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ORIGINAL RESEARCH

CE Prevalence of sarcopenia in patients with chronic intestinal failure—how are SARC-F and the EWGSOP algorithm associated before and after a physical exercise intervention

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Abstract

Introduction: Patients with chronic intestinal failure (IF) have a low degree of physical activity, decreased muscle mass, and decreased muscle strength, leading to a high risk of sarcopenia. We aimed to test the prevalence of sarcopenia by the use of SARC-F and EWGSOP and to investigate the association between the two at baseline and after 12 weeks of an exercise intervention.

Methods: Thirty-one patients with chronic IF completed 12 weeks of three weekly home-based individualized exercise sessions. Body composition was measured by bioimpedance analysis and physical function by handgrip strength (HGS) and timed up-and-go (TUG). Sarcopenia was assessed by SARC-F and EWGSOP. Multiple regression analysis was used to test for the association between the two tools.

Results: The prevalence of sarcopenia measured by EWGSOP was 59%. This prevalence did not change after the intervention. At baseline, 38.8% of patients were screened as at risk for sarcopenia by SARC-F. This decreased to 29.0% after the intervention ($P < 0.001$). A statistically significant increase was achieved in muscle mass ($P = 0.017$) and muscle mass index ($P = 0.016$). Furthermore, both TUG ($P = 0.033$) and HGS ($P = 0.019$) improved.

Conclusions: Sarcopenia is prevalent in patients with chronic IF. EWGSOP finds more patients to be at risk of sarcopenia than SARC-F but was not sufficiently sensitive to measure changes induced by the physical intervention. The significant change in SARC-F may illustrate that patients, themselves, find an improvement in self-perceived health.

KEYWORDS
EWGSOP, home parenteral nutrition, intestinal failure, physical exercise, SARC-F, sarcopenia

CLINICAL RELEVANCY STATEMENT

The European Working Group on Sarcopenia in Older People (EGWSOP) 2 recommends either using strength, need for assistance with walking, rising from a chair, climbing stairs, and falls (SARC-F) or clinical suspicion to find relevant cases for assessment by inclusion of physical function parameters. In this group of patients with chronic intestinal failure, fewer were found to be at risk of sarcopenia by SARC-F compared with EWGSOP. Based on these findings, we do not recommend the use SARC-F as an exclusion criterion before assessment, as recommended in EWGSOP2, but do recommend that clinical suspicion is always included regardless of the result of SARC-F.

INTRODUCTION

Sarcopenia is known as an acute or chronic muscle disease defined by low levels of muscle strength, muscle quantity and/or quality, and physical performance.[1] Chronic sarcopenia is observed in chronic and progressive conditions lasting >6 months. Sarcopenia has been associated with reduced quality of life, increased hospitalizations, altered hospitalization costs, and increased risk of mortality.[2-5] Inactivity and malnutrition seem to cause, as well as worsen, sarcopenia. Thus, screening for sarcopenia is relevant in many chronic conditions and may provide the opportunity for an early intervention. When sarcopenia is found by screening, it is recommended to perform a thorough assessment of muscle strength and muscle quantity and quality, which will help select treatment choices and monitor response to treatment.[5] For screening, completion of the strength, need for assistance with walking, rising from a chair, climbing stairs, and falls (SARC-F) questionnaire is recommended; for assessment, the European Working Group on Sarcopenia in Older People (EWGSOP) algorithm is advised.[5,6]

Chronic intestinal failure (IF) is commonly defined as "the reduction of gut function below the minimum necessary for the absorption of macronutrients and/or water and electrolytes, such that intravenous supplementation…is required to maintain health and/or growth."[7] Patients with chronic IF are known to have a generally low degree of physical activity and an impaired quality of life.[8,9] Among other factors contributing to the deterioration of patients' quality of life are large amounts of ostomy output, lack of independency, reduced functional level, and fatigue.[9] This is reflected in the decreased muscle mass and muscle strength that has been shown in these patients and is independent of body mass index (BMI).[10-13] In these patients, it may, therefore, be relevant to monitor and measure sarcopenia from an early state of disease to provide sufficient advice on exercise and strength training as well as to keep track of elements that may decrease the individual's possibility to be physically active, such as the large stomal outputs.

