ORIGINAL RESEARCH

Identifying Patients with Osteoarthritis at Risk of Sarcopenia using the SARC-F

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ABSTRACT

Background

Sarcopenia is an important modifiable risk factor in patients being considered for elective knee or hip replacement as it may be associated with a higher risk of post-operative joint replacement complications. Our objectives are to determine the prevalence of patients with osteoarthritis at risk of sarcopenia by using the SARC-F tool, and whether risk of sarcopenia is associated with referral to an orthopaedic surgeon.

Methods

We conducted a retrospective review of patients who were 60 years or older assessed at four Canadian musculoskeletal assessment centres. Patients completed the SARC-F as part of their assessment. Multivariable logistic regression analyses were conducted to determine association between risk of sarcopenia and the odds of referral to an orthopedic surgeon for surgical consultation.

Results

3,697 patients were included and 67.8% (2,508/3,697) were at risk of sarcopenia. Prevalence was highest in those assessed for hip replacement at 72.3% (635/878). Patients at risk of sarcopenia were more likely to be referred to an orthopaedic surgeon (OR 1.299; SD 1.074-1.571).

Conclusions

Patients with osteoarthritis assessed for joint replacement are at high risk of sarcopenia, particularly individuals undergoing potential hip replacement. Patients at risk of sarcopenia are more likely to be referred to orthopaedic surgery for surgical consultation.

Key words: osteoarthritis, sarcopenia, joint replacement, joint arthroplasty, SARC-F, hip, knee

INTRODUCTION

Osteoarthritis (OA) is one of the most common chronic conditions worldwide and a major cause of morbidity, disability, and health-care utilization.[1,2] Osteoarthritis is a leading cause of disability in Canada, affecting an estimated 1.5 million Canadians[3] and can lead to reduced quality of life, increased use of health services, and use of sick leave and disability benefits.[4–6] Total hip or knee replacement is an important intervention to relieve pain and improve function in patients with OA. In Canada during 2017–2018 there were 58,492 hip replacements and 70,502 knee replacements, representing an approximately 17% increase over five years.[3]

Sarcopenia is a skeletal muscle disorder characterized by low muscle strength and is associated with functional impairment and disability, increased mortality, and decreased quality of life.[7,8] The SARC-F tool is the recommended screening instrument by the European Working Group on Sarcopenia in Older People (EWGSOP2), which triggers further clinical evaluation.[9] In the new 2019 definition by EWGSOP2, the presence of low muscle strength alone can identify those with probable sarcopenia.[9] The diagnosis is confirmed with measurement of low muscle mass, and is considered to be severe when the individual exhibits a low physical performance.

Estimates on the prevalence of sarcopenia varies from 1–29% in community-dwelling adults, based on the population tested and the variety of measurements and tools used.[10,11] In those with OA, leg muscle mass has been shown to decrease with worsening OA severity.[12] Studies on the prevalence of sarcopenia in those with OA may indicate differences between

sexes, as well as differences between the joints affected. One study of 87 men with OA found 29.3% to be sarcopenic,[13] whereas another study of 241 women with OA found 4.5% to be sarcopenic overall, with the prevalence increasing to 9.1% in women with OA of the lower limbs.[14]

The consequences of sarcopenia in elective joint replacement is largely unknown; however, there is evidence that sarcopenia is associated with an increased risk of prosthetic joint infection[15] and is also associated with an increased risk of falls in patients with OA.[16] Current research in this area tends to focus on sarcopenic obesity, an increasingly recognized entity characterized by the presence of both sarcopenia and obesity, with the prevalence ranging from 1.3–35.4% in patients with hip and knee OA.[17,18] Obesity alone is a risk factor for both OA and perioperative complications in joint replacement surgery.[19,20]

The prevalence of sarcopenia in older adults being screened for elective joint replacement in Canada is currently unknown. Patients with OA may be at higher risk of sarcopenia, and these vulnerable patients may have longer recovery times and be at risk of serious post-operative complications. Our primary objective is to determine the prevalence of patients at risk of sarcopenia in this population using the SARC-F questionnaire. Our secondary objective is to determine whether the risk of sarcopenia is associated with a referral to an orthopaedic surgeon in Canadian musculoskeletal assessment centres.

