identified

After the removal of duplicates, 2832 studies were identified. After full-text screening, a total of 15 studies were deemed eligible for inclusion in this review. The PRISMA flow chart²⁴ summarizes the search strategy (Figure 1). Quantitative (n=11) studies predominated and the remaining were qualitative in design (n=4). Over 2000 participants were included in this review (n=2,018). Over 70% of participants were male. Four studies were limited to male only participants²⁵⁻²⁸, while only two were female only^{29,30}. Characteristics of the included studies are shown in Table 1. The majority of studies took place in North America (12/15) with the remainder in Australia (n=1) and Denmark (n=2).

Participant characteristics are shown in Table 2. The following physical variables were evaluated in studies included in this review; mobility status, frailty, flexibility, physical symptom burden, physical activity levels and exercise intensity achieved and fitness. Table 3 summarizes physical focused variables and Table 4 summarizes physical activity/sedentary behavior variables.

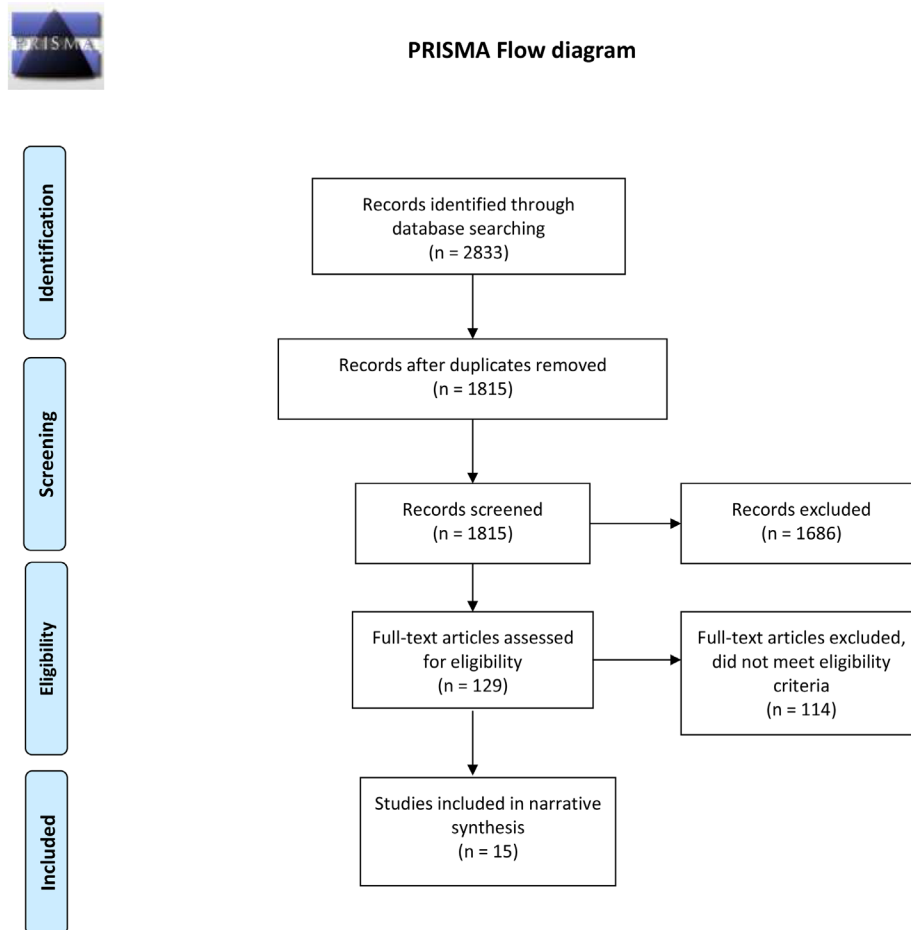


Figure 1. PRISMA flow diagram of review.

Table 1. Study characteristics.