Even though SARC-F often has been used for sarcopenia screening in patients with chronic IF type III, only one prevalence study is published using the EWGSOP algorithm. To our knowledge, no studies has evaluated how EWGSOP performs before and after a physical intervention in this patient group, or if the two tools are associated before and after an intervention. We, therefore, aimed to test the prevalence of sarcopenia in this patient group by the two tools and to investigate the association between SARC-F and the EWGSOP algorithm at baseline and after 12 weeks of a physical exercise intervention.[14]

METHODS

Participants and inclusion

This study is a secondary analysis of the article "Personalized exercise intervention in HPN patients—A feasibility study."[14] Patients with chronic IF type III were recruited among patients receiving HPN and/or parenteral fluids at the specialist outpatient clinic at Centre of Nutrition and Intestinal Failure at Aalborg University Hospital, Denmark. All patients received HPN or intravenous fluids, full or supplemental. Table 1 shows the demographic information. A full description of the 12-week intervention is outlined in the original publication.[14]

Data collection

At the time of inclusion, demographic information, including sex, age, height, comorbidities, and so on, were collected. Functional testing and bioimpedance analysis (BIA) were done on ambulatory visits by the biomedical laboratory scientist and by the nutritionist researcher and assistant on home visits. Weight was measured on a digital

TABLE 1 Baseline demographics

Baseline demographics	All patients (*N* = 31)
Women, *n* (%)	22 (70.1)
Age, mean, years (SD)	63.0 (14.0)
Weight, mean, kg (SD)	63.1 (16.1)
BMI mean, kg/m^2 (SD)	22.6 (5.2)
More than two years with HPN, *n* (%)	21 (67.7)
Days with HPN or IV-fluids, mean (SD)	5.1 (1.8)
Energy requirements covered by HPN, mean, % (SD)	43.2 (31.5)
Basic disease, *n* (%)	
IBD	13 (41.9)
Cancer	7 (22.6)
Ischemia	3 (9.7)
Surgical complications	2 (6.5)
Other	6 (19.35)

Abbreviations: BMI, body mass index; HPN, home parenteral nutrition; IBD, inflammatory bowel disease; IV, intravenous.

electronic scale (Seca 701) to the nearest 0.1 kg, and height was measured to the nearest 0.5 cm. The patients' own scales were used on home visits. BIA was measured in the tetra polar position using a BioScan 920-II (Maltron). Patients were advised to avoid physical activity for 8 h and to fully fast and avoid drinks for at least 2 h prior to the measurement. Patients with metallic implants or pacemakers were excluded from BIA measurements.

Timed up-and-go (TUG) was measured as the time it took to rise from a chair, walk 3 meters, turn around, walk back, and sit down. All patients performed the TUG test once and were offered a second try. Most patients accepted a second try. The best result of the two was noted. Normative values for the TUG test were as follows: <70 years of age, TUG < 9 s; 70–80 years of age, TUG < 10.2 s; >80 years of age, TUG < 12.7 s.[15]

Handgrip strength (HGS) was measured to the nearest 0.5 kg on the dominant hand with a handheld dynamometer (NC70142; North Coast Medical). The dynamometer was held in second-hand position, and the patient was instructed to sit up right on a chair with the shoulder in a natural position, with the elbow in a 90° position, and with the wrist in a natural position. All patients completed one try and were offered a second with a minimum of a 10-s break in between. The best of the two values was recorded. HGS was characterized by age- and sex-specific normative values.[16]

Sarcopenia by SARC-F and EWGSOP

Screening for sarcopenia was done with the SARC-F questionnaire in the Danish language.[17] The total score was calculated, and an SARC-F score ≥4 indicated a risk for sarcopenia.

