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Original Research Article

Association of Sarcopenia with Severity and Prognosis in Patients with Chronic Liver Disease

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Received: 20 Aug 2026 | Accepted: 29 Aug 2026 | Published: 30 Aug 2026

Abstract

Background : Chronic liver disease (CLD) is associated with progressive hepatic dysfunction and multiple complications that contribute to increased morbidity and mortality. Sarcopenia, characterized by loss of skeletal muscle mass and function, has emerged as an important extrahepatic manifestation of cirrhosis and a potential predictor of poor outcomes. This study was conducted to evaluate the association of sarcopenia with severity and prognosis among patients with chronic liver disease.

Methods : This prospective observational study included 90 patients diagnosed with chronic liver disease. All patients underwent clinical evaluation, laboratory investigations, assessment of liver disease severity using Child–Turcotte–Pugh (CTP) and Model for End-Stage Liver Disease (MELD) scores, and evaluation of skeletal muscle mass using computed tomography (CT)-based skeletal muscle index (SMI) at the third lumbar vertebral level. Patients were categorized into sarcopenic and non-sarcopenic groups, and their association with hepatic complications, hospitalization, and short-term outcomes was analyzed.

Results : Sarcopenia was identified in 35 patients (38.9%). Sarcopenic patients had significantly higher CTP scores (9.1 ± 1.8 vs 7.3 ± 1.6; $p<0.001$) and MELD scores (17.8 ± 5.4 vs 12.6 ± 4.3; $p<0.001$) compared with non-sarcopenic patients. Hepatic encephalopathy (45.7% vs 18.2%; $p=0.008$) and ascites (77.1% vs 45.5%; $p=0.003$) were significantly more frequent among sarcopenic individuals. Hospitalization rates were also higher in the sarcopenic group (65.7% vs 40.0%; $p=0.020$). Mortality showed a higher trend among sarcopenic patients (17.1% vs 5.5%), although statistical significance was not reached.

Conclusion : Sarcopenia is frequently observed in patients with chronic liver disease and is significantly associated with advanced disease severity, hepatic complications, and increased hospitalization risk. Assessment of skeletal muscle status may provide additional prognostic information and should be considered as an important component of comprehensive CLD management.

Keywords : Sarcopenia; Chronic liver disease; Liver cirrhosis; Skeletal muscle index; Child–Turcotte–Pugh score; MELD score; Prognosis

Introduction

Chronic liver disease (CLD) is a significant global health problem characterized by progressive hepatic injury, fibrosis, and deterioration of liver function, eventually resulting in cirrhosis and its complications. Multiple etiologies, including chronic viral hepatitis, alcohol-related liver disease, metabolic dysfunction-associated steatotic liver disease (MASLD), and autoimmune liver disorders, contribute to the development of CLD. [1] Advanced liver disease is associated with substantial

morbidity and mortality due to complications such as portal hypertension, ascites, hepatic encephalopathy, variceal bleeding, recurrent infections, malnutrition, and multi-organ dysfunction. Despite advances in diagnosis and treatment, accurate prediction of disease progression and identification of patients at increased risk of poor outcomes remain challenging.[2] Sarcopenia, defined as progressive loss of skeletal muscle mass, strength, and physical performance, has emerged as an important extrahepatic manifestation of chronic liver disease, particularly among patients with cirrhosis.[3] Cirrhosis-associated sarcopenia is a complex process influenced by multiple factors, including inadequate nutritional intake, impaired metabolism, chronic inflammation, hormonal disturbances, reduced physical activity, and increased muscle protein breakdown.[4] In advanced liver disease, impaired glycogen storage and altered amino acid metabolism result in increased dependence on skeletal muscle as an energy source, accelerating muscle depletion. The prevalence of sarcopenia is considerably higher among patients with chronic liver disease compared with the general population and varies according to diagnostic criteria, assessment methods, and severity of hepatic dysfunction. [5,6] Studies have reported sarcopenia in approximately 30–70% of patients with cirrhosis, with higher prevalence observed in advanced stages of disease. Skeletal muscle plays a crucial role in maintaining metabolic balance, mobility, immune function, and ammonia detoxification.[7] Therefore, loss of muscle mass can impair ammonia clearance and contribute to the development or worsening of hepatic encephalopathy. Sarcopenia has also been associated with increased risk of infections, recurrent hepatic decompensation, prolonged hospitalization, poor treatment tolerance, and increased mortality. Assessment of sarcopenia in patients with chronic liver disease remains challenging, particularly in individuals with ascites and fluid overload, where conventional nutritional and anthropometric assessments may underestimate muscle loss.[8] Imaging-based techniques, especially computed tomography (CT)-based measurement of skeletal muscle index (SMI) at the third lumbar vertebral level (L3), are considered reliable methods for evaluating muscle mass. CT-based assessment provides objective quantification of skeletal muscle depletion and can be performed using abdominal imaging routinely obtained during evaluation of cirrhosis and hepatocellular carcinoma surveillance. Other methods, including bioelectrical impedance analysis, dual-energy X-ray absorptiometry, handgrip strength, and physical performance testing, are also used for assessment of sarcopenia.[9]