METHODS

Study Design

This retrospective study was approved by the Hamilton Integrated Research Ethics Board.

Study Population

Patients over 60 years old who were assessed between September 2017 and August 2018 at four Canadian musculoskeletal assessment centres in Southern Ontario (including one academic hospital and three community hospitals) were included. Patients were excluded if they were under 60 years of age or if they did not have documentation of their SARC-F, Fried Frailty Score, or Oxford Hip/Knee scores.

Patients were referred by a primary care provider to a Canadian musculoskeletal assessment centre where they were assessed by an Advanced Practice Physiotherapist (APP). The APP conducted a history and physical exam, with a focus on patient function and pain (using the Oxford Hip and Knee questionnaires), as well as measures used to up to that point to treat OA pain.[21,22] Based on the APP assessment, a patient may either 1) be referred for surgical consultation to a central referral database, 2) referred to a surgeon of their choice, or 3) not be a joint replacement candidate and are given instructions on non-surgical management of OA.

Data Collection

All individuals seen in the joint assessment centres were entered into a database used for research and quality improvement purposes. Data collected included age, gender, joint assessed (hip, knee, or both), side assessed (left, right, or both), centre visited, whether the patient is referred to an orthopaedic surgeon for surgical consultation, and the Oxford Hip or Knee scores. As part of this study, self-reported SARC-F[23] and self-reported Fried Frailty questionnaires were also administered.

Study Assessments

Patients were mailed an information package prior to their clinic visit that included clinic information and Oxford Hip/Knee assessments which were completed at home and brought to their clinic visit. As part of this research project, the SARC-F and self-reported Fried Frailty questionnaire were included. APPs were blinded to both the SARC-F and Fried Frailty questionnaires.

SARC-F

The SARC-F is a five-item questionnaire developed as a simple and inexpensive screening tool for sarcopenia with low-to-moderate sensitivity (14–21%) and high specificity (90–94%), depending on the definition of sarcopenia used and population studied.[24–26] The The five questions focus on strength, assistance with walking, ability to rise from a chair, stair climbing, and falls, and takes 5 min to complete. Each component is scored 0 to 2, with a score of 4 or greater identifying individuals at risk of sarcopenia.[21-23] The SARC-F has been shown to be a predictor of clinically significant outcomes such as hospitalization, deficits in instrumental activities of daily living, and falls,[7,25,27] and is the recommended screening tool by the EWGSOP2.[9]

Covariates

The self-reported Fried Frailty Score is composed of five components including unintentional weight loss, weakness, poor endurance, slowness, and low physical activity.[28] The scores range from 0 to 5, where 0 means robust, 1 to 2 points means pre-frail, and 3 or more points means frail. The Fried Frailty Score has been shown in previous studies to reliably identify pre-frailty and frailty, and also predict adverse surgical outcomes such as length of stay and discharge to a rehabilitation centre.[29–31] The self-reported Fried Frailty Score has been shown to predict frailty transitions in patients living with chronic disease, and to predict disability, falls, and mortality in community-dwelling older men in Britain.[32,33]

The Oxford Hip Score is a 12-item questionnaire completed by patients that assesses function and pain, each on a scale from 1 to 5 (best to worst). The total score ranges from 12 to 60, with lower scores indicating better function and lower pain.[34,35] The Oxford Knee Score is similar in its structure and scoring.[36] The Oxford scores are useful tools to evaluate patient-reported, post-operative outcomes, and are also used in clinical studies and joint replacement databases.[37–39]

Statistical Analysis

Baseline characteristics were reported as means and standard deviations (SD) or as counts and per cent for categorical variables. Multivariable logistic regression analyses were

conducted to determine association between risk of sarcopenia and the odds of referral to an orthopaedic surgeon for surgical consultation. Separate analyses were performed for the total OA population and those with hip, knee, and OA at multiple sites (defined as either bilateral hip, bilateral knee, or hip and knee OA). All analyses were adjusted for age, sex, frailty status, and Oxford hip and knee scores. Odds ratios (OR) and corresponding 95% confidence intervals (95% CI) were calculated. Analyses were performed using the SAS/STAT (version 9.3; SAS Institute Inc., Cary, NC, USA) software package running on Windows 10.

