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ORIGINAL RESEARCH

Evaluation of Waist–Calf Circumference Ratio to Assess Sarcopenia in Older Patients with Chronic Low Back Pain: A Retrospective Observational Study

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Purpose: Chronic low back pain is prevalent among older adults, who are at a higher risk for sarcopenia. The waist-to-calf circumference ratio has emerged as a health indicator, reflecting the balance between central adiposity and muscle mass. This study examined the association between waist-to-calf circumference ratio and sarcopenia, as well as factors like muscle mass, strength, and physical performance in older patients with chronic low back pain.

Patients and Methods: Ambulatory patients aged 65 years and older with chronic low back pain were included. Sarcopenia was assessed using the 2019 diagnostic criteria from the Asian Working Group for Sarcopenia. We compared demographic data, pain-related factors, comorbidities, and measurements related to sarcopenia and obesity across quartiles of the waist-to-calf circumference ratio. The prevalence of sarcopenia and severe sarcopenia was investigated, and multivariable analysis was conducted to identify independent factors associated with sarcopenia.

Results: Among 592 patients, 85 had sarcopenia (14.3%), and 71 had severe sarcopenia (11.9%). Patients with a high waist–calf circumference ratio had more comorbidities and longer pain duration. The prevalence of severe sarcopenia increased with higher quartile of waist–calf circumference ratio (Q1=7.9%, Q2=8.6%, Q3=14.8%, Q4=16.9%, P=0.006). When recommended cut-off values for the parameters used to diagnose sarcopenia were applied, the numbers of patients with low grip strength and low physical performance but not low muscle mass were greater among patients with a high waist–calf circumference ratio. Also, a high waist–calf circumference ratio was significantly associated with severe sarcopenia.

Conclusion: In older patients with chronic low back pain, a high waist–calf circumference ratio was associated with severe sarcopenia, characterized by reduced muscle strength and impaired physical performance. The waist–calf circumference ratio might serve as a useful tool for assessing sarcopenia in this population.

Keywords: abdominal obesity, low back pain, older patients, sarcopenia, waist–calf circumference ratio

Introduction

Chronic low back pain (CLBP) is one of the most prevalent and disabling conditions in the older population.[1] Among these individuals, the prevalence of sarcopenia is notably higher, particularly in those with symptomatic degenerative lumbar spine disease, compared to those without pain.[2] Sarcopenia, in turn, is associated with poor treatment outcomes for CLBP.[3] The interplay between CLBP and sarcopenia may be mediated by decreased physical activity, muscle atrophy, and systemic inflammation, which exacerbate functional decline and disability.[4,5] Given these factors, identifying a simple and effective anthropometric measure to assess sarcopenia risk in older adults with CLBP is clinically relevant.

Anthropometric measurements, such as waist and calf circumferences, have long served as valuable indicators in clinical practice, aiding in risk identification, intervention planning, and outcome assessment. Waist circumference is

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a reliable measure of visceral obesity and is closely linked to various obesity-related health risks,[6,7] while calf circumference has consistently shown a positive correlation with skeletal muscle mass, as measured by dual-energy X-ray absorptiometry (DXA).[8–10] The waist-to-calf circumference ratio (WCR) provides a composite indicator of the balance between abdominal fat and leg muscle mass.[11] Whereas body mass index (BMI) represents an aggregate of lean and fat mass without specifying fat distribution, a high WCR is indicative of increased central adiposity.

The impact of abdominal obesity on health outcomes is particularly significant; it is more closely associated with metabolic syndrome, cardiovascular disease, and mortality than BMI-defined obesity.[12,13] Abdominal obesity has also been linked to higher intensity of low back pain and associated disability.[14,15]

Initially, WCR was studied as a predictor of carotid atherosclerosis risk in patients with metabolic diseases such as diabetes.[11] Recent studies have associated high WCR with sarcopenic obesity, frailty, cognitive decline, and reduced health-related quality of life among community-dwelling older adults.[16–20] In these populations, WCR has shown to be a stronger predictor of adverse health outcomes compared to BMI, waist circumference, or calf circumference alone.[16–20] However, the implications of WCR for sarcopenia among older adults with CLBP—a group with a unique combination of pain and risk for functional decline—remain unexplored.