The severity of chronic liver disease is traditionally evaluated using scoring systems such as the Child–Turcotte–Pugh (CTP) score and Model for End-Stage Liver Disease (MELD) score. However, these systems primarily assess hepatic dysfunction and do not account for nutritional status or skeletal muscle reserve. Increasing evidence suggests that sarcopenia provides additional prognostic information beyond conventional liver disease severity scores.[10] The coexistence of muscle depletion and impaired liver function identifies patients at higher risk of complications, hospitalization, and mortality. Recognition of sarcopenia may therefore improve risk stratification and guide individualized interventions, including nutritional optimization, exercise-based rehabilitation, and transplant evaluation. Although the prognostic significance of sarcopenia in cirrhosis has been widely investigated globally, data from Indian patients with chronic liver disease remain limited. Differences in nutritional status, dietary patterns, socioeconomic factors, disease etiology and baseline muscle reserves may influence the prevalence and clinical impact of sarcopenia in Indian populations. Understanding the association between sarcopenia, severity of liver disease, and clinical outcomes is therefore essential for improving patient management.[11] The present study was conducted to evaluate the association of sarcopenia with severity and prognosis among patients with chronic liver disease. The study aimed to determine the prevalence of sarcopenia and assess its relationship with hepatic disease severity, hospitalization, liver-related complications, and short-term clinical outcomes.

Methodology:

This prospective observational study was conducted among patients with chronic liver disease (CLD) attending the Department of Medicine at the study institution. The study was designed to evaluate the association between sarcopenia and severity of liver disease and to assess its impact on clinical outcomes and prognosis. The study period included patient recruitment, baseline assessment, and follow-up evaluation according to the predefined study protocol.A total of 90 patients diagnosed with chronic liver disease were enrolled in the study. Patients fulfilling the eligibility criteria were included after obtaining written informed consent.

Inclusion Criteria

Patients were included if they fulfilled the following criteria:

- Patients aged ≥18 years with a confirmed diagnosis of chronic liver disease.
- Patients with liver cirrhosis diagnosed based on clinical, biochemical,

radiological, and/or histopathological findings.
- Patients who underwent abdominal imaging allowing assessment of skeletal muscle mass.
- Patients willing to participate and provide written informed consent.

Exclusion Criteria

Patients were excluded if they had:

- Acute liver failure or acute-on-chronic liver failure at the time of enrollment.
- History of malignancy other than hepatocellular carcinoma under surveillance.
- Previous liver transplantation.
- Severe neurological or musculoskeletal disorders affecting mobility or muscle assessment.
- Conditions causing independent muscle wasting such as active tuberculosis, severe chronic infections, or advanced systemic illness.
- Incomplete clinical, laboratory, or imaging data.

Clinical and Demographic Assessment

All enrolled patients underwent detailed clinical evaluation. Demographic characteristics including age and sex were recorded. A comprehensive clinical history was obtained, including duration and etiology of liver disease, alcohol consumption, comorbidities, previous episodes of hepatic decompensation, history of hospitalization, and presence of complications such as ascites, hepatic encephalopathy, and variceal bleeding.Physical examination was performed for assessment of nutritional status, signs of chronic liver disease, fluid overload, and other clinical features of hepatic dysfunction.

Assessment of Liver Disease Severity

The severity of chronic liver disease was assessed using established prognostic scoring systems. Child–Turcotte–Pugh (CTP) classification was calculated based on serum bilirubin, serum albumin, international normalized ratio (INR)/prothrombin time, ascites, and hepatic encephalopathy. Model for End-Stage Liver Disease (MELD) score was calculated using standard parameters including serum bilirubin, creatinine, and INR.Patients were categorized according to disease severity based on these scoring systems, and the relationship between sarcopenia and severity of liver dysfunction was evaluated.

Laboratory Investigations

Baseline laboratory investigations were performed for all participants. The parameters assessed included complete blood count, liver function tests, renal function tests, coagulation profile, serum electrolytes, and other relevant biochemical investigations. Laboratory parameters were correlated with the presence of sarcopenia and clinical outcomes.

