

Prevalence of sarcopenia in older patients with colorectal cancer prior to chemotherapy

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Research Article

Keywords: Older adults, Colorectal cancer, Geriatric oncology, Sarcopenia, Frailty

Posted Date: September 24th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10699331/v1>

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Additional Declarations: No competing interests reported.

Abstract

Background: Sarcopenia increases the risk of chemotherapy-related toxicity, dose reduction, treatment discontinuation, surgical complications, reduced quality of life, and mortality, yet remains underrecognized in oncology. This study aimed to determine the prevalence of sarcopenia in older patients with colorectal cancer prior to chemotherapy and to investigate associations with physical activity and frailty.

Methods: This cross-sectional study used baseline data from the SaVe study and included patients aged ≥ 65 years scheduled for chemotherapy at two Danish hospitals (March 2023–October 2025). Sarcopenia was assessed according to EWGSOP2 criteria using muscle strength (handgrip strength or 30-Second Sit-to-Stand Test), muscle mass (DXA-derived appendicular lean mass), and physical performance (10-meter Walking Test). Results were compared with age- and sex-specific reference values from healthy Danish older adults. Physical activity was measured using an accelerometer (ActiGraph wGT3X-BT). Frailty was screened with the Clinical Frailty Scale (CFS) and Geriatric-8 (G8). Associations were analyzed using logistic regression and Fisher's Exact Test.

Results: A total of 112 patients (63% men; mean age 74 ± 5 years) were included. Sarcopenia prevalence was 12% (95% CI: 7–20%), while 33% (95% CI: 24–43%) had reduced muscle strength. Compared with reference values, impairments were observed in handgrip strength (16%), appendicular lean mass (21%), and gait speed (23%). Sarcopenia was significantly associated with abnormal G8 scores (OR 10.04) but not with CFS. Among 71 patients with activity data, higher moderate-to-vigorous physical activity and greater daily step counts were associated with lower odds of sarcopenia.

Conclusion: Muscle impairment is common in older patients with colorectal cancer prior to chemotherapy, even among those deemed fit for treatment. Systematic assessment of sarcopenia and physical activity may help identify vulnerable patients before frailty becomes clinically apparent.

Trial registration: ClinicalTrials.gov (NCT05710809).

Background

A higher absolute number of people with cancer underscores the need for focused attention on older adults with cancer and the challenges managing this heterogeneous patient group [1, 2]. Multimorbidity increase the risk of vulnerability, and at the time of cancer diagnosis, many have already experienced prolonged symptoms such as fatigue, unintentional weight loss, and reduced appetite [3], which may lead to reduced physical activity and increased risk of loss of muscle strength, muscle mass, and functional decline [4, 5].

According to the European Working Group on Sarcopenia in Older People (EWGSOP2) sarcopenia is defined by reduced muscle strength and muscle mass, with physical performance indicating disease severity [5]. Sarcopenia may be classified as primary (age-related), or secondary, resulting from factors

such as disease, physical inactivity, or poor nutrition [5]. In older adults with cancer, sarcopenia is often multifactorial and may coexist with or be exacerbated by cancer-associated cachexia [6]. While physical inactivity represents a potentially modifiable contributor to sarcopenia, its relative role compared with cancer-related metabolic alterations and ageing remains insufficiently understood. Objective assessment of physical activity may therefore provide important insight into the contribution of inactivity to sarcopenia in older adults with cancer.

Older adults with sarcopenia have an increased risk of falls, physical disability, loss of independence, reduced health-related quality of life (HRQoL), and mortality [5, 7–9]. In the oncological surgical setting, sarcopenia has also been identified as an independent risk factor for poor postoperative outcomes, including higher complications rates, delayed recovery, prolonged hospital stays, and increased risk of readmission and death [7, 8, 10, 11]. In line with this, impaired physical performance has been associated with increased risk of disability, cognitive decline, institutionalization, falls, and mortality [12, 13].

Frailty represents a multidimensional geriatric syndrome characterized by cumulative decline in physical and cognitive reserves and is similarly associated with adverse outcomes such as disability, falls, hospitalization, reduced HRQoL, and reduced survival [14–16]. Commonly used screening tools include the Clinical Frailty Scale (CFS) [15, 17, 18], and the Geriatric-8 (G8), the latter specifically developed for older adults with cancer reflecting the need for a cancer-specific approach to identify vulnerability [19, 20].

Although strongly associated with adverse outcomes, sarcopenia and frailty are potentially reversible, particularly when identified early [15, 21–23]. This emphasizes the clinical importance of timely identification to enable targeted interventions, primarily based on resistance training and adequate protein intake [21–23]. Nevertheless, sarcopenia and frailty remain underrecognized in routine clinical practice. Assessment of muscle health is not routinely performed, and functional status is typically evaluated using the Eastern Cooperative Oncology Group Performance Status (ECOG PS) [24]. This provides a limited and largely subjective assessment of functional capacity not adequately capturing reduced muscle strength, muscle mass, physical performance, or frailty [24–26]. Consequently, clinically relevant impairments may remain undetected, limiting knowledge of muscle health in older adults with cancer before treatment and highlighting the need for more comprehensive assessment [2].