Author and year	Study Location	Listed study type	Inclusion criteria	Living arrangement	Physical Focused Outcomes (measure)
Ballard, 2009	North Carolina, U.S.	Cross sectional	Age > 18 years Understood and spoke English	Resident in homeless shelters	Physical activity (questionnaire adapted from the Behavioral Risk Factors Surveillance Survey, qualitative exploration)
Bazari <i>et al.</i> 2018	California, U.S.	Qualitative study including semi-structured interviews	Age >50 years Able to give consent English speaking Homeless	Unsheltered locations	Symptom burden (semi-structured interviews)
Brown <i>et al.</i> 2012	Boston, U.S.	Cross sectional	Age >50 years Able to communicate in English Able to give consent	Emergency, transitional and day centers	Geriatric syndromes (Fried frailty criteria, Self-reported falls and mobility impairments)
Brown <i>et al.</i> 2016	California, U.S.	Prospective cohort study	Age >50 years Able to give consent English speaking Homeless	Overnight shelters, Unsheltered locations	Functional status (self-reported falls and mobility impairments)
Chau <i>et al.</i> 2002	Los Angeles, U.S.	Qualitative	Homeless English-speaking >18 years New to study	Homeless shelters	Daily exercise habit (self-report)
Gaderman <i>et al.</i> 2014	Vancouver, Toronto, Ottawa, Canada	Cross sectional	Age > 18 years	Homeless shelters	Physical and mental health conditions (SF12)
Gregg and Bedard 2016	Winnipeg, Canada	Cross sectional	Not specified	Homeless shelter	Exercise intention and attitudes (Intention to exercise Questionnaire) Fitness (1 mile treadmill walk test) Strength (grip strength) Flexibility (sit and reach)
Kenzor <i>et al.</i> 2015	Dallas, U.S.	Pilot study	>6th grade English literacy, Willingness to quit smoking Age > 18 years Willingness to attend weekly smoking cessation treatment sessions	Homeless shelter	Physical activity (7 items from the Behavioral Risk Factor Surveillance System Questionnaire: Physical Activity)
Patanwala <i>et al.</i> 2017	California, U.S.	Cross sectional analysis	Age >50 years English speaking Able to give informed consent	Overnight shelters, Unsheltered locations	Physical symptom burden (Patient Health Questionnaire-15)
Marmolejo <i>et al.</i> 2018	Los Angeles, US	2 group cross-sectional comparative study	Ability to give consent	Homeless young adults	Flexibility (sit and reach test)

Author and year	Study Location	Listed study type	Inclusion criteria	Living arrangement	Physical Focused Outcomes (measure)
Quine <i>et al.</i> 2004	Sydney, Australia	Qualitative study	Older men ≥ 50 years, In receipt of a pension or benefit Effectively single Non-home owners Living alone	No fixed abode	Physical activity levels (semi structured interviews)
Randers <i>et al.</i> 2010	Copenhagen, Denmark	Cross sectional	NS	Shelters	Fitness (VO ₂ max)
Randers <i>et al.</i> 2012	Copenhagen, Denmark	Controlled study	NS	Shelters	Fitness (VO ₂ max)
Raven <i>et al.</i> 2017	California, U.S.	Cross sectional	English speaking Age >50 years	Homeless encampments, all overnight homeless shelters	Functional limitations (Short physical performance battery)
Wilson, 2004	Midwest, U.S.	Cross-sectional study	Homeless women Registered residents of the shelters Could read and understand the English language	Homeless shelters	Physical activity levels (HPLPII)

Table 2. Details of participant characteristics.

Citation	Number of participants	Age mean (SD)	Gender	Race/Ethnicity	<High school education	Comorbid conditions
Ballard, 2009	126	41.99 ± 9.42 years	Female only M:0 F:126	African American (54%) White (32.5%) American Indian (4.8%) Mixed race (4.8%) Asian (1.6%) Other/unsure (4.4%)	31.8%	High blood pressure: 41.1% Asthma: 26.8% Arthritis: 25% STDs: 22.4%
Bazari <i>et al.</i> 2018	20	62 years	Male= 65% M:13 F:7	African American (85%)	NS	NS
Brown <i>et al.</i> 2012	247	56 years	Male= 92% M:187 F:60	White (39.7%)	26.1%	Hypertension (59%), arthritis (44.9%), depression (59.6%)
Brown <i>et al.</i> 2017	350	58 (54–61 years) ^a	Male= 77.1%	African American (79.7%), White (10.9%) Latino (4.6%), Other (4.9%)	25.7%	Hypertension (56%) Coronary artery disease or myocardial infarction (9.1%) Congestive heart failure (7.1%) Diabetes (14%) Stroke (11.2%) Respiratory disease (26.3%) Arthritis (44.6%) HIV/AIDS (5.5%)