RESULTS

A total of 4,802 study participants were referred and seen in the joint assessment centres from September 2017 to August 2018, of which 4,753 were 60 years old or greater. After excluding participants without required documentation (Oxford, SARC-F, and Fried scores), 3,697 (77.8%) participants were included in analysis. Excluded participants had a mean age of 71.8 (7.8) years old and 60.2% were female. The average SARC F was 4.6 (2.4) and Oxford score were 38.8 (9.3). Forty-four per cent of excluded participants were referred to an orthopaedic surgeon.

Of the 3,697 included in the analysis, 878 participants were screened for hip replacement, 1,683 participants were screened for knee replacement, and 1,136 were screened for multiple joints (either bilateral hip, bilateral knee, or hip and knee). The mean age of all patients was 71.0 (SD: 7.4) years old and 61% (2,255/3,697) were female. The mean (SD) Fried Frailty Score was 3.4 (1.2).

The mean (SD) SARC-F score was 4.6 (2.4) and 67.8% (2,508/3,697) participants had a SARC-F greater or equal to 4, which identifies individuals at risk of sarcopenia. A total of 51.3% (1,893/3,697) of participants were referred to an orthopaedic surgeon for consultation (Table 1).

Comparisons between the surgical referral population and those not referred are shown in Table 2 and multivariable odds ratios for surgical referral are shown in Table 3. Having a SARC-F score greater or equal to 4 was associated with increased referrals overall (OR 1.299; SD 1.074, 1.571) and in patients assessed for multiple joints (OR 1.567; SD 1.116, 2.199), but not in patients assessed for hip or knee replacement. Age was associated with increased referral rates overall and in patients assessed for knee replacement, but not in those assessed for hip replacement or multiple joints. Frailty status was not found to be associated with referral rates (OR 1.11, 95% CI=0.902, 1.355).

Within the SARC-F questionnaire, requiring assistance with walking "a lot or unable without help" was associated with increased referral overall (OR 1.515; SD 1.071, 1.717) and in patients assessed for multiple joints (OR 2.075; SD 1.140, 3.774), but not in the hip and knee populations alone. A history of four or more falls was associated with decreased referrals in patients assessed for multiple joints (OR 0.396; SD 0.231, 0.680) (Table 4).

TABLE 1.
Descriptive statistics of patients assessed for joint replacement based on joint assessed (hip, knee, or multiple)

	Total (n=3,697)	*Hip (n=878)*	*Knee (n=1,683)*	*Multiple[a] (n=1,136)*
Age: mean (SD)	71.0 (7.4)	71.8 (7.6)	70.5 (7.3)	71.0 (7.4)
Sex (F): n (%)	2255 (61%)	525 (59.8)	985 (58.5)	745 (65.6)
SARC–F total: mean (SD)	4.6 (2.4)	4.9 (2.4)	4.3 (2.3)	4.8 (2.3)
SARC–F (>=4): n (%)	2508 (67.8)	635 (72.3)	1063 (63.2)	810 (71.3)
Oxford Score : mean (SD)	38.4 (9.5)	40.2 (9.4)	37.2 (9.4)	38.6 (9.4)
Referral to orthopaedic surgeon: n (%)	1893 (51.3)	574 (65.7)	704 (41.9)	615 (54.3)

[a]Includes bilateral hip, bilateral knee, or hip and knee.