Assessment of Sarcopenia

Sarcopenia was assessed using imaging-based evaluation of skeletal muscle mass. Computed tomography (CT)-based measurement of skeletal muscle index (SMI) at the level of the third lumbar vertebra (L3) was performed. The cross-sectional area of skeletal muscle at the L3 vertebral level was measured and normalized according to height to calculate SMI (cm^2/m^2).Patients were classified as sarcopenic or non-sarcopenic based on established sex-specific cutoff values for skeletal muscle depletion. The presence of sarcopenia was subsequently analyzed in relation to liver disease severity, complications, hospitalization, and clinical outcomes.

Assessment of Clinical Outcomes and Prognosis

Patients were followed during the study period to assess clinical outcomes. The occurrence of liver-related complications, episodes of hepatic decompensation, hospitalization, and mortality were recorded. The association between sarcopenia and adverse clinical outcomes was evaluated.Hospitalization was defined as admission due to complications related to chronic liver disease, including hepatic encephalopathy, ascites-related complications, gastrointestinal bleeding, infections, or other liver-related causes.

Statistical Analysis

Data were collected and entered into a statistical database for analysis by SPSS 21. Continuous variables were expressed as mean ± standard deviation or median with interquartile range depending on data distribution. Categorical variables were presented as frequency and percentage.Comparison between sarcopenic and non-sarcopenic groups was performed using the independent Student's t-test or Mann–Whitney U test for continuous variables and Chi-square test or Fisher's exact test for categorical variables. Correlation between skeletal muscle index and liver disease severity parameters was assessed using Pearson's or Spearman's correlation analysis as appropriate.A p-value <0.05 was considered statistically significant. Statistical analysis was performed using appropriate statistical software.

Results:

A total of 90 patients with chronic liver disease were included in the present study. All patients underwent detailed clinical evaluation, laboratory assessment, evaluation of liver disease severity, and assessment

of skeletal muscle mass for detection of sarcopenia. The clinical characteristics, severity parameters, and outcomes were analyzed to determine the association between sarcopenia and prognosis in chronic liver disease.

The demographic and baseline clinical characteristics of the study population are summarized in Table 1. The mean age of patients was 54.8 ± 10.6 years, with the majority of patients belonging to the age group of 51–60 years. Male patients constituted the predominant group (72.2%), reflecting the higher prevalence of chronic liver disease among males in the study population.

Regarding the etiology of chronic liver disease, alcohol-related liver disease was the most common cause, followed by viral hepatitis and metabolic-associated liver disease. Ascites was present in a considerable proportion of patients, while hepatic encephalopathy and previous episodes of hospitalization were observed among patients with more advanced disease.

Table 1. Baseline Demographic and Clinical Characteristics of Study Participants (n = 90)

Parameter	Number (n)	Percentage (%)
Age group (years)		
≤40 years	10	11.1
41–50 years	22	24.4
51–60 years	34	37.8
>60 years	24	26.7
Sex		
Male	65	72.2
Female	25	27.8
Etiology of CLD		
Alcohol-related liver disease	38	42.2
Chronic viral hepatitis	24	26.7
MASLD	18	20.0
Autoimmune/other causes	10	11.1
Clinical complications		
Ascites	52	57.8
Hepatic encephalopathy	26	28.9
Variceal bleeding history	18	20.0
Previous hospitalization	42	46.7

Assessment of skeletal muscle mass using CT-based skeletal muscle index (SMI) demonstrated that sarcopenia was present in 35 patients (38.9%), while 55 patients (61.1%) had preserved skeletal muscle mass. Sarcopenic patients were predominantly males and had a higher frequency of advanced liver disease manifestations compared with non-sarcopenic patients Table 2, Figure 1

Table 2. Distribution of Sarcopenia Among Study Participants (n = 90)

Sarcopenia status	Number (n)	Percentage (%)
Sarcopenic patients	35	38.9
Non-sarcopenic patients	55	61.1
Total	**90**	**100**

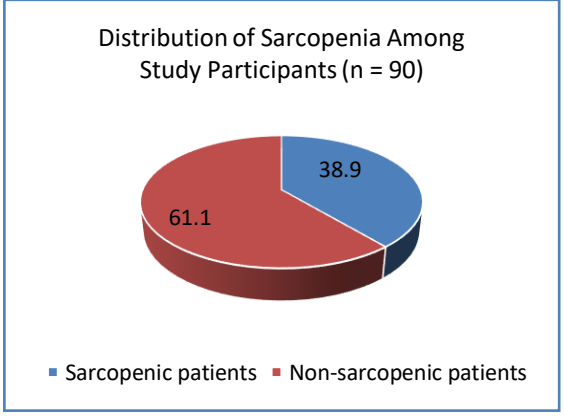

Figure 1 Distribution of Sarcopenia Among Study Participants (n = 90)

The relationship between sarcopenia and severity of liver dysfunction is presented in Table 3. Patients with sarcopenia had significantly higher Child–Turcotte–Pugh (CTP) and MELD scores compared with non-sarcopenic patients. Sarcopenia was more frequently observed among patients with advanced CTP class, indicating a significant association between muscle depletion and severity of hepatic dysfunction Table 3.

