*Age and Ageing* 2022; **51:** 1–9
https://doi.org/10.1093/ageing/afab252
Published electronically 30 December 2021



**RESEARCH PAPER**

# The feasibility and acceptability of assessing and managing sarcopenia and frailty among older people with upper limb fracture

Kinda Ibrahim[1], Mark A. Mullee[2], Natalie Cox[3], Cynthia Russell[4], Mark Baxter[5], Simon Tilley[6], Guiqing Lily Yao[7], Shihua Zhu[2], Helen C Roberts[8]

[1]Academic Geriatric Medicine and National Institute for Health Research Applied Research Collaboration (ARC) Wessex, University of Southampton, Southampton, UK
[2]Primary Care and Population Sciences, Faculty of Medicine, University of Southampton, Southampton, UK
[3]Academic Geriatric Medicine and the NIHR BRC Southampton, University Hospital Southampton NHS Foundation Trust, Southampton, UK
[4]Patient and Public Involvement, National Institute for Health Research Applied Research Collaboration (ARC) Wessex, University of Southampton, Southampton, UK
[5]Medicine for Older People, University Hospital Southampton NHS Foundation Trust, Southampton, UK
[6]Trauma and Orthopaedics, University Hospital Southampton NHS Foundation Trust, Southampton, UK
[7]Department of Health Sciences, College of Life Sciences, University of Leicester University, UK
[8]Academic Geriatric Medicine, Faculty of Medicine and National Institute for Health Research Applied Research Collaboration Wessex, University of Southampton.

Address correspondence to: Dr Kinda Ibrahim. Tel: 02381204656. Email: K.Ibrahim@soton.ac.uk

## Abstract

**Background:** sarcopenia and frailty are associated with increased risk of falls and fractures. This study evaluated the feasibility of assessing sarcopenia and frailty among older people attending fracture clinics.
**Methods:** patients aged 65+ years with an arm fracture attending fracture clinics in one UK city were recruited. Sarcopenia was assessed using gait speed, grip strength, skeletal muscle mass index SMI, SARC-F questionnaire and the European Working Group on Sarcopenia in Older People (EWGSOP) I and II criteria. Frailty was assessed using Fried Frailty Phenotype (FFP), FRAIL scale, PRISMA-7, electronic Frailty Index (e-FI), Clinical Frailty Score (CFS) and Study of Osteoporotic Fracture. The sensitivity and specificity of each tool was calculated against the EWGSOP II criteria (sarcopenia) and FFP (frailty). Patients identified to have either condition were referred for Comprehensive Geriatric Assessment (CGA). Interviews with 13 patients and nine staff explored the acceptability of this process.
**Results:** hundred patients (Mean age 75 years) were recruited. Most sarcopenia and frailty assessments were quick with complete data collection and were acceptable to patients and staff. Sarcopenia was identified among 4–39% participants depending on the tool and frailty among 9–25%. Both conditions were more common among men than women with all tools. The SARC-F and PRISMA-7 had the best sensitivity (100 and 93%, respectively) and specificity (96 and 87%). CGA among 80% of referred participants led to three interventions per participant (e.g. medication changes and investigations).
**Conclusion:** SARC-F and PRISMA-7 are recommended for use in fracture clinics to screen for sarcopenia and frailty.

**Keywords:** sarcopenia, frailty, fragility fracture, feasibility, Comprehensive Geriatric Assessment, older people

### Key Points

- It is feasible to assess for sarcopenia and frailty among older people with upper limb fractures.

- Prevalence of sarcopenia and frailty are higher among male patients who have upper limb fractures compared with female patients.
- Self-completed questionnaires such as SARC-F and PRISMA-7 are quick, sensitive and specific tools suitable for routine use.

## Introduction

Falls affect between 30 and 40% of older people aged ≥65 years each year, are costly and associated with increased mortality [1]. The most common fall-related injuries are fragility fractures [2], and 25% suffer a subsequent fracture, often of the hip, within 10 years [3]. Sarcopenia and frailty are recognised as risk factors for falls and fracture [4, 5] yet not routinely identified among those presenting with fragility fractures in fracture clinics. Although there is certainly overlap between frailty and sarcopenia, studies have determined that these are two separate clinical entities, both which can lead to poor functional outcomes [6]. For this reason, it is important to look for both frailty and sarcopenia when assessing an older adult.

A number of tools are available to identify sarcopenia and frailty, and selection should reflect patient factors, access to technical resources and the purpose of assessment [7]. The most widely accepted definition of sarcopenia is that proposed in 2010 by the European Working Group on Sarcopenia in Older People (EWGSOP) and updated in 2019 [8, 9] based on muscle strength, function and muscle mass assessments. The 5-item self-reported questionnaire (SARC-F) has been recommended as a screening tool for risk of sarcopenia suitable for use in community healthcare settings [10].

There is no consensus on the best measure of frailty with many tools currently available [11], but two major definitions with proposed assessment tools have emerged over the past decade: the fried frailty phenotype (FFP) and the Frailty Index (FI; [12]). According to the FFP, frailty is operationalised as a syndrome meeting three or more of five phenotypic criteria: weakness, slowness, low level of physical activity, exhaustion and unintentional weight loss [13]. The FI is derived from a count of the number of deficits present from a list of diseases, physical and cognitive impairments, psychosocial risk factors and common geriatric syndromes [14]. The FI is considered useful clinically in risk stratification and the electronic Frailty Index (e-FI) is commonly used in general practice in the UK for these purposes [15]. A number of other tools have been validated including the FRAIL Scale (a self-reported tool based on the phenotype) [16], the Canadian Clinical Frailty Scale (CFS; increasingly used in UK hospitals; [17]) and the brief PRISMA-7 questionnaire (recommended by the British Geriatrics Society; [18]).