Sarcopenia was defined from the criteria suggested by the EWGSOP algorithm (Figure 1), which is based on a combination of muscle mass, HGS, and TUG with sex- and age-specific normative values described above. From these criteria, sarcopenia is defined as a low muscle mass index in combination with either low HGS or TUG (Figure 1). Normal HGS and TUG in combination with low muscle mass index was defined as presarcopenia.[1]

Physical intervention

Five strength training exercises were included in the exercise intervention: plank, row and shoulder press with bands, squats/chair stands, and pushups.[18] A minimum of one set of 10 repetitions of each exercise three times a week for 12 weeks was recommended. There was no time demand to complete the exercises. At inclusion, the level of the exercises was individualized to meet the patient's physical ability at baseline. For instance, squats could be a regular squat with body weight or additional weight on the shoulders or chair stands where the patient would rise and sit from a chair, some even with support from one's hands on the armrest. Depending on the individuals' abilities and wishes, patients were provided with videos and/or written information with photos of the exercises. Some patients were given the opportunity to do other types of exercise instead of one or two of the weekly exercise sessions if it was something that the patient would not normally do. For instance, this could be half an hour of brisk and efficient walk.

Weekly, patients were contacted by phone during the 12 weeks to evaluate compliance, adapt the level of exercises if needed, and motivate the patient to continue the exercise program. Furthermore,

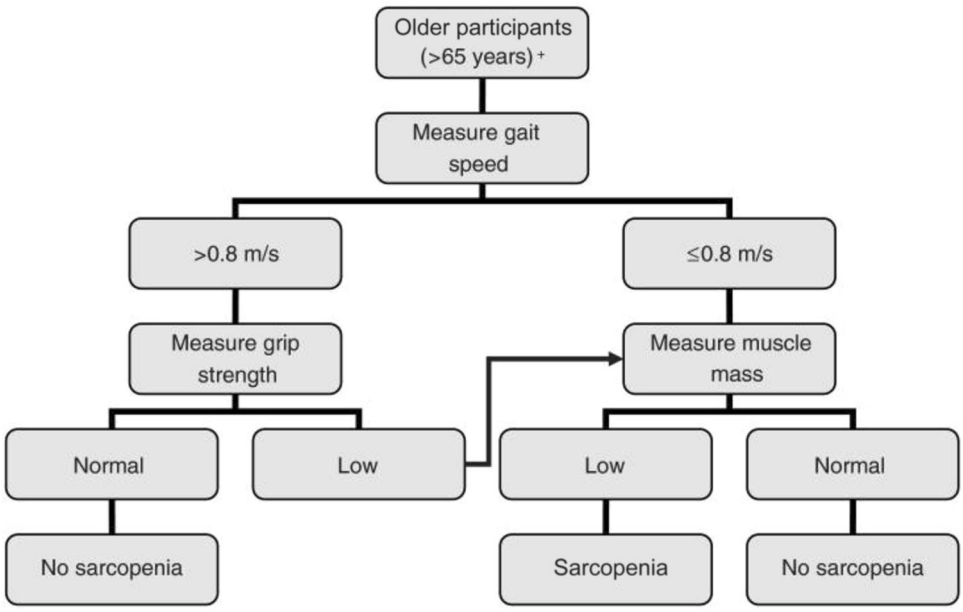

FIGURE 1 European Working Group on Sarcopenia in Older People–suggested algorithm for sarcopenia case finding in older adults.[5] Comorbidity and individual circumstances that may explain each finding must be considered. +This algorithm can also be applied to younger individuals at risk

at these weekly follow-ups, patients could ask questions about nutrition, exercise or other relevant participants. Few patients asked for further exercises and these were accommodated.

Compliance was estimated in percent of the completed exercises during all 12 weeks. As described, a few patients were given the opportunity to interchange some of the workouts with other physical activities. This was also recorded as compliance to the intervention. Habitual physical activity was not considered.

During the circumstances around coronavirus disease 2019 (COVID-19), some exceptions were made to the methods described above. For a time, researchers were not allowed physical contact with the patients. This does only apply to the end line data collection for some patients. To be able to complete the study, these patients were instructed after 12 weeks to do the TUG test at their homes. They were instructed by phone, and some received help by a home-nurse or a relative to complete the test. The SARC-F questionnaire was done by phone interview. All patients were followed up after the quarantine period by the nutritionist to complete the data collection. Thus, the BIA measurement for some patients was collected 1–3 weeks after the 12-week intervention.