Therefore, the aim of this study was to evaluate the prevalence and severity of sarcopenia, defined according to the EWGSOP2 criteria, in older adults (≥ 65 years) with colorectal cancer prior to initiation of chemotherapy. In addition, we compared these findings with age- and sex-specific reference values from healthy Danish older adults to quantify cancer-related reductions in muscle strength, muscle mass, and physical performance. Finally, we explored potential associations between physical activity and frailty with the presence of sarcopenia.

Methods

Design and setting

This study presents a prespecified cross-sectional baseline analysis from the ongoing SaVe study [27]. The baseline time point was selected because muscle health at treatment initiation is critical for risk stratification, treatment tolerance, and early intervention. Patients were consecutively recruited from the outpatient clinic at the Department of Oncology, at Copenhagen University Hospital - Herlev and Gentofte Hospital and Copenhagen University Hospital - Rigshospitalet.

Participants

Patients with colorectal cancer referred for neoadjuvant chemotherapy prior to potential surgical resection, adjuvant, or first-line palliative chemotherapy were considered eligible for inclusion if they met the following criteria: 1) age ≥ 65 years; 2) scheduled to initiate chemotherapy; 3) able to speak and read Danish and provide written informed consent; and 4) ECOG PS score ≤ 2 . The exclusion criteria were: 1) chemotherapy within the past two years and sequelae of neuropathy, vertigo/dizziness, or impaired balance; 2) severe physical disability limiting the ability to engage in physical exercise; 3) dementia, psychotic disorder, or another cognitive condition interfering with participation in a clinical exercise-based trial; or 4) attending a geriatric outpatient clinic within the previous six months.

Procedures and Data Sources

Procedures

After formal screening assessment and oral and written study information, patients signed informed content to participate before any study related assessment were conducted. Assessment of muscle strength and physical performance, CFS, and G8, were performed at the Department of Occupational Therapy and Physiotherapy, Rigshospitalet and whole-body dual-energy x-ray absorptiometry (DXA) scans were performed at the site of inclusion. All assessments were scheduled before treatment initiation and performed by trained physiotherapists or medical students following standardized procedures.

Clinical and demographic data

Chemotherapy regimens, age, sex, Body Mass Index (BMI), and ECOG PS were retrieved from the patients' electronical medical records.

Sarcopenia criteria

Sarcopenia was defined according to the EWGSOP2 criteria with patients classified into three categories: 1) probable sarcopenia, indicated by low muscle strength; 2) confirmed sarcopenia, characterized by

both low muscle strength and low muscle mass; and 3) severe sarcopenia, defined by the additional presence of impaired physical performance [5].

Muscle strength was assessed by maximal Hand Grip Strength (HGS) and the 30-Second Sit-To-Stand test (30STS) [28]. Muscle mass was assessed by DXA, and physical performance by habitual walking speed using the 10-meter walking test (10MWT).

The cut-off for low HGS according to EWGSOP2 was < 27 kg for men and < 16 kg for women [5]. The 30STS was used to test for lower limb strength. As no specific cut-offs are defined in the EWGSOP2 criteria, age- and sex-specific reference data from the Copenhagen Sarcopenia Study were used as cut-offs [29]. Low muscle strength was determined by either low HGS or low 30STS below stratified norm values.

Low muscle mass defined according to EWGSOP2 were: For women, appendicular lean mass (ALM) < 15 kg and ALM/height² < 5.5 kg/m²; for men, ALM < 20 kg and ALM/height² < 7.0 kg/m² [5]. Low gait speed according to EWGSOP2 was ≤ 0.8 meters/second for both women and men [5].

Muscle strength

Maximal HGS [30] was assessed using an electronic JAMAR dynamometer (JLW Instruments, Chicago, IL, USA). Patients were seated upright, the elbow flexed at 90°, and the arm supported by the armrest of the chair. Three tests were performed on each hand, in alternating order, and the highest value across both hands was recorded.

The 30STS was used as a widely applied and recommended proxy measure of muscle strength [5, 31]. Patients were seated on a 44 cm chair with arms crossed over the chest and feet flat on the floor. Following demonstration and one or two practice repetitions, patients were instructed to stand up and sit down as many times as possible within 30 seconds.

Muscle mass

Muscle mass was defined as ALM, representing the lean tissue of the upper and lower extremities [5]. Measurements were performed using DXA (Lunar iDXA, GE Medical Systems Lunar, Madison, WI, USA) with Encore software version 16.0 and reported both as an absolute value (kg) and adjusted for height in meters squared (ALM/height²).

Physical performance

Physical performance was measured as habitual gait speed in meters/second and assessed using the 10MWT [32]. A 12-meter course was used with standing start and time stopped after 10 meter not

including the deceleration phase [32]. Patients were instructed to walk in habitual walking speed and the best of three attempts was recorded [32].