Despite the increasing evidence for the association of fractures with sarcopenia and frailty, these conditions are typically not identified or treated among patients with fragility fractures in clinical practice. Comprehensive Geriatric Assessment (CGA) to optimise an older person's medical, functional and psychosocial function through input by multidisciplinary health and social care teams is accepted as a standard method to manage frailty and improve health outcomes [19]. CGA has also become best practice for management of patients with hip fracture as part of geriatric/orthopaedic co-management models in hospital [20]. We considered that this approach could also be useful for those with sarcopenia with or without frailty who might benefit from specific interventions targeting muscle health. The aim of this study was to evaluate the feasibility of assessing sarcopenia and frailty among people aged 65+ years attending fracture clinics with an upper limb fracture.

## Methods

### Setting and participants

The protocol for this study has been published [21]. Patients attending general fracture clinics in one UK acute hospital were eligible if they were aged ≥65 years with a single wrist or upper arm fracture. Patients with pathological fractures, multiple or lower limb fractures, an active cancer diagnosis, care home residents or those unable to provide an informed consent such as people diagnosed with dementia were excluded. Generic fracture clinics in the UK include nurses, orthopaedic doctors and nurses who each sees around 20 adult patients of all ages with a wide range of bone fractures, have access to X-Ray facilities and physiotherapists.

Based on the precision of estimating the lowest reported incidence of frailty (7%) or sarcopenia (16%), i.e. 7% we estimated that we may determine the true incidence to within 7% with a sample size of 100 or within 8% for a sample size of 80 patients, with 95% confidence. To allow for a 20% drop-out rate we aimed to recruit 100 participants to the study.

Ethical approval was given by the North East-Newcastle and North Tyneside 1 NRES Committee (REC Number: 18/NE/0377). Informed written consent was obtained from all participants.

### Data collection

#### *Baseline data collection*

Demographic data including age, gender, usual residence, marital status, type of fracture, number of falls in the previous year, number of comorbidities and medications were collected from patients in person by a trained member of the research team. Cognition was assessed using the 10-item Abbreviated Mental Test Score (AMTS; [22]), and activities of daily living (ADL) using the Barthel score [23].

Sarcopenia was assessed using the SARC-F questionnaire, gait speed (with a walking aid if normally used), maximum grip strength with the unfractured arm only, skeletal muscle index (SMI) and the EWGSOP criteria I and II (see Supplementary file 1 for full details and cut-off values, available in *Age and Ageing* online). Frailty was assessed using the FFP, FRAIL Scale, Study of Osteoporotic Fracture Criteria for Frailty (SOF), CFS, PRISMA-7 and the e-FI. To minimise participant fatigue, physical assessments (e.g. gait speed) were assessed before questionnaires, which were then completed in varying order between participants to minimise potential for bias.

#### *Follow-up data collection*

*Falls and fractures* Participants were asked to complete a fall diary and were contacted by a researcher by telephone at 3 and 6 months after recruitment to collect self-reported information on falls and fractures. Patients' electronic primary care and hospital records were also reviewed to abstract any documented falls or fractures.

*CGA outcomes* Patients identified as having sarcopenia and/or frailty using at least two tools were referred by the research team to existing local geriatric clinical services for specialist review including CGA. The actions or/and referrals resulting from CGA were captured through the 3 and 6 months participant telephone calls and from their primary and secondary care electronic records.

*Acceptability of the assessments* The views and experience of patients and staff of assessing sarcopenia and frailty in fracture clinics and subsequent CGA assessments were obtained using individual semi-structured interviews. Purposive sampling was used to select: (i) male and female patients with and without sarcopenia and/or frailty and (ii) practitioners working in fracture clinics (junior and senior nurses, orthopaedic consultants), and local geriatric clinical services who reviewed the study patients. All interviews were recorded and transcribed verbatim.

## Data analysis

### Quantitative analysis

Data were double entered onto a SPSS database V27 and summarised using appropriate descriptive statistics. The prevalence of sarcopenia and frailty were calculated for each tool. The feasibility and practicality of each tool were examined according to the number of missing variables (completion rate), the time required to complete them using a digital timer and resources. The sensitivity and specificity of sarcopenia assessments were assessed against the gold standard EWGSOP II by creating binary variables which allowed patients to be categorised into normal and low groups and into sarcopenia or no sarcopenia for EWGSOP I and no or probable, confirmed or severe sarcopenia for EWGSOP II. For frailty, the sensitivity and specificity for each assessment were assessed against the FPP as the gold standard by combining pre-frail and robust categories of the FFP, FRAIL scale and SOF to generate binary outcome variables: robust/pre-frail and frail. A cut off of 0.25 or more (moderate to severe frailty) was used to indicate frailty for the e-FI as suggested by the authors of the Rockwood Frailty Index and used in other comparison studies [24]. The Clinical Frailty Scale scores 1–4 were defined as non-frail, whereas 5 and above were considered as frail [25].