Table 3. Association Between Sarcopenia and Liver Disease Severity Scores (n = 90)

Parameter	Sarcopenic (n=35)	Non-sarcopenic (n=55)	p-value
CTP score (Mean ± SD)	9.1 ± 1.8	7.3 ± 1.6	<0.001
MELD score (Mean ± SD)	17.8 ± 5.4	12.6 ± 4.3	<0.001
CTP Class			
Class A	5 (14.3%)	20 (36.4%)	
Class B	18 (51.4%)	28 (50.9%)	
Class C	12 (34.3%)	7 (12.7%)	0.018

The frequency of liver-related complications according to sarcopenia status is shown in Table 4. Sarcopenic patients demonstrated a higher prevalence of hepatic encephalopathy, ascites, and recurrent decompensation compared with non-sarcopenic patients. Hepatic encephalopathy was observed significantly more frequently among patients with sarcopenia Table 4.

Table 4. Association Between Sarcopenia and Liver-Related Complications (n = 90)

Clinical complication	Sarcopenic (n=35)	Non-sarcopenic (n=55)	p-value
Ascites	27 (77.1%)	25 (45.5%)	0.003
Hepatic encephalopathy	16 (45.7%)	10 (18.2%)	0.008
Variceal bleeding	10 (28.6%)	8 (14.5%)	0.102
Recurrent decompensation	20 (57.1%)	17 (30.9%)	0.018

During follow-up, hospitalization due to liver-related complications occurred more frequently among sarcopenic patients. A total of 23 (65.7%) sarcopenic patients required hospitalization compared with 22 (40.0%) non-sarcopenic patients, demonstrating a significant association between reduced muscle mass and hospitalization risk Table 5, Figure 2

Table 5. Association Between Sarcopenia and Hospitalization Among Patients with CLD (n = 90)

Hospitalization status	Sarcopenic (n=35)	Non-sarcopenic (n=55)	p-value
Hospitalized	23 (65.7%)	22 (40.0%)	0.020
Not hospitalized	12 (34.3%)	33 (60.0%)	

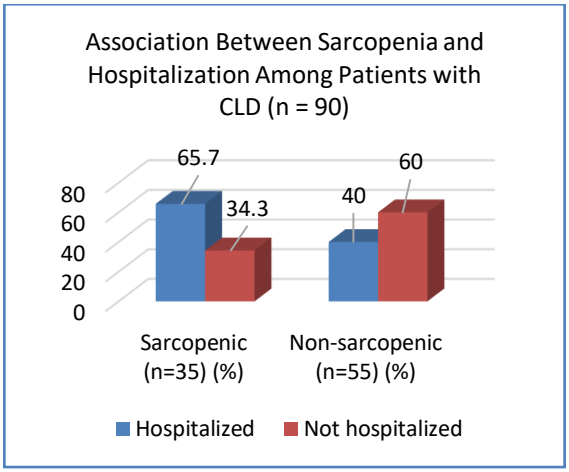

Figure 2 Association Between Sarcopenia and Hospitalization Among Patients with CLD (n = 90)

The relationship between sarcopenia and short-term outcomes is summarized in Table 6. Patients with sarcopenia demonstrated higher mortality and adverse clinical outcomes compared with non-sarcopenic patients. Mortality was observed in 6 (17.1%) sarcopenic patients compared with 3 (5.5%) non-sarcopenic patients; however, the difference did not reach statistical significance Table 6, Figure 3

Table 6. Association Between Sarcopenia and Clinical Outcomes (n = 90)

Outcome	Sarcopenic (n=35)	Non-sarcopenic (n=55)	p-value
Mortality	6 (17.1%)	3 (5.5%)	0.074

Hepatic encephalopathy-related admission	14 (40.0%)	9 (16.4%)	0.016
ICU admission	8 (22.9%)	5 (9.1%)	0.074
Overall adverse outcome	21 (60.0%)	19 (34.5%)	0.021