Therefore, this study aimed to assess the association between WCR and sarcopenia, as well as related factors like muscle mass, strength, and physical performance, in this population. Additionally, we sought to identify independent factors, including WCR, that are associated with sarcopenia.

Materials and Methods

Study Population

This study received approval from the institutional review board, and informed consent was not required due to its retrospective nature. The manuscript adheres to the STROBE guidelines for observational research. Prior research has indicated that unfavorable treatment outcomes in older patients with CLBP are associated with factors such as reduced grip strength and myosteatosis of the paraspinal muscle.[21,22] Accordingly, since 2022, we have been performing sarcopenia screenings and diagnoses for older patients presenting with chronic pain during their initial visit to our pain clinic. This retrospective analysis includes CLBP patients who underwent sarcopenia assessments following the 2019 diagnostic criteria of the Asian Working Group for Sarcopenia (AWGS).[23] Patients who attended our clinic from January to December 2022 for the treatment of low back pain were eligible for inclusion. We selected ambulatory individuals aged 65 and older who had a diagnosis of degenerative lumbar spine conditions confirmed by radiological imaging within one year of their initial visit. Chronic pain was defined as lasting three months or more. We excluded non-ambulatory patients, those with psychiatric or central nervous system disturbance that would hinder the sarcopenia assessment, individuals with abnormal calf asymmetry or pitting edema in the lower legs, and those with incomplete medical records necessary for the study.

Anthropometric and Muscle Mass Measurement

An experienced nurse practitioner specializing in geriatric assessments conducted all measurements, following the standardized procedures recommended by the AWGS.[23] Weight and height were measured according to standard procedures, with participants dressed in light clothing and without shoes. To ensure consistent weight distribution, patients were instructed to stand with their feet shoulder-width apart during the waist and calf circumference measurements. The waist was measured at the midline between the lowest rib and the iliac crest using a snug, but not tight, tape measure. Two readings were taken following a normal breath out, with the average recorded. The calf circumference was measured at the broadest part of each calf with a non-elastic tape, which was carefully placed to avoid skin compression and to lie flat, parallel to the ground. Measurements were taken twice for each leg, and the average was documented. WCR was calculated and divided into quartiles for analysis, as standardized thresholds were unavailable. Muscle mass and body fat were analyzed using a bioelectrical impedance device (Inbody H20N, InBody Co., Ltd., Seoul, Korea) to determine appendicular skeletal muscle mass, which was then used to calculate the skeletal muscle mass index (SMI) based on the patient's height squared. Bioelectrical impedance analysis (BIA) measurements with multifrequency devices

closely correlate with appendicular skeletal muscle mass measured by dual-energy X-ray absorptiometry and demonstrate adequate performance across multiple domains.[24] Participants underwent BIA in the morning while fasting to standardize body water distribution, and they were instructed to empty their bladder and bowels and to avoid physical activities, showering, sauna use, or any other activities that could affect body moisture.

Handgrip Strength and Physical Performance Assessment

Handgrip strength (HGS) was evaluated with a Smedley-type dynamometer (EH101; CAMRY, Guangdong, China). Each patient performed three attempts with each hand, standing upright with their arms fully extended.[23] The highest reading among the trials was selected for analysis. Physical performance was assessed using the Short Physical Performance Battery (SPPB), which includes three separate tests: balance, gait speed, and chair rise.[25] The balance test required patients to maintain three different stances—feet together, semi-tandem, and full-tandem—for up to 10 seconds, with the duration recorded until either movement occurred or the time limit was reached. For the gait speed test, patients walked a distance of 4 meters at their usual pace, and the average time from two trials was recorded. In the chair rise test, patients crossed their arms and stood up from a seated position five times in succession, with the total time taken being recorded. Each of the SPPB subtests was scored on a scale from 0 to 4, with a cumulative score ranging from 0 to 12, reflecting the overall performance across the tests.