Statistical analysis

The statistical analyses were performed in the Statistical Software Program, STATA, version 17. Missing data were indicated by "." and were excluded from the subsequent analysis. Dropouts were furthermore excluded from the analysis. The descriptive data are presented as the number of filled-in-replies (*n*) and percent (%) of the total population or mean ± SD.

The paired *t* test was used for paired group comparisons between baseline and postintervention measurements to investigate the effect of the intervention when the assumption of normality was met, whereas a Wilcoxon signed rank test was used if delta-data were not normally distributed. To investigate whether data were normally distributed, visual inspection was completed.

Multiple regression analysis was used to test for the association between sarcopenia (measured by SARC-F and measured by EWGSOP) as the dependent variables and BMI, sex, and age as risk factors. As four patients were excluded from the BIA measurements, this analysis was made on the remaining 27 patients. *P* values of <0.05 were considered statistically significant.

Ethical statement

The study was approved by the regional data protection agency Reg: 2019-126. First, a request was submitted to the regional scientific ethics committee. They found no need for full application as no biological material was collected for research purposes only. The study was conducted in accordance with the principles of the World Medical Association Declaration of Helsinki.

RESULTS

This study included 31 patients with chronic IF. Of these, 83.8% completed the intervention. Compliance to the intervention was 75.8%. Demographic features are seen in Table 1.

Body composition

After the intervention, a statistically significant increase was observed in muscle mass ($P = 0.017$) and muscle mass index ($P = 0.016$). All other parameters, including weight, BMI, fat-free mass, and fat mass, were not significantly changed after the intervention. All data on body composition are shown in Table 2.

Physical function

Both TUG ($P = 0.033$) and HGS ($P = 0.019$) improved significantly after the intervention and were statistically significant. TUG improved by 1.2 s, and HGS improved with 1.1 kg. Still, no significant change was seen in overall the euro-quality of life in five dimensions and five lenghts (EQ5D-5L) score or in the visual analogue score (VAS-score). Table 3 shows the results for physical measurements.

Sarcopenia

At baseline, 38.7% of the patients had an SARC-F score ≥4, and this decreased to 29.0% after the intervention. The mean score decreased from 3.3 (2.6) to 2.0 (2.5) after the intervention ($P < 0.001$).

Sixteen patients were identified as presarcopenic or sarcopenic at baseline measured with EWGSOP. In comparison, only 11 of these patients were identified as at risk for sarcopenia measured by SARC-F at baseline. Nine of the patients were identified as sarcopenic (presarcopenic or at risk for sarcopenia) by both measurements and five patients (18.2%) were not identified by both measurement at baseline. An agreement of 81.8% is thus seen between the two tools at baseline.

Sixteen patients were identified as presarcopenic or sarcopenic after the intervention when measured with EWGSOP, but only five patients were identified as at risk for sarcopenia when measured by SARC-F at postintervention. Three of the patients were identified as sarcopenic (presarcopenic or at risk for sarcopenia) by both measurements, and 13 patients (40.00%) were not identified by both measurements at postintervention. All patients identified as sarcopenic either by EWGSOP, SARC-F, or both measurements are seen in Table 4.

Associations

There was no significant association between sarcopenia measured by SARC-F and the participants' BMI at baseline or at postintervention.

TABLE 2 Data on body composition at baseline and at the end of the study

Body composition characteristics	Number	Start of study, mean (SD)	End of study, mean (SD)	Difference	*P* value
Weight, kg	31	63.1 (16.1)	63.6 (16.2)	−0.50	0.444
BMI, kg/m^2	31	22.6 (5.17)	22.7 (5.20)	−0.10	0.422
MM, kg	27	20.5 (4.82)	21.4 (4.97)	−0.90	0.017*
MMI	27	7.28 (1.05)	7.53 (1.05)	−0.25	0.016*
FFM, kg	27	44.0 (8.70)	46.2 (11.3)	−2.20	0.251
FFM, %	27	71.4 (9.49)	71.5 (9.62)	−0.14	0.692
FFMI	27	15.7 (1.69)	16.2 (2.49)	−0.52	0.245
FM, kg	27	19.0 (11.6)	19.7 (11.9)	−0.71	0.587
FM, %	27	28.6 (9.49)	28.4 (10.0)	0.21	0.602
FMI	27	6.87 (4.36)	7.04 (4.50)	−0.17	0.639