Citation	Number of participants	Age mean (SD)	Gender	Race/Ethnicity	<High school education	Comorbid conditions
Chau <i>et al.</i> 2002	221	46.7 years	Male=54% M:120 F:101	African-American (57%) Caucasian (26%) Other (17%)	60%	NS
Gadermann <i>et al.</i> 2014	100	43.3 +/- 11.9 years	Male= 69% M:69 F:31	White (55%), Aboriginal (30%) Other (15%)	27.2%	Arthritis/rheumatism, joint problems (43.9%), Hepatitis C (31.6%), Migraines (28.6%), Mental health conditions (52.5%), Substance abuse (40.2%), Depression (34%), Substance dependence (26.6%), GAD (15.6%), PTSD (12.5%)
Gregg and Bedard 2016	18	41.05 ± 11.32 years	Male = 100% M:18 F:0	NS	NS	NS
Kendzor <i>et al.</i> 2015	57	49.4 +/- 7.7 years	Male = 66.6%	African-American (54.4%) Latino (3.5%) Mixed race(5.3%)	NS	NS
Marmolejo <i>et al.</i> 2018	40	21.4 ± 2.3 years	Male = 67.5% M:27 F:13	White (30%) Hispanic (27.5%) African American (20%) American Indian/ Alaska Native 3(7.5%) Native Hawaiian/ Pacific Islander 1(2.5%) Missing (12.5%)	15%	NS
Pantalawa <i>et al.</i> 2017	283	59 (51–82) ^a	Male=75.6% M:214 F:69	African American (82.4%) White (9.6%) Other (21.9%)	21.9%	Heart related (17.2%) Respiratory related (23.7%) Diabetes (18.3%) Arthritis (46.8%) Cirrhosis/liver disease (21.0%) Kidney disease (5.4%) Cancer (5.9%) HIV/AIDS (6.2%)
Quine <i>et al.</i> 2004	32	66 years	Male = 100% M:32, F:0	Australian born (66%) Born overseas (33%)	NS	'Significant' health difficulties (66%)
Randers <i>et al.</i> 2010	15	29 ± 2 years	Male = 100% M:15,F:0	NS	NS	NS
Randers <i>et al.</i> 2012	22	37 ± 10 years	Male = 100% M:22, F:0	NS	NS	NS
Raven <i>et al.</i> 2017	350	58 (54–61) ^a	Male = 77.1% M:270 F:80	African American (79.7%) Non-African American (20.3%)	74.3%	Chronic illness (23.9%), Acute illness (21.6%), Pain (19.2%) PTSD (32.6%) Depression (53.3%)

Citation	Number of participants	Age mean (SD)	Gender	Race/Ethnicity	<High school education	Comorbid conditions
Wilson, 2004	137	36 years (range 18–60)	Female only M:0 F:137	White (53%) African American (43.8%)	22%	Physical diseases: Asthma: 27% Chronic bronchitis: 25.5% Hypertension: 20.4% Arthritis: 16.8% STD: 16.8% Ulcer: 15.3%

NS: not stated, *Median(IQR)

Table 3. Physical focussed variables measured in systematic review studies.