The feasibility of referring patients to local geriatric services and using existing care pathways was determined by reporting the number of patients identified to have frailty and/or sarcopenia who were referred to those services and then received CGA, and the number and type of follow-up interventions.

### Qualitative analysis

Interviews transcripts were analysed using inductive thematic analysis [26]. A descriptive coding scheme was developed from transcripts based on participants' perceptions and experiences. Coding proceeded in an iterative way with detailed memos linking identified themes (see Supplementary file 2, available in *Age and Ageing* online). The perceptions and views of different participants were compared using constant comparison. A software program (NVivo 12) was used to facilitate data analysis.

## Results

Hundred patients were recruited between March 2019 and February 2020 with 80 (80%) followed-up for 6 months (Figure 1). Participants' mean age was 75 years, 80% were female with a mean of six comorbidities but good cognitive and ADL scores (Table 1). The median number of days between sustaining the fracture and data collection was 42 days (IQR, 20–64). One quarter of patients regularly walked with at least one aid. They had experienced a median of two falls in the past year and two-thirds had experienced previous fractures (including hip fracture among 5%). 14/80 (18%) patients followed up for 6 months had at least one further fall and two patients sustained hip fractures (both identified as having sarcopenia and frailty with all tools).

### Prevalence of sarcopenia and frailty

Sarcopenia was identified among 4–39% patients depending on the tool used and among 18% by at least two tools (Table 2). The prevalence of frailty also varied by the tool used and ranged from 9 to 25% and 20% were frail using at least two tools. Males had a higher prevalence of sarcopenia and frailty across all tools and were slightly older (mean age 77 versus 75 years) with more comorbidities and medications than female participants. About 12% were identified to have both frailty and sarcopenia using the gold standard assessments (FPP and EWGSOP II, respectively).