Physical activity

Physical activity was objectively measured using the waist-worn ActiGraph wGT3X-BT accelerometer (ActiGraph, Pensacola, FL, USA) for ten days with a wash-out period the first four days. Recordings were included if they contained data from at least four days with a minimum of eight hours of wear-time/day. Data were processed in ActiLife using 10 second epochs. Wear-time was determined using the Choi et al algorithm [33]. Periods identified as non-wear were visually inspected and short intervals (< 60 minutes) surrounded by activity were reclassified as wear-time when judged to reflect prolonged sedentary behavior. The amount of Moderate to Vigorous Physical Activity (MVPA) in minutes and step counts was recorded. Measurements from both weekdays and weekends were included, assuming minimal variation in activity levels between these days, given that the majority of participants were retired and not working.

Frailty screening

Frailty was estimated using CFS and G8 screening tools. The CFS is a subjective, judgment-based tool relying on clinical appraisal of functional ability, comorbidity, and cognitive status providing a global frailty score on a 9-point scale ranging from 1 (very fit) to 9 (terminally ill), with frailty defined as a score ≥ 5 points [17, 18]. The G8 is a cancer-specific screening tool combining subjective information with objective measures across eight domains: mobility, neuropsychological issues, polypharmacy, age, appetite changes, weight loss, BMI, and self-rated health with a total score range from 0 (heavily impaired) to 17 (not at all impaired) and cut-off for being frail at ≤ 14 points [20].

Statistical analysis

Continuous variables were summarized using means and standard deviations (SD) for normally distributed data and medians with interquartile ranges (IQR) for non-normally distributed data. Distribution of continuous variables was assessed visually using histograms and quantile-quantile (Q-Q) plots. Binary and categorical variables were reported as frequencies (n) and percentages (%).

Data are presented as frequencies and proportions on group level and visually presented using a Venn diagram. Low muscle mass was determined by either having ALM or $\text{ALM}/\text{height}^2$ under the respective cut-off criteria.

Measurements of HGS, ALM, $\text{ALM}/\text{height}^2$ and the 10MWT were analyzed according to criteria described above [5, 29]. In addition, all measures were compared with reference values from the Copenhagen Sarcopenia Study, with values > 1 SD below the mean classified as reduced and values > 2 SD as severely reduced [29].

Data are presented as frequencies and proportions on group level and visually presented as stacked bar plots with overlaid individual data points, stratified by age and sex categories. The prevalence of sarcopenia was calculated with 95% confidence interval (CI) based on the exact binomial method.

Subgroup analyses of prevalence of sarcopenia between treatment groups and sex were calculated using Fishers Exact Test.

Associations between sarcopenia and physical activity (MVPA, step counts) were examined using logistic regression models with odds ratios (ORs) and 95% CI reported. Associations between sarcopenia and frailty (CFS, G8) were assessed using Fisher’s exact test due to small cell counts. In addition, sensitivity analyses including age as a covariate were conducted. All analyses were conducted using the R statistical software (v4.3.2; R Core Team).

Results

One-hundred-and-twelve patients were included (Figure 1). Clinical characteristics are presented in Table 1.

Table 1 Clinical characteristics of the study population

	Treatment					
	Overall n = 112	Male n = 70	Female n = 42	Adjuvant n = 54	Palliative n = 22	Neo-adjuvant n = 36
Age (years), mean (SD)	74 (5)	74 (5)	74 (5)	73 (7)	75 (6)	74 (5)
Sex, male, n (%)	70 (63)			32 (29)	15 (13)	23 (20)
BMI, mean (SD)	26 (5)	27 (4)	25 (6)	26.5 (3.9)	26.7 (7.4)	25.6 (4.3)
ECOG PS, n (%)						
0	65 (58)	41 (59)	24 (57)	37 (69)	10 (46)	18 (50)
1	40 (36)	27 (39)	13 (31)	15 (28)	9 (41)	16 (44)
2	6 (5)	1 (1)	5 (12)	2 (4)	2 (9)	2 (6)
Missing	1 (1)	1 (1)	0 (0)	0 (0)	1 (5)	0 (0)
CFS, n (%)						
<5	103 (92)	67 (96)	36 (86)	51 (94)	21 (95)	31 (86)
≥5	3 (3)	0 (0)	3 (7)	2 (4)	0 (0)	1 (3)
Missing	6 (5)	3 (4)	3 (7)	1 (2)	1 (5)	4 (11)
G8, n (%)						
≤14	62 (55)	37 (53)	25 (60)	30 (56)	15 (68)	17 (47)
>14	42 (38)	29 (41)	13 (31)	22 (41)	5 (23)	15 (42)
Missing	8 (7)	4 (6)	4 (10)	2 (4)	2 (9)	4 (11)

SD = Standard deviation, BMI = Body Mass Index, PS = Performance Status, CFS = Clinical Frailty Scale, G8 = Geriatric-8

According to EWGSOP2 criteria, complete-case analyses of 106 patients showed that 35 patients (33%, 95% CI: 24%-43%) had probable sarcopenia. Confirmed sarcopenia was identified in 11 patients (10%), and severe sarcopenia in two patients (2%) with additionally low performance (Figure 2). Thus, the overall prevalence of sarcopenia or severe sarcopenia was 13/106 (12%, 95% CI: 7%-20%). The prevalence of sarcopenia did not differ significantly between sex ($p=0.36$) or treatment groups ($p=0.20$). The six missing observations were due to illness, low surplus energy or lack of physical or mental capacity on the day of assessment based on patient-reported reasons for non-completion. Sex- and treatment-specific prevalence estimates are presented in Supplementary Table S1.