Definition of Sarcopenia

In this study, cut-off values recommended by the AWGS 2019 were used to determine sarcopenia: low SMI was defined as <7.0 kg/m² for males and <5.7 kg/m² for females; low HGS was set at <28 kg for males and <18 kg for females; and a low score on the SPPB was defined as a total score of ≤9.[23] Sarcopenia was characterized by both low muscle mass and strength (low SMI + low HGS), whereas severe sarcopenia was defined as the combination of low muscle mass, low strength, and poor physical performance (low SMI + low HGS + low SPPB score).[23]

Patient Demographics and Clinical Data

Demographic, pain-related, and clinical data were retrieved from the institutional electronic medical record database. Demographic information included age, sex, and BMI. Medical history and current medications were reviewed to identify comorbid conditions such as a history of falls, cerebrocardiovascular diseases, diabetes mellitus, osteoporosis, and urinary incontinence. Pain-related variables were assessed, including the presence of leg pain (sciatica), pain duration, and the average and maximum pain intensity scores from the previous week, measured on a 0 to 10 numeric rating scale.

Statistical Analysis

Descriptive statistics are reported as mean values with standard deviations and ranges for continuous variables, and categorical variables are presented as counts and percentages for variables that did not follow a normal distribution, medians and interquartile ranges are provided, with normality assessed using the Shapiro–Wilk test. To compare demographic data, comorbidities, pain-related factors, and sarcopenia/obesity parameters across the quartiles of WCR, one-way analysis of variance with Bonferroni post-hoc corrections was applied for normally distributed continuous variables, and the Kruskal–Wallis test was used for non-normally distributed continuous variables. Categorical variables were compared using the chi-square test, with post-hoc pairwise comparisons adjusted using Bonferroni corrections for differences across WCR quartiles. Trends in the prevalence of sarcopenia and severe sarcopenia by quartile, as well as comparisons of the number of patients with sarcopenia-related parameters below the AWGS 2019 cut-offs according to WCR quartile, were analyzed using the chi-square test for linear by linear association. The associations of WCR with sarcopenia and severe sarcopenia were determined using a multivariable logistic regression model, with odds ratios and 95% confidence intervals. The adjusted model included age, sex, BMI, WCR, comorbidities, and pain-related variables, selected through backward elimination. Statistical analyses were performed using IBM SPSS Statistics, version 26.0 (IBM Corp, Armonk, NY), with significance set at a P-value of less than 0.05.