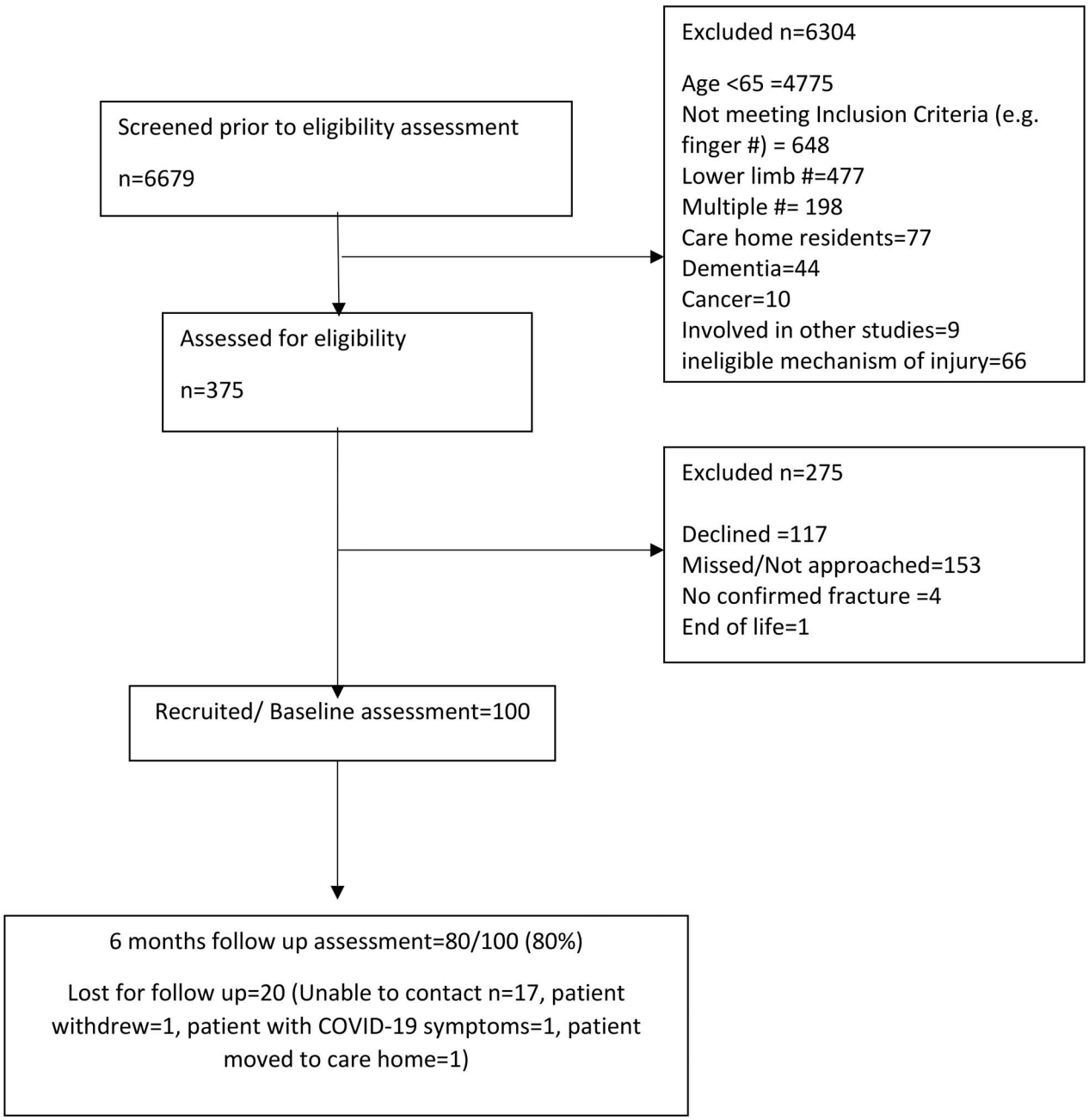


**Figure 1.** Study recruitment Consort diagram.

### Feasibility of assessing sarcopenia and frailty

Data collection were complete for grip strength (100%) but missing for 2% gait speed (due to incomplete researcher data entry) and 8% bioimpedance data (contraindicated in 7 participants (pacemaker) and declined by one other). The EWGSOP II and EWGSOP I criteria therefore had 8 and 10% missing data, respectively. All frailty assessments had 100% completion rates apart for FPP (98% reflecting the missing gait speed data; Table 2).

The assessments of grip strength, gait speed and the SARC-F were quick, but the bioimpedance took several minutes leading to a median completion time of 8–9 min for the EWGSOP criteria. For frailty assessments, the median completion time ranged from 1 min (PRISMA-7 and CFS) to 6 min for the FPP (Table 2).

The sensitivity and specificity of each tool against the gold standards are shown in Table 3. Most tools had high specificity scores. For sarcopenia, SARC-F had the best sensitivity (100%) and specificity (96%) against the EWGSOP II criteria. Compared with the FPP, PRISMA-7 had the highest sensitivity (93%) and good specificity (87%).

### Feasibility of using the existing CGA care pathways

Twenty participants (20%) were identified with sarcopenia and/or frailty using at least two tools. Five participants had

**Table 1.** Patients' baseline characteristics

| Number (%) | All *n* = 100 | Male *N* = 20 | Female *N* = 80 |
|---|---|---|---|
| Age (years)[a] | 75 (SD 7) | 77 (SD 7.78) | 75 (SD 7) |
| Marital status | 13 (13%) | 3 (15%) | 10 (12%) |
| Single | 55 (55%) | 15 (75%) | 40 (50%) |
| Married | 6 (6%) | 1 (5%) | 5 (6%) |
| Divorced or separated | 24 (24%) | 1(5%) | 23 (29%) |
| Widowed | 2 (2%) | 0 (0%) | 2 (3%) |
| Cohabiting | | | |
| Usual residence | 43 (43%) | 6 (30%) | 37 (46%) |
| Private home living alone | 55 (55%) | 13 (65%) | 42 (53%) |
| Private home living with friends or relatives | 1 (1%) | 1 (5%) | 0 (0%) |
| Sheltered accommodation | 1 (1%) | 0 (0%) | 1 (1%) |
| Residential Home | | | |
| Number of comorbidities [a] | 6 (SD 3.5) | 9 (SD 4.7) | 5 (SD 2.6) |
| Number of medications [a] | 5 (SD 3.4) | 8 (SD 3.4) | 5 (SD 3.3) |
| Number of falls in the last 12 months [b] | 2 (IQR 1,2) | 2 (IQR 1,2) | 2 (IQR 1,3) |
| Type of fracture | 55 (55%) | 5 (25%) | 50 (63%) |
| Wrist | 25 (25%) | 6 (30%) | 19 (24%) |
| Humerus | 20 (20%) | 9 (45%) | 11 (13%) |
| Other upper limb fracture | | | |
| Previous fractures | 36 (36%) | 9 (45%) | 27 (34%) |
| No | 64 (64%) | 11 (55%) | 53 (66%) |
| Yes | | | |
| Weight lost in the last year? | 19 (19%) | 6 (30%) | 13 (17%) |
| Body Mass Index (kg/m2)[a] | 26.92 (SD 5.14) | 28.40 (SD 5.86) | 26,56 (SD 4.92) |
| AMTS Cognitive functioning score[b] | 10 (IQR 9,10) | 10 (IQR 9,10) | 10 (IQR 9,10) |
| Barthel (Activity of Daily Living score) | 100 (IQR 97,100) | 95 (IQR 88,100) | 100 (IQR, 98,100) |

[a]Mean (standard deviation). [b]Median (interquartile range). AMTS, abbreviated mental test score.

received CGA in the past 6 months. The remaining 15 participants were referred for CGA and 12 were assessed. These participants typically received three actions from the referral including: further referral to health and social community services (81%), medication changes (56%), additional scans and investigations requested (50%), lifestyle advice for diet, exercise or sleep hygiene (38%), a follow-up appointment (19%) and end of life care (6%).

### Acceptability of the assessments and referrals

Individual face-to-face interviews were conducted with a purposive sample of 13 patients in their homes soon after the initial assessments to maximise recall and nine staff members (for more details see Supplementary file 2, available in *Age and Ageing* online).

Most patients reported that the questions used to screen for sarcopenia and frailty were straightforward and easy to answer. Most patients found the grip strength, gait speed and chair rise tests easy to perform. However, a few patients found the tests painful, especially those with humerus fractures, and some patients reported that laying on the couch for the bioimpedance assessment was painful or difficult. Staff reported concerns about potential risk of falling in some patients when completing these tests and one patient mentioned similar concerns. The staff participants described that the best tool to be used in generic fracture clinics should be valid, pragmatic, quick and easy to perform and proposed that a digital questionnaire could be completed in clinic or a self-completed questionnaire posted to patients in advance with the appointment letter (Table 4). Staff identified barriers and facilitators to the implementation of screening routinely in practice (see Supplementary file 2, available in *Age and Ageing* online).