Muscle strength was assessed in 108 individuals with low HGS according to EWGSOP2 criteria identified in four patients (4%). Using Danish age- and sex-specific reference data, 18 (17%) patients were

classified with reduced or severely reduced HGS [29] (Figure 3a, Table S1). Using the same Danish reference data, 35 (32%) patients demonstrated reduced or severely reduced lower-body muscle strength, with the corresponding classification shown in Figure 3b.

Muscle mass was assessed in 110 individuals with low muscle mass according to EWGSOP2 criteria and defined by ALM, kg and by ALM/height² observed in 20 (18%) and 29 (26%) patients, respectively. Overall, low muscle mass according to EWGSOP2 was identified in 32 (30%) patients. When compared with Danish reference values, 23 (21%) patients were classified with reduced or severely reduced muscle mass [29] (Table S1).

Physical performance (10MWT) was assessed in 108 individuals with low physical performance according to EWGSOP2 criteria observed in five patients (5%). Based on Danish reference values, 25 (23%) patients were classified with reduced or severely reduced physical performance [29] (Figure 3c, Table S1).

To illustrate the overlap between low muscle strength, low muscle mass, and low physical performance, a Venn diagram was constructed including participants with complete data across all three domains (n=106) (Figure 2).

Frailty prevalence differed markedly between the screening tools, with 3% of patients classified as frail by CFS compared with 55% by G8 (Table 1) (Figure 4). In unadjusted analyses, sarcopenia was not significantly associated with CFS status (OR=3.68, 95% CI 0.06-75.70, p=0.33). In contrast, sarcopenia was significantly associated with frailty assessed by G8 (OR 9.88, 95% CI 1.36-438.57, p=0.01).

Physical activity was assessed in 71 individuals (Table 2). Missing data were due to technical or practical issues, patient reluctance, or unmet validity criteria.

Table 2 Physical activity level measured with physical activity monitor (3-axis accelerometer) ActiGraph wGT3X-BT

Accelerometry	Overall n = 71	Male n = 43	Female n = 28	Treatment		
				Adjuvant n = 37	Palliative n = 12	Neo- adjuvant n = 22
Daily average MVPA (minutes), median (IQR)	19 (9-31)	15 (10-31)	23 (7-28)	21 (8-35)	25 (15-31)	14 (11-27)
Number of daily steps, mean (SD)	4416 (1987)	4328 (1778)	4551 (2300)	4470 (2126)	5162 (2362)	3918 (1382)

MVPA = Moderate-to-Vigorous Physical Activity, IQR = Interquartile range, SD = Standard deviation

The daily average MVPA ranged from 30 seconds to 71 minutes and number of daily average steps from 778 to 10,113. In the unadjusted logistic regression model, higher daily average MVPA (minutes) was associated with lower odds of sarcopenia (OR=0.91, 95% CI 0.80-0.99) with statistical significance in likelihood-ratio testing ($p=0.02$) but a borderline result using the Wald test ($p=0.07$). Adjusting for age did not change the overall interpretation of the results. For every additional 1,000 steps/day, the odds of having sarcopenia significantly decreased (OR=0.50, 95% CI 0.22-0.90), with statistical significance confirmed by likelihood-ratio testing ($p=0.02$) and a similar result using the Wald test ($p=0.05$). Adjusting for age did not change the overall interpretation of the results.

Discussion

In this cross-sectional study of older patients with colorectal cancer assessed prior to chemotherapy, the prevalence of sarcopenia or severe sarcopenia according to the EWGSOP2 criteria was 12%. Reduced muscle strength was observed in 33% of patients, reduced muscle mass in 30%, and impaired physical performance in 5%. When interpreted against Danish age- and sex-specific reference values, the corresponding proportions with reduced or severely reduced muscle strength, muscle mass, and physical performance were 32%, 21%, and 23%, respectively. Physical activity was low, with patients accumulating a mean of 4,416 steps/day (range 778 – 10,113) and a median of 19 minutes/day spent in MVPA (range 0.5–71 minutes). Screening for frailty identified 3% using CFS and 55% using G8.

The observed prevalence is comparable to a previous Danish study of older patients evaluated prior to colorectal cancer resection, showing a sarcopenia prevalence of 13% exclusively among frail patients according to G8 [34]. In contrast, only approximately half of our study population screened positive on G8, yet the prevalence of sarcopenia remained similar. If G8 screening were strongly associated with sarcopenia, a higher prevalence would be expected in the preoperative colorectal cancer study. This supports that sarcopenia and frailty assessed by G8 represent overlapping but distinct constructs, with sarcopenia capturing muscle-specific impairment rather than general vulnerability.

Consistent with this interpretation, a substantial proportion of patients in the present study had probable sarcopenia or sarcopenia despite being considered relatively fit and eligible for chemotherapy. This suggests that sarcopenia may be present before frailty is detected and underscores the importance of systematic sarcopenia screening [22].