Physical Variable	Type of Measure	Total number of studies	Authors
Mobility	Self-reported difficulty walking	2	Brown <i>et al.</i> (2012) Brown <i>et al.</i> (2016)
Lower extremity functioning	Short Physical Performance Battery	3	Raven <i>et al.</i> (2017)
Frailty	Fried criteria	1	Brown <i>et al.</i> (2012)
Flexibility	Sit and Reach Test	1	Marmolejo <i>et al.</i> 2018 Gregg and Bedard (2016)
Strength	Grip Strength	1	Greg and Bedard (2016)
Physical health/symptom burden	Physical symptom burden (self-report)	1	Bazari <i>et al.</i> (2018)
	SF-12 (Physical component)	1	Gaderman <i>et al.</i> (2014)
	Patient Health Questionnaire-15	1	Pantanwala <i>et al.</i> (2017)
Exercise capacity	1 mile walk test	1	Greg and Bedard (2016)
	VO ₂ max	2	Randers <i>et al.</i> (2010) Randers <i>et al.</i> (2012)

Mobility status

Mobility status was evaluated in two studies. Overall results indicated that many people homeless experiencing homelessness have difficulty mobilizing. In two studies^{10,31} mobility was measured by self-reported difficulty walking. Brown *et al.* 2012³¹ sampled 247 homeless adults, and found that 102 (41.3%) self-reported difficulty walking³¹. Brown *et al.* 2017 included 350 participants aged 50 or older and reported mobility impairments in over one quarter of participants (26.9%) and 33.7% reported one or more falls in the previous 6 months. Results of this

study indicated that greater mobility impairments (defined as difficulty across a room) were found in participants < 50 years, compared to those ≥ 50 years.

Functional limitations

Raven *et al.* 2017 reported that over half (58.4%, n=204) of participants had limitations in lower extremity function measured by the Short Physical Performance Battery³². This study included participants with a median (IRQ) age of 58 (54–61) years.

Table 4. Physical activity/sedentary behaviour focussed measures.

Author		Type of measure	Detail of measure	Subscale (if relevant)	Main Result
Ballard, 2009		Questionnaire	Health Promotion Model Measures	Physical activity subscale [Health-promoting Lifestyle Profile II (HPLP II)]	2.08 (0.66) Range: 1.00–3.88
Chau <i>et al.</i> 2002		Interview	Asked in interview if exercise was 'daily', 'sometimes' or 'never'	N/A	125 (56%) exercised daily, 86 (39%) exercised sometimes, 10 (5%) never exercised
Gregg & Bedard, 2016		Reporting of frequency of exercise	Exercise defined as "at least three times per week, for at least 20–30 min in duration, and at least moderate-to-vigorous intensity"	N/A	8 (44%) participants reported exercising regularly
Kendzor <i>et al.</i> , 2015		Questionnaire	Behavioural Risk factor Surveillance System Questionnaire	Insufficient physical activity defined as <150 minutes of moderate physical activity or <75 minutes of vigorous physical activity (or less than an equivalent combination of the two)	During the previous week, 26.3% did not meet recommended physical activity guidelines
Marmolejo <i>et al.</i> 2018		Self-report paper questionnaire but unclear exactly how physical activity measured		'Low frequency' physical activity 0–2 times per week	N=14, 36.8%
				'High frequency' Physical activity 3+ times/week	N=24, 63.2%
Quine <i>et al.</i> (2004)		Self-report	Semi-structured interview	N/A	Physical activity (walking) emerged as a theme
Wilson		Questionnaire	Health Promotion Model Measures	Physical activity subscale [Health-promoting Lifestyle Profile II (HPLP II)]	2.05 (+/-0.98)

N/A: not applicable

Frailty

Frailty was evaluated in one study³¹. Frailty was measured using the Fried criteria³³ 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.

Flexibility

Flexibility was assessed in two studies^{34,35} and compared to control groups. The Sit and Reach test³⁶ was used which targets hamstring and lower back flexion. Other flexibility tests employed were the butterfly test (targets adductor muscles), the trunk flexibility test and shoulder stretch³⁶. Mean (SD) results for the sit and reach test, butterfly test, left shoulder, right shoulder, left trunk twist and right trunk twist were 26.2 (9.01), 17.83 (7.29), 0.59 (9.55),

2.42 (7.54), 8.89 (7.96), 12.22 (8.23) respectively³⁴. It was noted that participants who were homeless were less flexible ($p < 0.05$) in four stretch tests compared to a control group of university students. Similar low values were reported for the Sit and Reach test in the Gregg and Bedard (2016)³⁵ study of 24.32 ± 8.07 cm.