## Discussion

This study has demonstrated that screening for sarcopenia and frailty in a busy fracture clinic is feasible and acceptable to patients and staff. Simple brief self-completed questionnaires such as the SARC-F for sarcopenia and the PRISMA-7 for frailty had good sensitivity and specificity and required little additional resource. In this study 20% of older arm fracture patients were identified to have sarcopenia or frailty, with a higher prevalence among men. Referral to local geriatric clinical services was feasible and those patients referred had unmet needs identified and actioned indicating that these referrals were appropriate.

The prevalence of sarcopenia and frailty was higher than reported rates among community-dwelling older people: up to 39% of older people in our study were identified to have sarcopenia and up to 25% frailty depending on the tool used; the conditions were coexistent in 12% of participants. A recent systematic review identified 10 (8 in hip fracture) articles that reported that sarcopenia was identified among 12–95% males and 18–64% females with fragility fractures [5]. Frailty has also been demonstrated among up to 70% of older people with vertebral or hip fracture [27, 28]. Importantly, very few studies have estimated the prevalence

**Table 2.** Prevalence of sarcopenia and frailty and feasibility of data collection

| Tools | Scores (number, %) | | | Time taken (minutes) (median, range) | Missing data | Resources required |
|---|---|---|---|---|---|---|
| Sarcopenia | | | | | | |
| SARC-F | All<br>Sarcopenia = 18 (18%) | Male<br>8 (40%) | Female<br>10(12%) | 1(1–4) | 0 | Paper |
| Gait speed | Slow = 16 (16%) | 8 (40%) | 8 (12%) | 1 (1,3) | 2(2%) | Measuring tape<br>Timer |
| Grip strength | Low = 39 (39%) | 12(40%) | 27(34%) | 2 (1,2) | 0 | Hand dynamometer |
| BIA | Low = 5 (5%) | 5 (29%) | 0 (0%) | 5 (4,6) | 8 (8%) | BIA machine |
| EWGSOP I | Sarcopenia = 4/90 (4%) | 4(29%) | 0 (0%) | 9 (7,15) | 10 (10%) | BIA machine<br>Hand dynamometer<br>Measuring tape and Timer |
| EWGSOP II | Sarcopenia = 12/92 (13%) | 5(36%) | 7(9%) | 8 (6,12) | 8 (8%) | BIA machine<br>Hand dynamometer<br>Measuring tape<br>Timer |
| Frailty | | | | | | |
| Fried Frailty Phenotype | Pre-frail = 44 (45%)<br>Frail = 15 (15%) | 11(55%)<br>7 (35%) | 33 (42%)<br>8 (11%) | 6 (3, 11) | 2 (2%) | Hand dynamometer<br>Measuring tape<br>Timer<br>Weighing scales |
| FRAIL scale | Pre-frail = 27 (27%)<br>Frail = 9 (9%) | 5 (25%)<br>7 (35%) | 22 (28%)<br>2 (2%) | 4 (1,8) | 0 (0%) | Paper |
| SOF | Pre-frail = 39 (39%)<br>Frail = 13 (13%) | 6 (30%)<br>7 (35%) | 33 (41%)<br>6 (8%) | 3 (1,6) | 0 (0%) | Weighing scale<br>Chair |
| PRISMA-7 | Frail = 25 (25%) | 13(65%) | 12(15%) | 1 (1,4) | 0 (0%) | Paper |
| e-FI | Mild frailty 31(31%)<br>Moderate = 12(12%)<br>Severe = 3 (3%) | 9 (45%)<br>5(25%)<br>2(10%) | 22 (28%)<br>7 (9%)<br>1 (1%) | 2 (1,8) | 0 (0%) | Access to electronic patient data system |
| CFS | Mild to moderate = 8(8%)<br>Severe =6 (6%) | 3 (15%)<br>5 (25%) | 5 (6%)<br>1 (1%) | 1 (1,2) | 0 (0%) | Paper |

BIA, bioimpedance; CFS, Clinical Frailty Index; e-FI, electronic Frailty Index; EWGSOP, European Working Group on Sarcopenia in Older People; SOF, study of osteoporotic fractures.

**Table 3.** The sensitivity and specificity of sarcopenia and frailty tools against the gold standards

| **Sarcopenia tools** | | EWGSOP II | | Sensitivity | Specificity |
|---|---|---|---|---|---|
| | | Yes | No | | |
| EWGSOP I | Sarcopenia | 3 | 1 | 25% | 99% |
| | No sarcopenia | 9 | 77 | | |
| SARC-F | Sarcopenia | 12 | 3 | 100% | 96% |
| | No sarcopenia | 0 | 77 | | |
| Gait speed slow | Slow | 9 | 4 | 75% | 94% |
| | Normal | 3 | 74 | | |
| Grip strength | Low | 12 | 24 | 100% | 71% |
| | Normal | 0 | 56 | | |
| Skeletal Muscle Index | Low | 3 | 2 | 25% | 97% |
| | Normal | 9 | 78 | | |
| Frailty tools | | FRIED frailty phenotype | | Sensitivity | Specificity |
| | | Frail | Robust/pre-frail | | |
| FRAIL scale | Frail | 8 | 1 | 53% | 99% |
| | Robust/pre-frail | 7 | 82 | | |
| SOF scale | Frail | 7 | 6 | 47% | 93% |
| | Robust/pre-frail | 8 | 77 | | |
| PRISMA-7 | Frail | 14 | 11 | 93% | 87% |
| | Robust | 1 | 71 | | |
| eFI | Moderate/severe frailty | 9 | 6 | 60% | 93% |
| | Robust/mild | 6 | 77 | | |
| Clinical Frailty Scale | Moderate/severe frailty | 6 | 0 | 40% | 100% |
| | Robust/Mild | 9 | 85 | | |