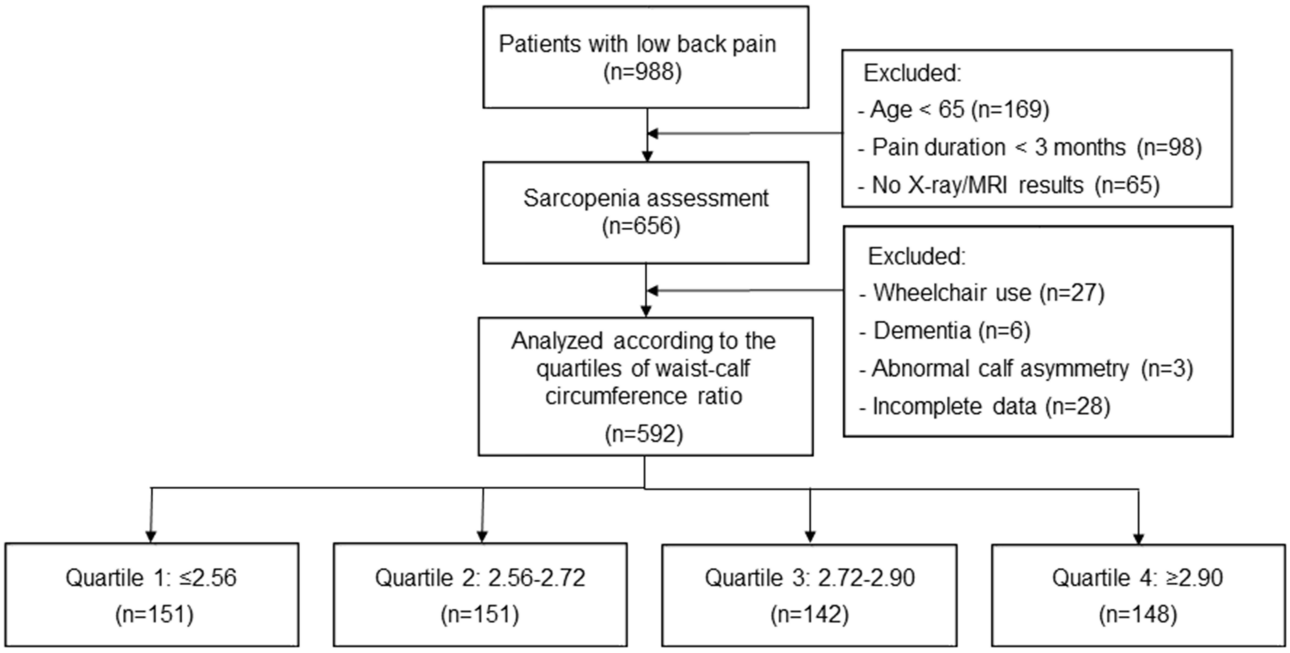

Figure 1 Flow diagram of the study.

Results

After the exclusion process, we included 592 CLBP patients aged 65–90 years in our analyses (Figure 1). Based on the AWGS 2019 diagnostic criteria for sarcopenia, 85 patients (14.3%) were identified with sarcopenia, of whom 71 patients (11.9% of all patients) had severe sarcopenia.

Table 1 presents patient demographics, comorbid medical conditions, sarcopenia and obesity-related measurements, and pain-related data, categorized by quartiles of WCR. Patients with a higher WCR tended to be older, female, and had higher BMI and body fat percentages. Patients with a higher WCR had more comorbidities, except fall history. Patients in higher WCR quartiles exhibited higher waist circumference, lower calf circumference, reduced HGS, and lower SPPB scores compared to those in the first quartile of WCR. Patients in the fourth WCR quartile had lower muscle mass than

Table 1 Comparison of Patient Characteristics, Comorbidities, Sarcopenia/Obesity-Related Measurements, and Pain-Related Data According to Quartile of Waist–Calf Circumference Ratio

Variables	Q1 (≤2.56) (n = 151)	Q2 (2.56–2.72) (n = 151)	Q3 (2.72–2.90) (n = 142)	Q4 (≥2.90) (n = 148)	P-Value
Patient characteristics					
Age, years	69.41 ± 5.26 [c,d] (65–86)	70.71 ± 6.24 [d] (65–89)	72.34 ± 5.96 [a,d] (65–88)	74.73 ± 6.18 [a,b,c] (65–90)	<0.001
Female, n	97 (64.2) [d]	95 (62.9) [d]	94 (66.2) [d]	119 (80.4) [a,b,c]	0.002
BMI, kg/m^2	24.12 (21.51;26.40) [b,d]	24.95 (23.20;26.93) [a]	25.17 (23.20;27.22)	25.58 (23.35;28.23) [a]	<0.001
<25	93 (61.6) [c,d]	79 (52.3)	68 (47.9) [a]	61 (41.2) [a]	<0.001
≥25	58 (38.4) [c,d]	72 (47.7)	74 (52.1) [a]	87 (58.8) [a]	
Comorbidities, n					
Fall history	42 (27.8)	40 (26.5)	36 (25.5)	41 (27.7)	0.938
Cerebro-cardiovascular disease	32 (21.2) [c,d]	33 (21.9) [c,d]	48 (34.0) [a,b]	53 (35.8) [a,b]	0.001
Diabetes	31 (20.5) [d]	36 (23.8) [d]	40 (28.4)	50 (33.8) [a,b]	0.006
Osteoporosis	22 (14.6) [c,d]	21 (13.9) [c,d]	33 (23.4) [a,b]	38 (25.7) [a,b]	0.003
Urinary incontinence	12 (7.9) [d]	18 (11.9)	19 (13.5)	27 (18.2) [a]	0.008

(*Continued*)

Table 1 (Continued).