Abbreviations: BMI, body mass index; FFM, fat-free mass; FFMI, FFM index; FM, fat mass; FMI, FM index; MM, muscle mass; MMI, MM index.
*value found statistically significant.

TABLE 3 TUG and HGS at baseline and after the intervention

Physical function measurement	Number	Start of study, mean (SD)	End of study, mean (SD)	Difference	*P* value
TUG, s	31	8.9 (5.5)	7.7 (3.8)	1.2	0.033*
HGS, kg	28	26.7 (7.8)	28.8 (7.5)	−1.1	0.019*

Abbreviations: HGS, handgrip strength; TUG, timed up-and-go.
*stasticically significant.

TABLE 4 Comparison of patients identified as sarcopenic

	EWGSOP, *n* (%)		SARC-F, *n* (%)		Repeats in both groups, *n* (%)	
Sarcopenia	Baseline	Postintervention	Baseline	Postintervention	Baseline	Postintervention
Values	16 (59.3)	16 (59.3)	11 (40.7)	5 (18.5)	9 (81.8)	3 (60)

Abbreviations: EWGSOP, European Working Group on Sarcopenia in Older People; SARC-F, strength, need for assistance with walking, rising from a chair, climbing stairs, and falls.

A significant negative association ($P = 0.048$) between sarcopenia and BMI is seen at baseline when sarcopenia is measured by EWGSOP. There is a significant positive association ($P = 0.045$) between age and EWGSOP and a negative significant association ($P = 0.00$) between sex and sarcopenia measured by EWGSOP at baseline that can be seen (see Table 5).

After the intervention, a significant negative association ($P = 0.045$) is seen between EWGSOP and BMI. Furthermore, a significant negative association ($P = 0.002$) seen between sex and sarcopenia measured by EWGSOP (see Table 6).

TABLE 5 Associations between EWGSOP and BMI, age, and sex at baseline

Variable: EWGSOP baseline	Coefficient	*P* value	CI
BMI baseline	−0.048	0.048	−0.097 to 0.000
Age	0.018	0.045	0.000 to 0.036
Sex	−1.077	0.000	−1.584 to 0.057

Abbreviations: BMI, body mass index; EWGSOP, European Working Group on Sarcopenia in Older People.

DISCUSSION

This study found a high prevalence of sarcopenia in patients with chronic IF. EWGSOP found 59% of patients at risk at baseline, which is almost equal to an earlier study that found 53% at risk in a similar group of patients.[12] The study by Oke et al found 83% of patients at risk of sarcopenia by measuring muscle mass with computerized tomography scan at third lumbar vertebrae. After the intervention, a significant improvement was found in HGS and TUG as well as in muscle mass. Neither of these are reflected in the EWGSOP, which

TABLE 6 Associations between EWGSOP and BMI, age, and sex at postintervention

Variable: EWGSOP postintervention	Coefficient	*P* value	CI
BMI postintervention	−0.054	0.045	−0.106 to 0.001
Age	0.0186	0.060	−0.001 to 0.038
Sex	−0.907	0.002	−1.460 to 0.355

Abbreviations: BMI, body mass index; EWGSOP, European Working Group on Sarcopenia in Older People.

defined the same patients at risk of sarcopenia postintervention. Thus, the EWGSOP may not be sufficiently sensitive to measure differences in these patients because they are still physically weak, even though they increased strength as shown by TUG and HGS, which both improved. This might reflect that a substantial percentage of patients with IF suffered from severe sarcopenia and only changed in severity of sarcopenia after the intervention. This may partly be the reason why no changes are seen by EWGSOP. As a screening tool, SARC-F, however, is a subjective patient-reported outcome questionnaire and finds 22% less patients at risk after the intervention, indicating that patients themselves find an improvement in self-perceived health. In the postintervention analysis, only three patients were found at risk by both tools, opposed to nine at baseline, a statistically significant and clinically relevant difference.