CFS, Clinical Frailty Index; e-FI, electronic Frailty Index; EWGSOP, European Working Group on Sarcopenia in Older People; SOF, study of osteoporotic fractures.

**Table 4.** Participants' views on the different methods of assessing sarcopenia and frailty

| Tools | Views supported by quotes |
|---|---|
| Questionnaire based assessments (i.e. SARC-F, FRAIL scale, PRISMA-7. . .) | I think paper based is easier, but there are people with problems even with that, you know. With sight and err, like visual problems as well as sometimes problems with, if you got a, if the fractures on the dominant arm, so it's tricky (SF101, orthopaedic consultant)<br>I mean a questionnaire would probably be the most sensible way of doing it and somebody there to actually go through the questionnaire with that patient. Kind of eek out the information from them (SF108, orthopaedic nurse) |
| Grip strength test | Yeah, quite easy, yeah. Cos it's not my lower arms at all, it's only the shoulder. My hands I've got, quite strong grip, I always have had you know. (SF033, M, Frail)<br>But there again you could have the grip strength, for example, integrated into the side of the terminal. so press your hand on the thing and it tells you what to do. And associate it with your hospital number; that would be great (SF102, orthopaedic consultant)<br>I think the grip strength certainly would be the easiest one to do cos they're still sat just outside the Fracture Clinic and they could come back to the Nurse and say, 'had my X-ray'. 'That's great, just ask you to do this but now can you squeeze as tight as you can, okay that's great'. (SF101, orthopaedic consultant) |
| Gait speed test | I mean not, that sounds daft really, because although my granddaughter took me, I didn't walk around holding onto her. I haven't, since it's been done. But having a person with you, just gives you that confidence, but the fact that I walked down that corridor and nobody walked down there with me 'yes'. (SF003, F, Pre-frail)<br>The break? was actually parted on the shoulder on the ball, and any movement at all like walking, was not good. I wouldn't repeat it if didn't have to. Yeah, it was painful (SF033, M, Frail)<br>I mean, the gait speed is obviously free (SF107, Geriatric practitioner). |
| Chair rise test | I had to hold my arms like this and get up several times, I was alright at doing that (SF055, F, Non-frail)<br>I knew what I was doing and I knew if I went forward, cos sometimes when I bend, I keep going. I don't know what it is, there's a little man on my shoulder pushing me, little forward and its kinda like that if I get up quick it's the blood pressure dropping, you know (SF-17, F, Frail) |
| Muscle mass test using BIA machine | Then she wanted me to lie down on one of the benches. Well that was one of the most excruciating cos I couldn't lie down at that time, and I had to lie down, (SF003, F, pre-frail)<br>Yeah that was a pain. . ., cos I wear um, stockings, you know the elastic stockings up to the knees. So, I had to take one of those off, 'it's a . . . to get back on again' (SF055, F, non-frail). |

of sarcopenia and frailty among people with upper limb fracture, who may have different characteristics and will follow different management pathways.

In this study, the high prevalence of sarcopenia and frailty largely reflects the high proportion of male participants who were identified to be living with sarcopenia and/or frailty. Male sex is a risk factor for increased mortality in hip fracture [29] and low grip strength and muscle mass is reported to be more common among male patients with hip fracture than females [30, 31]. One study found that sarcopenia was significantly more prevalent among men than women with wrist (40% versus 25%), hip (84% versus 42%) and ankle fractures (50% versus 21%; [32]). Men typically have greater isometric strength, bone size and strength than women. Thus, men experience fewer fractures than women. However when this does happen, it is more likely that fragility fracture in men relates to higher frailty and less directly related to osteoporosis alone [33]. These findings suggest early screening of older male patients presenting with upper limb fragility fractures for sarcopenia and frailty could be an opportunity for timely intervention through CGA/falls and bone health assessment that may prevent progression to hip fracture.

We report that the SARC-F and PRISMA-7 have the best combination of sensitivity and specificity when compared with the gold standards (EWGSOP II and FFP, respectively) in this study. A recent Korean study among 115 patients with hip fracture also reported that the SARC-F questionnaire had high sensitivity (95%) and moderate specificity (56%) when compared with the EWGSOP II criteria [34]. Similarly the PRISMA-7 was reported to be the most reliable and accurate tool among older people in the emergency department in Ireland [35] and to have a high sensitivity 88% and specificity 78% among Turkish older community-dwelling people [36].