The observed prevalence is also in line with a systematic review reporting a sarcopenia prevalence of 10% among adults ≥ 60 years [35]. This review primarily included community-dwelling older adults, not excluding individuals with cancer. As such, the reported prevalence likely reflects both age-related (primary) and cancer-related (secondary) sarcopenia [5, 22]. In contrast, the prevalence in the present study was substantially higher compared with Danish healthy older adults of similar age, where prevalence ranged from 1.7% to 4.1% [29, 36], suggesting that sarcopenia may develop early already at the time of treatment planning. This interpretation is supported by evidence of accelerated declines in muscle mass, strength, and physical performance following a cancer diagnosis [37].

Reduced muscle strength was the most prevalent impairment affecting 33% of patients, indicating a substantial proportion at risk of developing sarcopenia. Muscle mass was reduced in 30% of patients and as the most rapidly affected domain following a cancer diagnosis [37] and associated with increased chemotherapy-related toxicity [38], this highlights the clinical importance of routine sarcopenia screening before chemotherapy initiation in older adults with cancer [22]. In contrast, few patients met the EWGSOP2 criteria for low physical performance, whereas more showed reduced performance compared with Danish reference values, suggesting limited sensitivity of the EWGSOP2 cut-offs for early gait speed impairment. The low prevalence may reflect a previously high functional level not yet substantially affected by reductions in muscle strength and mass. Despite relatively preserved physical performance, objectively measured physical activity was low, with few patients meeting current recommendations [39, 40]. Although it is unclear whether inactivity was longstanding or recent, reduced physical activity can rapidly affect muscle strength and mass [41], whereas declines in physical performance emerge later consistent with the EWGSOP2 framework, with physical performance determining severe sarcopenia [5].

Together, low physical activity and impairments in muscle strength and mass indicates a high risk of further functional decline and sarcopenia progression. Assessment of physical activity therefore provides an opportunity to identify modifiable risk factors and initiate targeted interventions, such as prehabilitation, prior to treatment.

Beyond its established association with chemotherapy-related toxicity, postoperative complications, and mortality [5, 7–11], chemotherapy may itself induce or accelerate sarcopenia [37, 42]. Accordingly, patients in the present study may be at risk of further muscle declines during the chemotherapy trajectory.

Discrepancies between EWGSOP2 cut-offs and Danish reference values were evident across sarcopenia domains [29], which have also been reported previously [36]. The EWGSOP2 thresholds are based on more extreme deviations from healthy reference population [5], whereas Danish reference values identify impairment at lower deviations [29]. These methodological differences likely explain the higher proportion of patients classified as impaired using population-based standards and suggest limited sensitivity of EWGSOP2 cut-offs for detecting early decline in oncological populations.

Marked differences were also observed between frailty screening tools. As G8 classified a substantially larger proportion of patients as frail than CFS, it likely reflects differences in tool design and intended populations. Incorporating nutrition-related items, G8 is highly sensitive to weight- and muscle loss, whereas CFS captures broader domains such as function, comorbidity, and cognition. In this oncological context, with a relatively high prevalence of muscle deterioration, G8 may better reflect vulnerability related to muscle health, whereas reliance on CFS may underestimate the risk of sarcopenia and muscle-related vulnerability.

Strengths and limitations

A key strength of this study is the comprehensive pre-treatment assessment using standardized, objective measures of muscle strength, muscle mass, and physical performance. In addition, physical activity was quantified objectively, allowing evaluation of activity levels beyond performance-based testing. Unlike many previous studies of sarcopenia in oncology, muscle mass was not assessed in isolation but interpreted alongside functional measures, allowing for a more clinically meaningful characterization of sarcopenia. Furthermore, the use of EWGSOP2 cut-off values alongside Danish age- and sex-specific reference data provided complementary perspectives from both an international guideline framework and a population-based reference context.

A limitation of this study is the likely underrepresentation of the most vulnerable patients. Only one-third of eligible patients consented to participate, and patients considered too frail for chemotherapy were excluded. Moreover, missing data were more common among patients with illness, low surplus energy or lack of physical or mental capacity, suggesting that missingness was predominantly not at random. Due to the low recruitment rate, the study population may be affected by selection bias, as older adults with higher levels of frailty or limited surplus energy are less likely to participate in clinical studies [43]. As a result, the prevalence of sarcopenia in this study is likely underestimated.

Implications for practice and research

Notably, this study demonstrates that sarcopenia is common in older patients with colorectal cancer already prior to chemotherapy initiation, even among patients considered fit for treatment and with normal frailty score. Reliance on general functional measures such as ECOG PS or frailty screening tools alone may therefore lead to under-recognition of clinically relevant muscle impairment [25, 26]. A Systematic pre-treatment screening for sarcopenia may have the potential to identify patients at increased risk of treatment-related toxicity, functional decline, and progression to severe sarcopenia [22, 38].