TABLE 2.
Descriptive data of patients assessed for joint replacement based on decision for referral to orthopedic surgeon

	Referred to Surgeon (n=1,893)	*Not Referred (n=1,796)*
Age: mean (SD)	71.4 (7.5)	70.4 (7.3)
Sex (F): n (%)	1176 (62.1)	1074 (59.8)
SARC–F total: mean (SD)	5.2 (2.2)	3.9 (2.3)
SARC–F (>=4): n (%)	1497 (79.1)	1005 (56.0)
Oxford Score: mean (SD)	41.5 (8.4)	35.0 (9.5)

TABLE 3.
Multivariable odds ratios and 95% confidence intervals of study participants referred to orthopaedic surgeon adjusted for age, sex, Fried frailty score, and Oxford hip/knee scores[a]

	Total (n=3,697)	*Hip (n=878)*	*Knee (n=1,683)*	*Multiple[b] (n=1,136)*
Hip (vs. knee)	**2.255 (1.875, 2.711)**	NA	NA	NA
Multiple (vs. knee)	**1.550 (1.314, 1.829)**	NA	NA	NA
Age	**1.017 (1.007, 1.027)**	1.008 (0.986, 1.030)	**1.023 (1.009, 1.038)**	1.014 (0.966, 1.031)
Sex (F)	0.951 (0.820, 1.102)	0.837 (0.604, 1.160)	0.955 (0.770, 1.183)	1.069 (0.819, 1.395)
SARC–F (>=4)	**1.299 (1.074, 1.571)**	1.378 (0.916, 2.071)	1.078 (0.816, 1.422)	**1.567 (1.116, 2.199)**
Oxford Score	**1.070 (1.60, 1.076)**	**1.102 (1.077, 1.127)**	**1.073 (1.057, 1.09)**	**1.048 (1.030, 1.066)**

[a]Results in bold are statistically significant.
[b]Includes bilateral hip, bilateral knee, or hip and knee.

TABLE 4.
Multivariable OR and 95% CI of study participants referred to orthopedic surgeons based on individual items of the SARC-F, adjusted for age, sex, Fried frailty score, and Oxford hip/knee scores: 0 = none, 1 = some, and 2 = a lot or unable[a]

	Total (n=3,697)	*Hip (n=878)*	*Knee (n=1,683)*	*Multiple (n=1,136)*
Difficulty lifting/carrying 10 lbs (1 vs. 0)	1.049 (0.850, 1.294)	1.111 (0.692, 1.785)	1.051 (0.776, 1.423)	1.083 (0.739, 1.588)
Difficulty lifting/carrying 10 lbs (2 vs. 0)	0.805 (0.613, 1.057)	0.697 (0.382, 1.271)	0.789 (0.526, 1.183)	0.928 (0.573, 1.504)
Difficulty walking across a room (1 vs. 0)	**1.374 (1.099, 1.717)**	1.250 (0.756, 2.065)	1.221 (0.881, 1.691)	**1.768 (1.186, 2.635)**
Difficulty walking across a room (2 vs. 0)	**1.515 (1.071, 2.143)**	1.498 (0.693, 3.238)	1.184 (0.698, 2.008)	**2.075 (1.140, 3.774)**
Difficulty transferring from a chair or bed (1 vs. 0)	1.121 (0.907, 1.386)	1.143 (0.702, 1.859)	1.991 (0.723, 1.358)	1.192 (0.822,1.728)
Difficulty transferring from a chair or bed (2 vs. 0)	1.141 (0.808, 1.613)	1.263 (0.560, 2.847)	0.801 (0.467, 1.374)	1.489 (0.842. 2.636)
Difficulty climbing a flight of 10 stairs (1 vs. 0)	1.097 (0.762, 1.579)	0.811 (0.390, 1.687)	1.238 (0.709, 2.162)	1.004 (0.499, 2.020)
Difficulty climbing a flight of 10 stairs (2 vs. 0)	1.227 (0.815, 1.849)	0.886 (0.366, 2.145)	1.174 (0.629, 2.191)	1.376 (0.644, 2.939)
# of falls in past year (1–3 falls vs. none)	0.933 (0.793, 1.099)	0.875 (0.608, 1.261)	1.120 (0.883, 1.422)	0.765 (0.569, 1.027)
# of falls in past year (4 or more falls vs. none)	0.737 (0.540, 1.005)	0.744 (0.339, 1.634)	1.125 (0.724, 1.748)	**0.396 (0.231, 0.680)**

[a]Results in bold are statistically significant.