Strength

Strength was measured in one study³⁵ using a grip strength test³⁷ which was reported to be mean (SD) 43.24 (6.79). Values from the homeless cohort age 41.05 ± 11.32 years were reported to be comparable to a reference population.

Physical health/symptom burden

Physical symptom burden was evaluated in three studies, assessed in 3 different ways. Patanwala *et al.* (2017) evaluated physical

symptoms in homeless aged ≥ 50 years³⁸ using the Patient Health Questionnaire-15 (PHQ-15)³⁹. They reported that over one-third (34%, n= 96) had a moderate-high physical symptom burden. The most common physical symptoms were joint pain, fatigue, back pain and sleep difficulties.

Similarly, Gaderman *et al.* (2014) using the SF-12⁴⁰, reported that the physical component summary scale was 43.6 (SD=11.0), which was ‘substantially lower’ than US population normative values⁴¹. In this study it was found that 87.9% (n=53) of participants suffered at least one physical health condition.

These findings concur with a qualitative study included in this review. Bazari *et al.* (2018) reported that physical symptoms experienced by homeless adults interfere with daily functioning⁴². They included 20 participants aged between 52 and 78 years (median age 62). It was found that daily challenges 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...” (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...I just feel like I’ve aged so quickly in my life” (F, 58)

Fatigue was also a factor.

“I guess every day that I have to walk I’m tired. I guess that’s the main thing: that I go from bench to bench and feel tired” (M, 58)

Physical activity levels

Physical activity levels were measured in six studies. Diverse methods were employed to assess this construct in each study. Insufficient physical activity levels among homeless adults were generally reported across studies (Table 4). Kendzor *et al.* (2015) examined modifiable health risk factors among homeless smokers (n= 57)⁴³. The results showed that 26.3% did not meet recommended physical activity levels in the previous week. Chau *et al.* 2002 asked about exercise habits during an interview which mainly focused on cancer risk behaviours and screening. It was reported that 56% (n=125) performed daily exercise, but no details of the definition of exercise was supplied. Gregg and Bedard (2016) evaluated ‘regular exercise’ as per Courneya and Bobick, 2000⁴⁴ and reported that 44% (n=8) exercised “at least three times per week, for at least 20–30 min in duration, and at least moderate-to-vigorous intensity”. Wilson (2005) explored health-promoting behaviours of women who were living in shelter accommodation (n= 137)³⁰. The study employed the Health-Promoting Lifestyle Profile II (HPLPII)⁴⁵ and found that participants scored lowest in the physical

activity subscale which is shown in Table 5 although overall it was reported that total levels of health-promoting behaviours were similar to another study of low income and homeless women⁴⁶.

Quine *et al.* (2004)²⁸ employed semi structured interviews and a number of facets of physical activity emerged. It 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)

Physical activity was also undertaken as a necessity.

“It’s a good walk [to a meals centre] and they put on a hot breakfast” (M, 68)

Physical activity was also used as a time filler

“if there’s something on like a movie worthwhile I’ll watch that and if there’s not I’ll for out for a walk for an hour and come back” (M, 75).

Exercise capacity

Randers *et al.* (2010) reported VO₂ max levels for 15 people experiencing homelessness who were engaging in a football training program. Reported VO₂ max levels were 33.5 +/- 2.0 ml.kg.min⁻¹⁴⁷. Similarly, Randers *et al.* 2012 reported VO₂ max levels for 22 men experiencing homelessness before and after a 12 week soccer training program. Reported VO₂max levels

Table 5. Health-Promoting Lifestyle Profile - Physical activity subscale.

Health-Promoting Lifestyle Profile - Physical activity subscale (From Wilson, 2004)	Mean (SD)
Follow a planned exercise program	1.78 (0.77)
Exercise vigorously for 20 or more minutes at least three times a week (such as brisk walking, bicycling, aerobic dancing, using a stair climber)	2.05 (0.98)
Take part in light to moderate physical activity (such as sustained walking 30–40 minutes 5 or more times a week)	2.28 (0.93)
Rake part in leisure-time (recreational) physical activities (such as swimming, dancing, bicycling)	2.02 (0.76)
Do stretching exercises at least 3 times per week	1.90 (0.89)
Get exercise during usual daily activities (such as walking during lunch, using stairs instead of elevators, parking away from destination and walking)	2.59 (0.94)
Check my pulse when exercising	1.53 (0.80)
Teach my target heart rate when exercising	1.61 (0.76)

were 36.7 +/- 7.6 ml.kg.min⁻¹ which appeared higher than a control group (33.7 +/- 4.5)⁴⁸. One further study evaluated fitness using the 1 mile walk test²⁵ with a result of 16.48 +/- 2.42 minutes which was reported to be similar to reference values for age and gender.