Overlooking impaired muscle health in the neoadjuvant and perioperative setting may contribute to higher complication rates, delayed recovery, prolonged hospital stays, increased readmissions and mortality [7, 8]. Moreover, overestimation of functional capacity may delay initiation of supportive measures, including prehabilitation with exercise and nutritional optimization, and may result in treatment decisions that exceed the patient's physiological reserve, adversely affecting HRQoL and independence [2, 13, 44].

Longitudinal studies are therefore needed to characterize trajectories of muscle strength, muscle mass, and physical function during cancer treatment and to evaluate whether early screening and intervention improve treatment tolerance and clinical outcomes. In addition, refinement of sarcopenia assessment strategies and cut-off values tailored to oncological populations warrants further investigation.

Conclusion

In this study sarcopenia was present in 12% of older patients with colorectal cancer already prior to initiation of chemotherapy, and impairments in muscle strength (33%) and muscle mass (30%) were highly prevalent compared to healthy counterparts. Muscle impairments were more frequent than expected based on population reference values and were also observed in patients not screening positive for frailty. These findings indicate that clinically relevant muscle impairment may already be present at the time of treatment planning and underscore the importance of routine sarcopenia screening.

Abbreviations

BMI

Body Mass Index

CFS

Clinical Frailty Scale

CI

Confidence interval

DXA

Dual-energy x-ray absorptiometry

ECOG PS

Eastern Cooperative Oncology Group Performance Status

EWGSOP2

European Working Group on Sarcopenia in Older People

G8

Geriatric-8

HGS

Hand Grip Strength

HRQoL

Health-related quality of life

IQR

Interquartile ranges

MVPA

Moderate to Vigorous Physical Activity

OR

Odds ratio

Q-Q

Quantile-quantile

SD

Standard deviations

10MWT

10-meter walking test

Declarations

Ethics approval and consent to participate

The study was carried out in accordance with the Declaration of Helsinki II [45]. The study has been approved by the Regional Ethics Committee (j.nr. H-22064206) and the Danish Data Protection Agency (P-202386).

Written informed consent was obtained from all participants prior to inclusion.

Consent for publication

Not applicable.

Availability of data and materials

Data of study results in anonymized form is available for use upon reasonable request.

Competing interests

All authors declare that they have no relevant financial or non-financial interests to disclose.

Funding

This study was supported by grants from Copenhagen University Hospital - Rigshospitalet Research Fund (grant number R239-A10.335), The Danish Health Foundation (grant number 22-B-0280), Danish Physiotherapists Research Foundation (grant numbers R68-A1777, R56-A1418, R39-A1114), and The Dagmar Marshalls Foundation, Einar Willumsens Foundation, L.F. Foghts Foundation (grant number 22286), Johannes Fog's Foundation (grant number 2024-0082), and Th. Maigaard's Successor Mrs. Lily Benthine Lund's Foundation. The funding sources had no role in the design of the study nor its execution, data analyses, interpretation of the data, or the decision to publish or disseminate the results.

Author contributions

Roles and Responsibilities

KSP, CML, CS and JC designed the study. All authors contributed to the design of the intervention and the decision of outcome measures. KSP, CS, and JC were primarily responsible for developing the statistical analysis plan. All authors contributed to the development of standard operating procedures. KSP, CS, and JC drafted the manuscript, and all authors reviewed and applied feedback. All authors have read and approved the final version of the manuscript.

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Acknowledgements

We wish to express our gratitude to all participating patients for dedicating their time to this study, and to the patient panel for their valuable insights and guidance throughout the project. We also acknowledge the Department of Clinical Physiology and Nuclear Medicine, Copenhagen University Hospital, Herlev and Gentofte for providing facilities to perform DXA scans. Special thanks are extended to the staff from the outpatient clinics at the Department of Oncology, Copenhagen University Hospital, Herlev and Gentofte and Copenhagen University Hospital, Rigshospitalet, and the Department of Occupational Therapy and Physiotherapy, Copenhagen University Hospital, Rigshospitalet, for their support in patient recruitment and assessment.