Variables	Q1 (≤2.56) (n = 151)	Q2 (2.56–2.72) (n = 151)	Q3 (2.72–2.90) (n = 142)	Q4 (≥2.90) (n = 148)	P-Value
Sarcopenia/obesity measurements					
Waist circumference, cm	84.03 ± 8.55 [b,c,d]	89.81 ± 6.69 [a,d]	91.71 ± 8.00 [a,d]	96.70 ± 9.41 [a,b,c]	<0.001
Calf circumference, cm	34.87 ± 3.37 [c,d]	34.05 ± 2.34 [c,d]	32.68 ± 2.87 [a,b,d]	31.37 ± 2.77 [a,b,c]	<0.001
SMI, kg/m^2	6.77 ± 1.44	6.94 ± 1.33 [d]	6.75 ± 1.26	6.50 ± 1.30 [b]	0.045
Body fat percentage, %	28.12 ± 8.49 [c,d]	29.60 ± 6.97 [a,d]	30.66 ± 7.63 [a,d]	34.76 ± 7.17 [a,b,c]	<0.001
HGS, kg	23.87 ± 8.99 [d]	24.19 ± 8.58 [d]	21.83 ± 7.49	19.82 ± 6.39 [a,b]	<0.001
SPPB, 0–12	7.68 ± 2.05 [c,d]	7.30 ± 1.99 [d]	6.95 ± 1.95 [a,d]	6.26 ± 2.22 [a,b,c]	<0.001
Pain-related data					
Leg pain, yes	100 (66.2)	96 (63.6)	103 (72.5)	103 (69.6)	0.269
Pain duration, months	12.00 (3.00–516.00) [d]	18.00 (3.00–720.00)	24.00 (3.00–600.00)	36.00 (3.00–480.00) [a]	<0.001
<12 months	58 (38.4) [d]	50 (33.1)	45 (31.7)	39 (26.4) [a]	0.028
≥12 months	93 (61.6) [d]	101 (66.9)	97 (68.3)	109 (73.6) [a]	
Average pain score, NRS 0–10	4.75 ± 1.79	4.91 ± 1.88	5.00 ± 1.78	4.47 ± 2.22	0.095
NRS <7	132 (87.4)	123 (81.5)	119 (83.8)	131 (88.5)	0.666
NRS ≥7	19 (12.6)	28 (18.5)	23 (16.2)	17 (11.5)	
Maximal pain score, NRS 0–10	6.95 ± 1.97	7.02 ± 1.59	7.01 ± 1.75	7.15 ± 1.84	0.805
NRS <7	63 (41.7)	62 (41.1)	59 (41.5)	58 (39.2)	0.692
NRS ≥7	88 (58.3)	89 (58.9)	83 (58.5)	90 (60.8)	

Notes: Values are presented as mean ± standard deviation (range), median (interquartile range), or number of patients (%). The results of post-hoc testing with Bonferroni-corrected p <0.05 are indicated as: a, vs Q1; b, vs Q2; c, vs Q3; d, vs Q4.
Abbreviations: BMI, body mass index; SMI, skeletal muscle mass index; HGS, handgrip strength; SPPB, Short Physical Performance Battery; NRS, numeric rating scale.

those in the second quartile, but muscle mass did not differ significantly between the fourth quartile and the first or third quartile. As WCR increased, patients had longer duration of pain, but the presence of leg pain and pain scores were similar among the groups. The prevalence of sarcopenia and severe sarcopenia according to WCR quartile is illustrated in Figure 2. As WCR increased, the number of patients with sarcopenia tended to increase, but the changes were not statistically significant (Q1=11.9%, Q2=11.3%, Q3=16.2%, Q4=18.2%, P=0.063). However, the proportional increase in the prevalence of severe sarcopenia as WCR increased was significant (Q1=7.9%, Q2=8.6%, Q3=14.8%, Q4=16.9%, P=0.006).

When applying the AWGS 2019 cut-off values for parameters used to diagnose sarcopenia, significantly more patients with low HGS and low SPPB scores were in the higher WCR quartiles (Q3 and Q4) than in the lower WCR quartiles (Q1 and Q2). The number of patients with low SMI was comparable across WCR quartiles (Table 2). In a multivariable analysis, older age, female sex, lower BMI, and fall history were associated with sarcopenia in older patients with CLBP. Also, older age, lower BMI, fall history, and higher WCR (Q3 and Q4) were significantly associated with severe sarcopenia in our study population (Table 3).