DISCUSSION

Our study found the prevalence of patients at risk of sarcopenia based on the SARC-F was highest in the hip OA population at 72.3%, compared to 63.2% in the knee OA population and 71.3% in the multiple joint population. This is much higher than previously reported prevalence of sarcopenia in community-dwelling older adults with OA of the hip and knee. The high prevalence may be partly explained by patients with OA reporting difficulty with walking, climbing stairs, and falls (all components of the SARC-F) secondary to pain and not solely due to low muscle strength and mass. Additionally, the SARC-F is a case finding tool, and not diagnostic of sarcopenia, which leads to a higher prevalence of patients at risk.

The diagnosis of sarcopenia is confirmed with measurement of low muscle mass and function.[9] Physical measures of

muscle strength used to measure sarcopenia include handheld dynamometry, gait speed, and short physical performance batteries.[40] Low muscle mass can be measured with a variety of modalities including magnetic resonance imaging, computed tomography, and dual X-ray absorptiometry.[40–43] These tools vary in terms of their validity and reliability, and some may not be practical in a clinical setting.[40] We chose the SARC-F because it is the recommended screening tool for sarcopenia and is practical for use in a busy clinical environment.[44]

Sarcopenia and frailty have a high degree of clinical overlap;[45] however, even after adjusting for frailty by the Fried phenotype, a SARC-F score greater or equal to 4 was still associated with a 29.9% increase in odds of referrals to orthopaedic surgeons. When we looked at individual questions within the SARC-F, requiring assistance with walking was associated with a 51.5% increase in odds of referrals to orthopaedic surgeons overall, emphasizing the importance of mobility on decisions around surgical referrals. From the patient perspective, a previous study of 379 patients demonstrated their willingness to undergo elective joint replacement is influenced predominantly by mobility (walking and ability to climb stairs), with those experiencing greater disability more willing to undergo surgery.[46]

While there are limited data on unfavourable outcomes in patients with sarcopenia undergoing joint replacement surgery, sarcopenia in other surgical populations is associated with surgical complications including increased mortality, wound infection, and length of stay.[18,35,36] Additionally, patients with lower limb pain from OA and sarcopenia have worse function, and may be at higher risk for falls and fractures.[47] Sarcopenia is a modifiable risk factor with effective interventions, including nutritional and exercise-based interventions, to increasing muscle mass and function.[48,49] A recent review showed a variety of exercise programs are effective in reducing pain, and improving strength and function, specifically in patients with OA and are generally well-tolerated.[50] These interventions could be key in treating sarcopenia in patients with OA prior to joint replacement surgery to reduce postoperative complications.

Our study has limitations, including limited data regarding patient comorbidities, medications, and body mass index, which are all potential factors associated with referrals. Additionally, we do not know what proportion of patients referred for surgical consultation underwent joint replacement surgery. We did not directly measure muscle mass and instead used the SARC-F as a tool to identify participants at risk of sarcopenia. Study strengths include a large data set reflecting real-life clinical practice.

Future directions include linking our data with important patient-related outcomes in those who have undergone joint replacement surgery to determine whether the SARC-F is predictive of unfavourable surgical outcomes or complications. By identifying potentially preventable outcomes, we could target patients for interventions to improve sarcopenia. The SARC-F is a simple cost-effective tool that can be implemented in arthroplasty centres to identify these at-risk patients.

CONCLUSION

Patients with osteoarthritis being assessed for joint replacement are at high risk of sarcopenia and are more likely to be referred to orthopaedic surgery for surgical consultation. Patients assessed for hip replacement are at the highest risk of sarcopenia. Sarcopenia is an important modifiable risk factor to identify in patients being considered for elective knee or hip replacement as it may be associated with poor outcomes. The SARC-F is a simple and cost-effective tool that can be used in clinical settings to identify at-risk patients.

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CONFLICT OF INTEREST DISCLOSURES

The authors declare that no conflicts of interest exist.

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