Even though SARC-F is considered a screening tool, the EWGSOP defined more patients at risk of sarcopenia than SARC-F. This may be due to the fact that presarcopenia by EWGSOP is included in the statistical analysis. This approach was chosen because SARC-F only indicates a risk factor for sarcopenia and as such, presarcopenia is also to be considered a risk for sarcopenia. However, because the SARC-F defines less patients as at risk than EWGSOP, a consideration may be whether this leads to false-negatives findings when EWGSOP2 recommends that SARC-F is used as an initial screening for sarcopenia.[1] In clinical practice, it may be considered whether SARC-F should be implemented in the course of treatment. In our patient group, fewer patients were found to be at risk of sarcopenia by SARC-F compared with EWGSOP, and even fewer after the intervention. Accordingly, it should be considered to screen patients with EWGSOP1,[5] or at least, not using SARC-F as inclusion criteria for monitoring physical function measures as recommended in EWGSOP2.[1] The EGWSOP2 recommends either using SARC-F or clinical suspicion to find relevant cases for measuring physical parameters. Based on our study, we recommend that clinical suspicion is always included, regardless of the result of SARC-F. In case of lacking access to physical measures, we consider it advisable to use SARC-F only before initiation of rehabilitation or other therapeutic efforts are initiated.

Even though improvements were seen in physical function, no significant change was seen in overall EQ5D-5L score or in the VAS-score, as described in the previous publication.[14] We found no associations between BMI/sex or sarcopenia, and thus find that it is relevant to screen and assess those overweight, as also addressed by former studies.[10,11,13,19]

Strengths and limitations

The population included in this study is representative of the Danish chronic intestional failure population because patients come from half the country. Well known for this heterogeneous population, compliance varied very much between patients, and some needed more instructions and motivation than others. Thereby, it can be argued that the intervention was not equal and may thus bias the results; however, this is very like other interventions in the daily practice around the treatment of these patients, although it would hardly be acceptable for an randomized controlled trail design study. The study protocol was written and accepted by authorities before the publication of EWGSOP2. Therefore, it was unfortunately not possible to use this renewed version in this study. COVID-19 played as an overall challenge to make the study by protocol. Therefore, standardization of the data collection was difficult, and not all data were collected on the same days, or in test facilities. Strengths and limitations are furthermore described in the previous publication.[14] This study assessed sarcopenia with two different tools in a broad age distributed population with a high risk of sarcopenia, and to whom lacking physical abilities is an acknowledged risk to quality of life.[9] Measuring sarcopenia with these two tools and comparing them at baseline and after an intervention study has, to our knowledge, not been done earlier in this group of patients.

CONCLUSION

Sarcopenia is prevalent in patients with chronic IF. EWGSOP defined more patients at risk of sarcopenia than SARC-F but was not sufficiently sensitive to measure changes after a physical intervention in these frail patients. This may, however, be due to the severity of sarcopenia in this group of patients. The positive response to intervention by SARC-F may illustrate that patients' themselves find an improvement in self-perceived health. More studies investigating the effect of exercise/rehabilitation in patients with chronic IF are needed to define the effects on body composition, physical function, quality of life, and risk of sarcopenia.

AUTHOR CONTRIBUTIONS

Signe Graungaard and Mette Holst equally contributed to the conception and design of the research. Lea Geisler contributed to the acquisition and analysis of the data; Lars Vinter-Jensen, Henrik H. Rasmussen, Marianne Køhler, and Jens R. Andersen contributed to

the interpretation of the data; Signe Graungaard and Mette Holst drafted the manuscript. All authors critically revised the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final manuscript.

CONFLICT OF INTEREST

None declared.

DATA AVAILABILITY STATEMENT

The data for this study are not available because the patients were not asked for permission to the distribution in the signed consent.

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