Discussion

A significant finding of this study is the association between a high WCR and severe sarcopenia, characterized by diminished muscle strength and poor physical performance, among older patients with CLBP. Abdominal fat is the most metabolically active adipose tissue in the body,[26] and it secretes pro-inflammatory adipokines such as tumor necrosis factor-α, interleukin-6, retinol-binding protein-4, lipocalin-2, leptin, and resistin.[26,27] These adipokines are significantly involved in immune regulation, inflammatory responses, fatty acid oxidation, and insulin resistance.[27] Dysregulated production or secretion of these adipokines in abdominal obesity has negative effects on both the metabolic and mechanical functioning of skeletal muscle.[28–30]

Observational studies have demonstrated that elevated inflammatory markers and high fasting triglycerides were inversely correlated with muscle strength.[30,31] Indeed, similar to our results, abdominal obesity was significantly associated with lower muscle strength after adjustment for BMI in a previous study conducted in a large sample.[32]

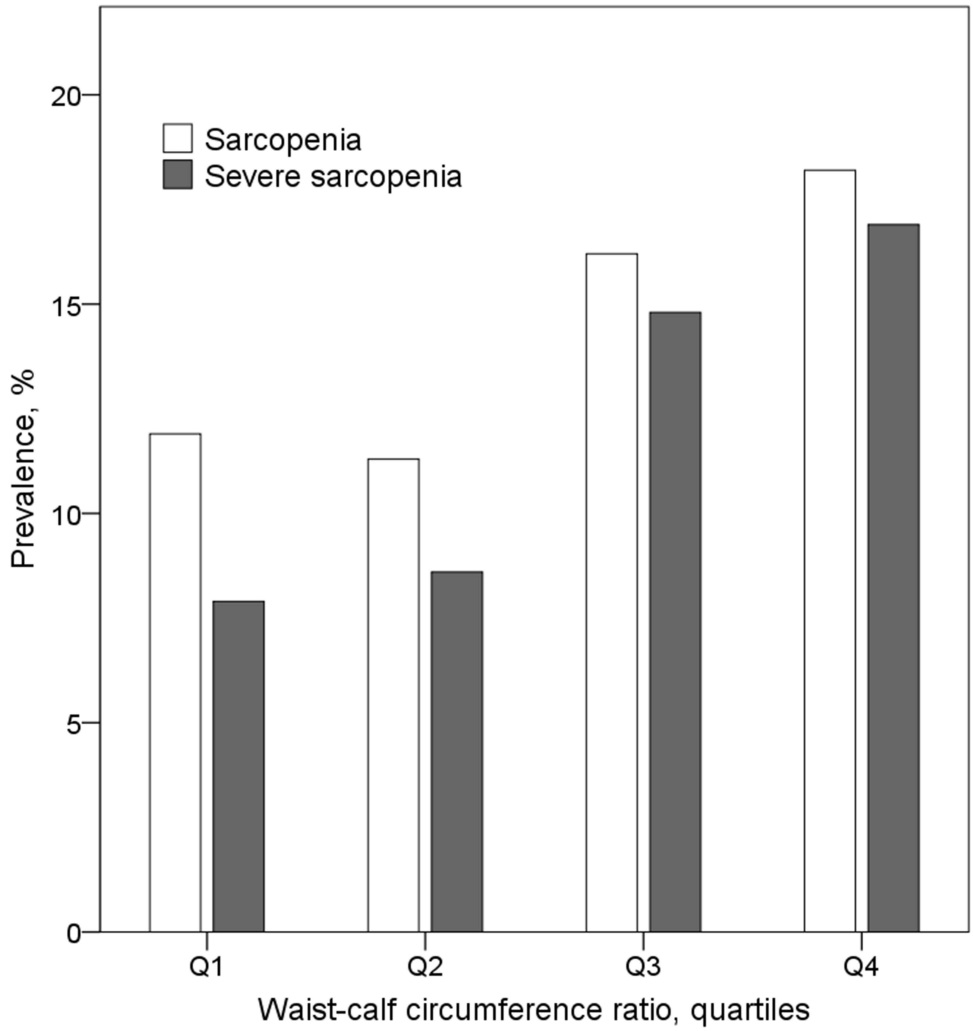

Figure 2 Prevalence of sarcopenia (Q1=11.9%, Q2=11.3%, Q3=16.2%, Q4=18.2%, P=0.063) and severe sarcopenia (Q1=7.9%, Q2=8.6%, Q3=14.8%, Q4=16.9%, P=0.006) according to quartile of the waist–calf circumference ratio in the study population.