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Figures

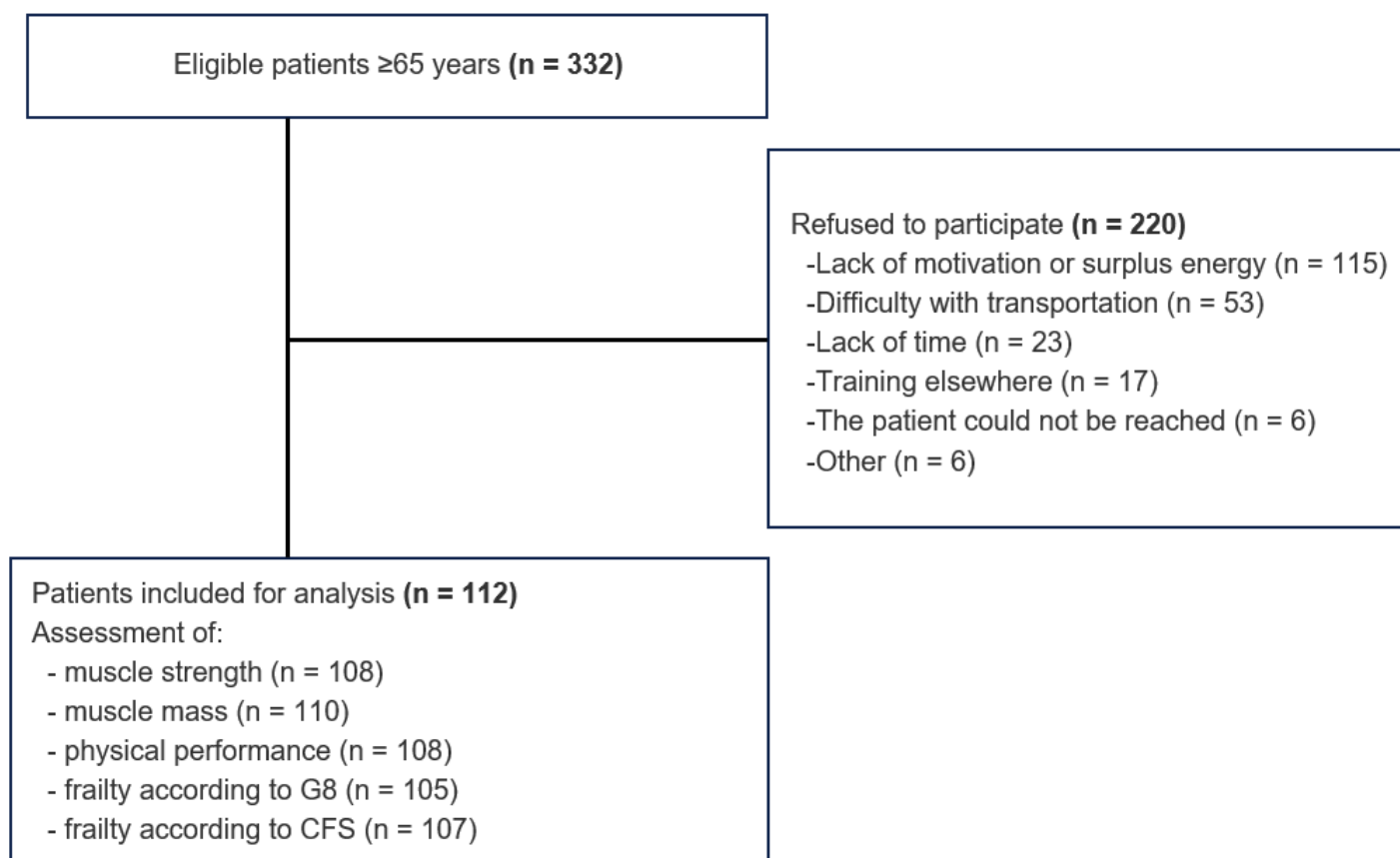


Figure 1

Flowchart of patient inclusion and reasons for not participating.



Figure 2

Venn diagram of distribution of patients according to EWGSOP2 criteria of low muscle strength, low muscle mass, and low performance showing the total number of patients with complete data (n = 106)