CGA is reported to help identify those with an increased risk of hip fractures allowing the implementation of prevention strategies [37] and to reduce complications, disability and mortality in older patients after hip-fracture surgery [20]. Geriatric/orthopaedic co-management have primarily focussed on management of hip fracture in the setting of acute trauma and incorporates peri-operative care, falls assessment and secondary fracture prevention. In the UK, the best practice tariff for hip fracture care has led to investment in this service but, to date, not earlier in the pathway when patients experience less severe fractures such as upper limb fractures. Our study suggests that there may be a role for orthogeriatricians beyond hip fracture as part of fracture prevention services. This study has shown that using existing CGA pathways to manage older people identified to have frailty and sarcopenia in fracture clinic is feasible on a small scale, but this need to be tested on a larger scale. Furthermore, the outcomes of CGA among older patients with arm fractures have not yet been investigated.

### Strengths and limitations

This is the first study to report not only the prevalence of both sarcopenia and frailty among older people with upper limb fracture but also the feasibility of assessing the two conditions using a range of tools in fracture clinics. However, this small study was unable to determine the effectiveness of

identifying and managing frailty and sarcopenia in older adults with upper limb fragility fractures. Participants were recruited from one UK county so the results might not be representative of fracture clinics and CGA services elsewhere. Hand dominance does affect grip strength: right handed people typically have up to 10% stronger grip with their right hand compared with their left, whereas left handed people have equal grip in both hands [38]. Assuming most people fracture their dominant wrist, this may have reduced the maximum grip in some people in this sample (which included 45% humeral and other arm fractures) but unlikely by more than 2 kg which is unlikely to be significant in practice. The study plans included a health economic evaluation of the intervention: this was not possible due to the coronavirus pandemic that started in March 2020 in the UK and disrupted many health services and care pathways.

## Conclusions

This study has demonstrated that identifying sarcopenia and frailty in a busy fracture clinic is feasible and acceptable to patients and staff. About 20% of older people with arm fractures had sarcopenia and/or frailty, with a higher prevalence among men. The SARC-F and PRISMA-7, simple brief self-completed questionnaires, had good sensitivity and specificity and would be suitable for routine clinical use in this population. The 15% participants referred to geriatric clinical services for CGA had a range of unmet needs identified and actioned indicating the appropriateness and potential benefits of these referrals. Further research is required to evaluate the effectiveness and cost-effectiveness of identifying and managing sarcopenia and frailty among older patients with arm fracture to prevent future falls and fractures.

**Supplementary Data:** Supplementary data mentioned in the text are available to subscribers in *Age and Ageing* online.

**Acknowledgement:** We would like to acknowledge all patient and staff participants and we are grateful to our patient and public members for their contributions.

**Declaration of Conflicts of Interest:** None.

**Declaration of Sources of Funding:** This work was supported by the National Institute of Health Research (NIHR) Research for Patient Benefit (RfPB) program grant number (PB-PG-0317-20043). The views expressed are those of the authors and not necessarily those of the NHS, the NIHR, or the Department of Health. HCR and KI received support from the NIHR Applied Research Collaboration (ARC) Wessex and the University of Southampton. HCR and NC received support from the NIHR Southampton Biomedical Research Centre.

## References

1. Donald IP, Bulpitt CJ. The prognosis of falls in elderly people living at home. Age Ageing 1999; 28: 121–5.
2. Kanis JA, Oden A, Johnell O, Jonsson B, de Laet C, Dawson A. The burden of osteoporotic fractures: a method for setting intervention thresholds. Osteop Int 2001; 12: 417–27.
3. van Geel TA, van Helden S, Geusens PP, Winkens B, Dinant GJ. Clinical subsequent fractures cluster in time after first fractures. Ann Rheum Dis 2009; 68: 99–102.
4. Ravindrarajah R, Hazra NC, Charlton J, Jackson SHD, Dregan A, Gulliford MC. Incidence and mortality of fractures by frailty level over 80 years of age: cohort study using UK electronic health records. BMJ Open 2018; 8: e018836.
5. Wong RMY, Wong H, Zhang N *et al.* The relationship between sarcopenia and fragility fracture-a systematic review. Osteop Int 2019; 30: 541–53.
6. Cesari M, Landi F, Vellas B, Bernabei R, Marzetti E. Sarcopenia and physical frailty: two sides of the same coin. Front Aging Neurosci 2014; 6: 192.
7. Mijnarends DM, Meijers JM, Halfens RJ *et al.* Validity and reliability of tools to measure muscle mass, strength, and physical performance in community-dwelling older people: a systematic review. J Am Med Dir Assoc 2013; 14: 170–8.
8. Cruz-Jentoft AJ, Baeyens JP, Bauer JM *et al.* Sarcopenia: European consensus on definition and diagnosis report of the European working group on sarcopenia in older people. Age Ageing 2010; 39: 412–23.
9. Cruz-Jentoft AJ, Bahat G, Bauer J *et al.* Sarcopenia: revised European consensus on definition and diagnosis. Age Ageing 2019; 48: 16–31.
10. Malmstrom TK, Miller DK, Simonsick EM, Ferrucci L, Morley JE. SARC-F: a symptom score to predict persons with sarcopenia at risk for poor functional outcomes. J Cachexia Sarcopenia Muscle 2016; 7: 28–36.
11. Theou O, Brothers TD, Mitnitski A, Rockwood K. Operationalization of frailty using eight commonly used scales and comparison of their ability to predict all-cause mortality. J Am Geriatr Soc 2013; 61: 1537–51.
12. Chen X, Mao G, Leng SX. Frailty syndrome: an overview. Clin Interv Aging 2014; 9: 433–41.
13. Fried LP, Tangen CM, Walston J *et al.* Frailty in older adults: evidence for a phenotype. J Gerontol A Biol Sci Med Sci 2001; 56: M146–57.
14. Jones DM, Song X, Rockwood K. Operationalizing a frailty index from a standardized comprehensive geriatric assessment. J Am Geriatr Soc 2004; 52: 1929–33.
15. Clegg A, Bates C, Young J *et al.* Development and validation of an electronic frailty index using routine primary care electronic health record data. Age Ageing 2016; 45: 353–60.
16. Morley JE, Malmstrom TK, Miller DK. A simple frailty questionnaire (FRAIL) predicts outcomes in middle aged African Americans. J Nutr Health Aging 2012; 16: 601–8.
17. Rockwood K, Song X, MacKnight C *et al.* A global clinical measure of fitness and frailty in elderly people. CMAJ 2005; 173: 489–95.
18. Raiche M, Hebert R, Dubois MF. PRISMA-7: a case-finding tool to identify older adults with moderate to severe disabilities. Arch Gerontol Geriatr 2008; 47: 9–18.
19. Lee H, Lee E, Jang IY. Frailty and comprehensive geriatric assessment. J Korean Med Sci 2020; 35: e16.
20. De Rui M, Veronese N, Manzato E, Sergi G. Role of comprehensive geriatric assessment in the management of osteoporotic hip fracture in the elderly: an overview. Disabil Rehabil 2013; 35: 758–65.