Although no causal relationship has been determined between abdominal obesity and chronic pain, the coexistence of pain and obesity seems to be closely linked to physical function impairment.[33]

In older patients with CLBP, symptoms such as sciatica and neurogenic claudication can initiate a harmful cycle where decreased physical activity leads to muscle atrophy, further worsening deconditioning and disability.[4,5] Abdominal obesity causes malalignment of the lumbar spine by anteriorly shifting the center of gravity, and it loads abnormal forces onto the weight-bearing joints in the lower limbs.[5,14] Systemic inflammation and dysregulation of the hypothalamic-

Table 2 The Number of Patients with Sarcopenia-Related Parameters Below the AWGS 2019 Cut-Offs According to Quartile of Waist–Calf Circumference Ratio

Variables	Q1 (≤2.56) (n = 151)	Q2 (2.56–2.72) (n = 151)	Q3 (2.72–2.90) (n = 142)	Q4 (≥2.90) (n = 148)	P-value
Low SMI, n	44 (29.1)	36 (22.0)	44 (31.0)	40 (27.0)	0.968
Low HGS, n	52 (34.4) [c,d]	50 (33.1) [c,d]	68 (47.9) [a,b]	82 (55.4) [a,b]	<0.001
Low SPPB, n	94 (62.3) [c,d]	103 (68.2) [c,d]	113 (79.6) [a,b]	126 (85.1) [a,b]	<0.001

Notes: The cut-off values for each parameter recommended by AWGS 2019 were used to identify low SMI (males: <7.0 kg/m^2, females: <5.7 kg/m^2), low HGS (males: <28 kg, females: <18 kg), and low SPPB (total score ≤9). The results of post-hoc testing with Bonferroni-corrected p <0.05 are indicated as: a, vs Q1; b, vs Q2; c, vs Q3; d, vs Q4.

Abbreviations: SMI, skeletal muscle mass index; HGS, handgrip strength; SPPB, Short Physical Performance Battery; AWGS, Asian Working Group for Sarcopenia.

Table 3 Factors Associated with Sarcopenia and Severe Sarcopenia

	Variables	Adjusted OR	95% CI	P-Value
Sarcopenia	Age, years	1.078	1.037–1.120	<0.001
	Female	2.038	1.112–3.735	0.021
	BMI, kg/m^2	0.759	0.698–0.826	<0.001
	Fall history, yes	2.753	1.635–4.637	<0.001
Severe sarcopenia	Age, years	1.058	1.014–1.104	0.010
	BMI, kg/m^2	0.761	0.693–0.836	<0.001
	Fall history, yes	2.932	1.672–5.144	<0.001
	Waist–calf circumference ratio, quartiles			
	Q1 (≤2.56)	1.000		
	Q2 (2.56–2.72)	1.389	0.573–3.363	0.467
	Q3 (2.72–2.90)	2.465	1.083–5.609	0.031
	Q4 (≥2.90)	2.911	1.252–6.765	0.013

Abbreviations: OR, odds ratio; CI, confidence interval; BMI, body mass index.

pituitary-adrenal axis in obesity contribute to altered mood, sleep disturbance, and fatigue, which are also frequently found in chronic pain.[5] Collectively, these changes in biomechanical and systemic factors that are caused by abdominal obesity can adversely affect musculoskeletal pain and accelerate the decline of physical function in chronic pain conditions.

The WCR showed a significant correlation with BMI; however, despite including the calf circumference measurement, it appeared to poorly reflect global skeletal muscle mass in this study. Our previous research[34] demonstrated that calf circumference is a reliable indicator of muscle mass in older adults with CLBP, yet this association was not observed in the current study. One possible explanation is that high abdominal fat, which serves as a storage site for female hormones, has been associated with a lower risk of muscle mass loss after menopause.[35,36] Additionally, higher fat mass in the legs is generally observed in females,[37] and leg edema is more prevalent among older females than males.[38] Given that 68.4% of the patients in this study were female, those factors might have affected our finding of no association between WCR and muscle mass. A previous study[39] highlighted that BMI has limitations in assessing sarcopenic obesity due to a low correlation with SMI, suggesting that WCR may have similar limitations. However, calf circumference can still be a useful indicator, and more refined assessment methods are needed for accurate evaluation of muscle mass.