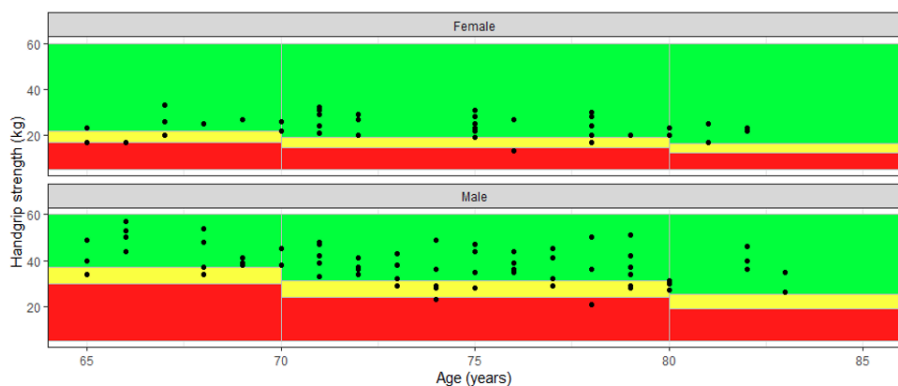


Figure 3a

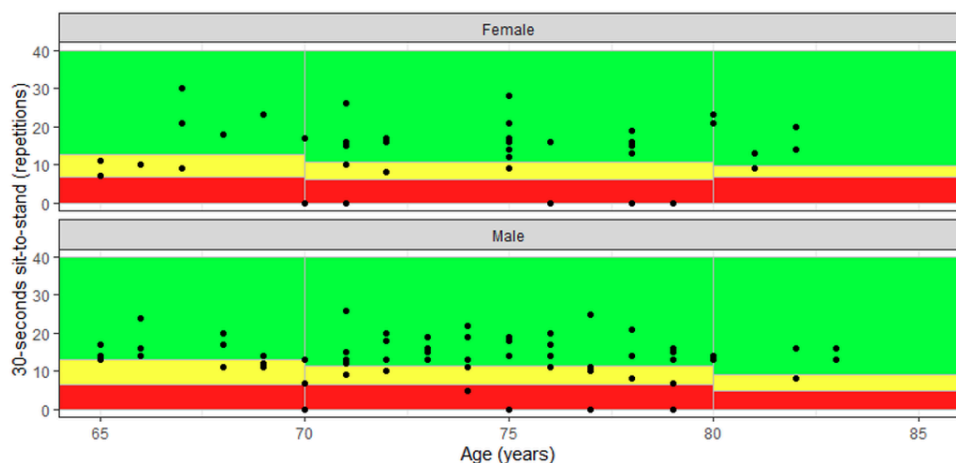


Figure 3b

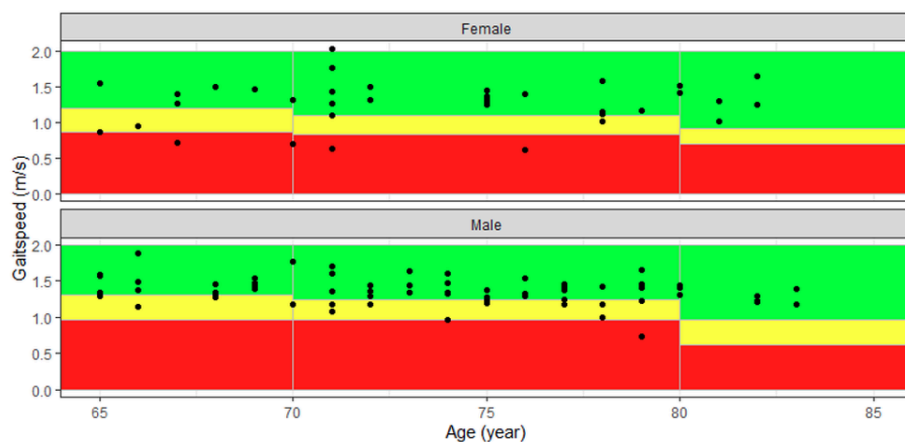


Figure 3c

Figure 3

a Distribution of patients with normal (green), reduced (yellow), and severely reduced (red) handgrip strength (HGS) according to Danish reference material [38]

b Distribution of patients with normal (green), reduced (yellow), and severely reduced (red) 30-seconds sit-to-stand (30STS) according to Danish reference material [38]

c Distribution of patients with normal (green), reduced (yellow), and severely reduced (red) habitual gait speed (10MWT) according to Danish reference material [38]

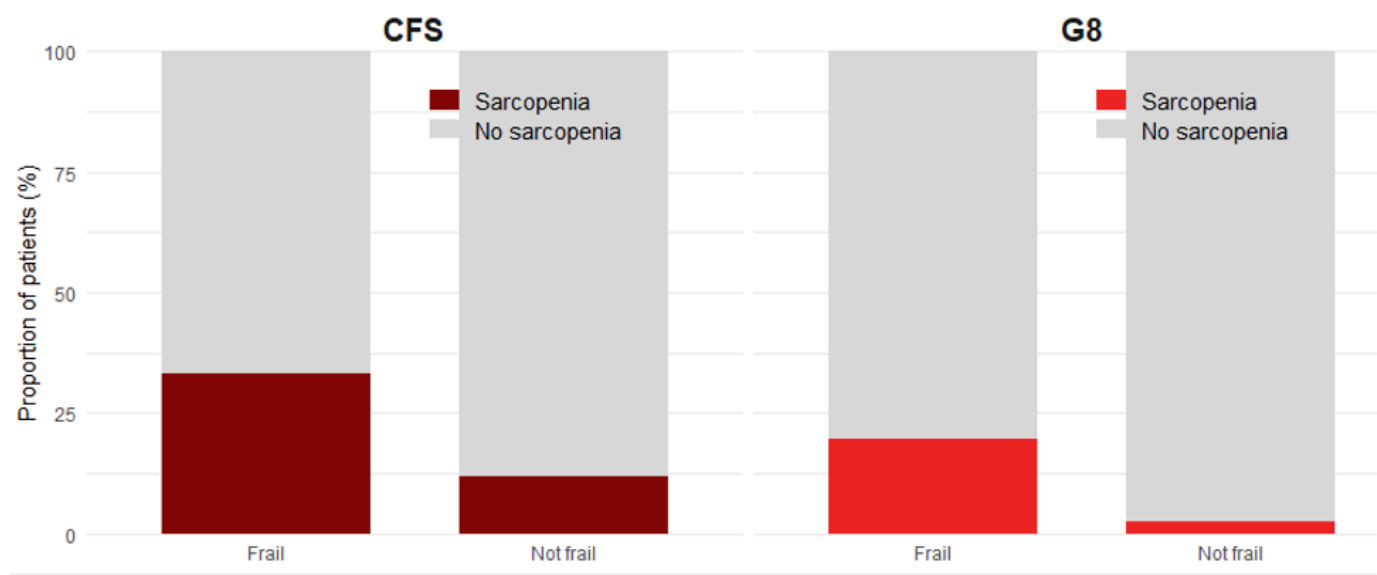


Figure 4

Overlap between sarcopenia and frailty screened by the CFS and the G8. Bars represent proportions of patients with and without sarcopenia within frailty and non-frailty categories.

Supplementary Files

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