21. Ibrahim K, Mullee M, Yao GL *et al.* Southampton arm fracture frailty and sarcopenia study (SAFFSS): a study protocol for the feasibility of assessing frailty and sarcopenia among older patients with an upper limb fracture. BMJ Open 2019; 9: e031275.
22. Hodkinson HM. Evaluation of a mental test score for assessment of mental impairment in the elderly. Age Ageing 1972; 1: 233–8.
23. Wade D, Collin C. The Barthel ADL index: a standard measure of physical disability? Int Disabil Stud 1988; 10: 64–7.
24. Gilbert T, Neuburger J, Kraindler J *et al.* Development and validation of a hospital frailty risk score focusing on older people in acute care settings using electronic hospital records: an observational study. Lancet (London, England) 2018; 391: 1775–82.
25. Chong E, Chia JQ, Law F, Chew J, Chan M, Lim WS. Validating a standardised approach in Administration of the Clinical Frailty Scale in hospitalised older adults. Ann Acad Med Singapore 2019; 48: 115–24.
26. Braun V, Clarke V. Using thematic analysis in psychology. Qual Res Psychol 2006; 3: 77–101.
27. Walters S, Chan S, Goh L, Ong T, Sahota O. The prevalence of frailty in patients admitted to hospital with vertebral fragility fractures. Curr Rheumatol Rev 2016; 12: 244–7.
28. Inoue T, Maeda K, Nagano A *et al.* Undernutrition, sarcopenia, and frailty in fragility hip fracture: advanced strategies for improving clinical outcomes. Nutrients 2020; 12: 3743.
29. Darwich A, Assaf E, Klein R, Gravius S, Wölfl CG, Jawhar A. Risk factors affecting mortality in patients with hip fractures at a regional trauma center. Z Gerontol Geriatr 2021; 54: 561–70.
30. Landi F, Calvani R, Ortolani E *et al.* The association between sarcopenia and functional outcomes among older patients with hip fracture undergoing in-hospital rehabilitation. Osteoporos Int 2017; 28: 1569–76.
31. Steihaug OM, Gjesdal CG, Bogen B, Kristoffersen MH, Lien G, Ranhoff AH. Sarcopenia in patients with hip fracture: a multicenter cross-sectional study. PLoS One 2017; 12: e0184780.
32. Hong W, Cheng Q, Zhu X *et al.* Prevalence of sarcopenia and its relationship with sites of fragility fractures in elderly Chinese men and women. PLoS One 2015; 10: e0138102.
33. Doherty W, Stubbs T, Chaplin A *et al.* Implementing grip strength assessment in hip fracture patients: a feasibility project. J Frailty, Sarcop Falls 2021; 06: 66–78.
34. Ha YC, Won Won C, Kim M, Chun KJ, Yoo JI. SARC-F as a useful tool for screening sarcopenia in elderly patients with hip fractures. J Nutr Health Aging 2020; 24: 78–82.
35. O'Caoimh R, Costello M, Small C *et al.* Comparison of frailty screening instruments in the emergency department. Int J Environ Res Public Health 2019; 16: 3626.
36. Yaman H, Ünal Z. The validation of the PRISMA-7 questionnaire in community-dwelling elderly people living in Antalya, Turkey. Electron Physician 2018; 10: 7266.
37. Ramírez-Martín R, Castell Alcalá MV, Alarcón T *et al.* Comprehensive geriatric assessment for identifying older people at risk of hip fracture: cross-sectional study with comparative group. Fam Pract 2017; 34: 679–84.
38. Roberts HC, Denison HJ, Martin HJ *et al.* A review of the measurement of grip strength in clinical and epidemiological studies: towards a standardised approach. Age Ageing 2011; 40: 423–9.


**Received 21 June 2021; editorial decision 11 October 2021**