While recent guidelines affirm that low muscle mass is crucial for diagnosing sarcopenia, low muscle strength is emphasized as the primary characteristic of the condition.[23,40] Additionally, poor physical performance indicates severe sarcopenia.[40] In this study, the prevalence of severe sarcopenia, based on the AWGS 2019 criteria (low SMI + low HGS + low SPPB score), was found to be 11.9% among older patients with CLBP. This figure is nearly four times higher than the 3.3% prevalence reported among 2123 ambulatory community-dwelling older adults in a previous study.[10] Physical performance in our study was assessed using the SPPB, which evaluates lower limb function.[26] Given the nature of CLBP, patients in this study may exhibit below-average SPPB scores, highlighting their increased vulnerability to severe sarcopenia.

Anthropometric measurements, while not adequately reflecting muscle quality or functional aspects, suggest that a high WCR is significantly associated with severe sarcopenia in older patients with CLBP. This suggests that WCR could be a practical tool for diagnosing sarcopenia and assessing its severity in clinical settings, especially since physical performance tests often require considerable time, space, and trained personnel.

Fall risk, which is influenced by multiple factors such as unsafe gait, mental state, and sensory deficits,[41] and pain intensity, for which no clear physiological or endocrine mechanisms linking adipose tissue have been established,[42] did not show significant differences across WCR quartiles. However, a high WCR was most frequently observed in patients with multiple comorbidities and a longer duration of pain in this study. Therefore, a multidimensional assessment approach that considers both systemic conditions and the clinical characteristics of chronic pain is essential when evaluating sarcopenia in this population.

Our study has several important strengths. First, unlike most previous studies that relied solely on self-reported disability, we validated our findings using well-established physical performance tests, conducted by an experienced nurse practitioner. Second, we assessed a comprehensive range of sarcopenia and obesity-related parameters, including waist circumference, calf circumference, SMI, body fat percentage, HGS, and SPPB scores, allowing for a thorough investigation of the relationship between WCR and sarcopenia.

However, our study presents several limitations. First, it was conducted at a single institution with a patient population of a homogeneous racial background, which may affect the generalizability of the results to other clinical settings and diverse populations. Second, the inclusion criteria required complete clinical data, which introduces a potential for selection bias. Third, the cross-sectional nature of the study prevents the establishment of causal relationships between WCR and sarcopenia. Additionally, we did not perform a sex-stratified analysis, as our primary focus was on the overall association between WCR and sarcopenia-related factors. Given the potential influence of sex differences on WCR, future studies with larger and more balanced cohorts should further explore this aspect. Longitudinal studies are necessary to validate these findings and explore potential causal associations.

Conclusions

This study highlights a significant correlation between WCR and factors associated with sarcopenia in older patients with CLBP. The findings emphasize the importance of anthropometric measurements in assessing sarcopenia risk, revealing that increased WCR is linked to higher rates of both sarcopenia and severe sarcopenia. Although WCR may not replace imaging-based evaluations of muscle mass for assessing sarcopenia, it could serve as an accessible screening tool. Further research is needed to validate its effectiveness and explore targeted interventions for this vulnerable population.

Abbreviations

CLBP, Chronic low back pain; DXA, dual-energy X-ray absorptiometry; WCR, Waist–calf circumference ratio; BMI, Body mass index; AWGS, Asian Working Group for Sarcopenia, BIA, Bioelectrical impedance analysis; SMI, Skeletal muscle mass index; HGS, Handgrip strength; SPPB, Short Physical Performance Battery.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethics Approval and Consent to Participate

This study was approved by the Institutional Review Board of Yonsei University Health System, Seoul, Republic of Korea (IRB No. 4-2024-0163) Informed consent was waived by the IRB of Yonsei University Health System under the "Waiver of Informed Consent for Retrospective Studies" due to the study's retrospective nature. Patient data confidentiality was strictly maintained in accordance with the institutional and ethical guidelines. This study complied with the principles of the Declaration of Helsinki.

Consent for Publication

Participants provided written consent for publication.

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Author Contributions

All authors made a significant contribution to the work reported, including the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas. All authors took part in drafting, revising, or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

The authors declare that they have no competing interests in this work.

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