Discussion

This review provided a snapshot of existing literature in the area of physical functioning limitations and physical activity levels in people experiencing homelessness. The scoping review methodology enabled a broad range of inter-related physical related variables (mobility status, functional levels, frailty, flexibility, physical symptom burden, physical activity levels and exercise capacity) to be usefully subsumed into one review which gives a broad overview of this topic area. It is clear from this review that the experience of homelessness negatively influences physical –focused parameters but the diversity of measures limited our ability to synthesize data for the purposes of this review.

This review included 2,018 participants, of which females were underrepresented so less appears to be known about the physical profile of females experiencing homelessness compared to males. The majority of studies included in this review were quantitative in design (n=11), while 3 were qualitative. Almost 80% of studies were based in North America, with the rest of studies from other high income countries of Denmark and Australia. There appears to be a large evidence gap in the evaluation of physical variables among people in low and middle income countries. Four studies were from the Hope Home study, a longitudinal study of middle aged homeless individuals based in California which also limited diversity of the study cohort within this review.

Studies predominately appeared to include people in shelter accommodation. The proportion of people sleeping rough who were included in studies within this review was low and it is probable that their physical health variables may be worse than individuals living in sheltered accommodation. Despite the frequency of hospital visits and stays in this population^{11,49}, no study profiled hospitalized homeless individuals. It is likely that this cohort may be especially vulnerable and debilitated and requires further evaluation with regard to physical focused variables.

Despite the disparity in measures, there generally appears to be a pattern of low physical functioning levels and poor physical activity levels among people experiencing homelessness compared to expected levels. A high physical symptom burden was also noted particularly in relation to joint pain, fatigue, back pain and sleep problems³⁸. Flexibility levels were also significantly lower than control group findings³⁴. This finding suggests a global decline or substandard level of physical fitness and function among homeless adults and an earlier onset of geriatric conditions which has been shown previously⁵⁰, the reasons for which need to be further elucidated. In the study by Brown *et al.*, 2017, it was noted that despite a median age of 58 years, participants had rates of geriatric conditions similar or equivalent to adults in the general population with a median age of nearly 80 years^{51,52}. Similarly, the study by Raven *et al.* included participants with a median age of 58 years

and reported that almost 60% had limitations in lower extremity function. This was also shown in the earlier study by Brown³¹ and provides more evidence for the need for geriatric style rehabilitation services needed for people experiencing homelessness¹⁰.

At odds with the majority of studies, two Danish studies^{27,47} which evaluated fitness in a population of people experiencing homelessness who were participating in street soccer showed comparable fitness levels to control group values but mean ages were in the 3rd decade in these studies. Gregg and Bedard also showed that fitness and strength were comparable to reference ranges among healthy populations⁵³ in also a relatively young cohort with an average age of 41.05 +/- 11.32 years. It is possible that these groups are not representative of the population as a whole, nonetheless the diversity of people experiencing homelessness and spectrum of ability is important to consider. It is also possible that physical functioning limitations may develop after the 3rd and 4th decades for some people experiencing homelessness.

While reported physical activity levels varied between studies, a large proportion of participants experiencing homelessness appeared to have low physical activity levels³⁴. Promoting physical activity may mitigate against some of the burden of physical and mental health issues suffered by people experiencing homelessness⁵⁴. One study²⁸ highlighted a nuanced view indicating that physical activity was undertaken not necessarily for health gain but by participants out of necessity to access meals and to fill in time.

The number of outcomes and measures suggests a lack of empirical data in the area to aid clinical decision makers and researchers about the overall physical health status of people experiencing homelessness. Physical focused measures included in this review were for the most part cursory in nature and were subsidiary to other study outcomes. While a diversity of outcomes were included in studies included in this review, self-report measures were predominantly used rather than more robust objective methods with the exception of two studies which employed a gold standard measure to evaluate VO₂ max^{33,34}. Studies by Brown *et al.* (2011), Brown *et al.* (2017) and Raven *et al.* (2017) were the only studies to examine mobility impairment. Only one study used the Short Physical Performance Battery, a useful battery of physical performance tests to assess functional status⁵⁵. Only one study evaluated frailty and falls (Brown *et al.* 2011). All studies which evaluated physical activity used self-report measures which lack reliability and are prone to inaccuracies⁵⁶.

The general lack of robust data which extensively evaluates physical functioning and physical activity among people experiencing homelessness may be also partly due to concerns regarding vulnerability and potential or perceived ability to participate in research can result in exclusion from research. This can lead to a lack of evidence on which to base policies and design suitable housing services.

Strengths and limitations

This review appears to be the first attempt to systematically present literature pertaining to physical functioning limitations and

physical activity levels in adults experiencing homelessness. The scoping review methodology employed in this review was suitably broad to bring together evidence from heterogeneous methodology sources including observational, mixed method and qualitative designs of the experience of physical limitations in people experiencing homelessness as well as the diverse reporting of outcomes¹⁶. This scoping review allowed various inter-related physical aspects such as frailty, cardiovascular fitness, and flexibility among others. This methodology was also useful to examine emerging evidence in this relatively new field of research. In a topic as broad as physical functioning limitations it has helped focus on where future research and eventual systematic reviews should be targeted.

A number of limitations pertained to this review, however. Firstly, studies lacked a consistent definition of homelessness. As diverse study designs were included in this review, this resulted in strong heterogeneity which precluded the ability to quantitatively analyse results. A formal assessment of methodological quality of the included studies was not performed as scoping reviews aim to include a broad overview of available evidence, irrespective of quality¹⁶. Finally, potentially relevant evidence from other languages may have been missed as this review only included English language papers.

Bearing in mind the prevalence of physical functioning limitations, we would advocate that all clinicians should screen this population for physical deficits so appropriate rehabilitation or other services can be initiated. We appreciate however, that the non-uniformity of outcomes and measurement tools applied presents a challenge to clinicians. Recommendations on appropriate physical functioning and physical activity measures are needed which are suitable to use in this population to prevent waste of valuable healthcare resources⁵⁷. Studies should focus on reliability, validity and responsiveness of physical functioning measures for people experiencing homelessness as a basis for more effective clinical assessment and management. Further research should determine a core outcomes set⁵⁸ applicable to this population. Ideally this would be a quick standardized physical test battery so reliable consistent data can be collated to highlight at risk groups, inform clinical decision making and practice and advocate for better services. Further consistent primary research needs to be conducted before a comprehensive

systematic review can be conducted. Factors possibly contributing to physical functioning limitations such as age, co-morbidities as well as a host of other factors also need further exploration.

Conclusion

This review shows that adults experiencing homelessness appear to suffer physical functioning limitations and low physical activity levels but the inconsistency in measurement methods limits our ability to extensively profile this population at this time. Given the low levels of physical functioning shown in people experiencing homelessness, greater prominence and robustness of measurement methods should be applied to fully interrogate this area. Further research is necessary so adequate rehabilitation regimes and support can be put in place for this vulnerable population. This scoping review will guide future research and systematic review development in this emerging area.

Data availability

Underlying data

All data underlying the results are available as part of the article and no additional source data are required.

Extended data

Open Science Framework: Physical functioning limitations and physical activity of people experiencing homelessness: A review. <https://doi.org/10.17605/OSF.IO/7VGZP20>

This project contains the following extended data:

- Supplementary File 2 Search Strategy - Copy.docx (Study search strategy)

Reporting guidelines

Open Science Framework: PRISMA-ScR checklist for 'Physical functioning limitations and physical activity of people experiencing homelessness: A scoping review'. <https://doi.org/10.17605/OSF.IO/7VGZP20>

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