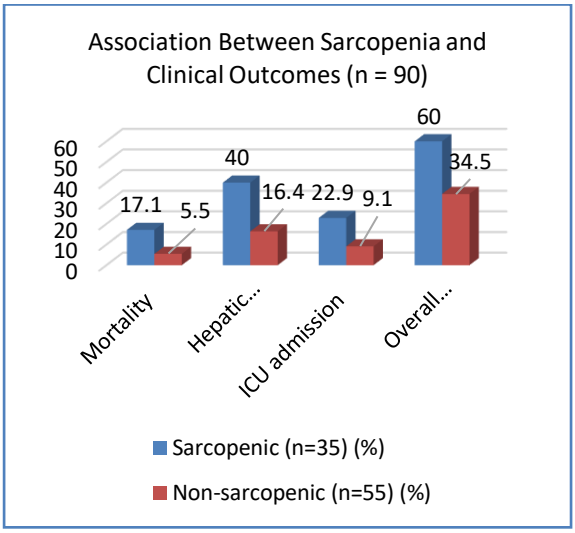

Figure 3 Association Between Sarcopenia and Clinical Outcomes (n = 90)

Discussion

Chronic liver disease (CLD) is associated with metabolic disturbances, nutritional impairment, and progressive skeletal muscle loss. Sarcopenia has emerged as an important extrahepatic complication of cirrhosis and an independent predictor of disease severity and adverse outcomes. The present study evaluated the prevalence of sarcopenia among patients with chronic liver disease and assessed its association with liver disease severity, complications, hospitalization, and prognosis. In the present study involving 90 patients with chronic liver disease, sarcopenia was identified in 35 patients (38.9%) using CT-based skeletal muscle index (SMI) assessment. This prevalence is consistent with previous reports, where sarcopenia among cirrhotic patients has been reported in approximately 30–70% of cases depending on diagnostic criteria and disease severity. Tantai et al. [12], in a meta-analysis including 22 studies with 6965 cirrhotic patients, reported an overall sarcopenia prevalence of 37.5%, with higher occurrence among males, alcohol-related liver disease, and advanced Child–Pugh classes. The comparable prevalence observed in our study highlights the significant burden of sarcopenia among patients with CLD. In our study, sarcopenia was predominantly observed among males and patients with advanced liver disease. Male predominance may be explained by differences in baseline muscle mass, higher prevalence of alcohol-related liver disease, and greater exposure to catabolic factors associated with cirrhosis. Similar findings were reported by Tantai et al. [12], who demonstrated a higher prevalence of sarcopenia among male patients with cirrhosis. A significant association was observed between sarcopenia and severity of liver dysfunction. Sarcopenic patients had significantly higher CTP scores (9.1 ± 1.8 vs 7.3 ± 1.6; $p<0.001$) and MELD scores (17.8 ± 5.4 vs 12.6 ± 4.3; $p<0.001$) compared with non-sarcopenic patients. Additionally, sarcopenia was more frequent among patients with Child–Pugh class C disease (34.3% vs 12.7%; p=0.018). These findings suggest that progressive hepatic dysfunction is associated with accelerated muscle depletion. Hanai et al. [13] demonstrated progressive skeletal muscle loss with worsening cirrhosis severity, reporting annual muscle area decline of −1.3%, −3.5%, and −6.1% in Child–Pugh class A, B, and C patients, respectively. The relationship between sarcopenia and advanced liver disease is multifactorial. Cirrhosis causes reduced glycogen storage, increased proteolysis, altered amino acid metabolism, chronic inflammation, and hormonal imbalance, resulting in accelerated muscle wasting. Skeletal muscle contributes significantly to ammonia detoxification; therefore, muscle depletion reduces ammonia clearance and increases the risk of hepatic encephalopathy. In the present study, hepatic encephalopathy was significantly higher among sarcopenic patients (45.7% vs 18.2%; p=0.008). Previous studies have similarly demonstrated that sarcopenia increases the risk of hepatic encephalopathy and contributes to poor clinical outcomes in cirrhosis. Sarcopenia was also significantly associated with liver-related complications in our study. Ascites was more frequent among sarcopenic patients (77.1% vs 45.5%; p=0.003), and recurrent hepatic decompensation was significantly higher in the sarcopenic group (57.1% vs 30.9%; p=0.018). Reduced muscle mass reflects poor physiological reserve and may predispose patients to infections, metabolic stress, and impaired recovery from acute complications. Hospitalization rates were significantly higher among sarcopenic patients (65.7% vs 40.0%; p=0.020). Similar findings were reported by Kenchappa et al. [14], who demonstrated that sarcopenia was associated with increased hospitalization and poorer prognosis among patients with chronic liver disease. Increased hospitalization among sarcopenic patients may be attributed to a higher frequency of hepatic encephalopathy, ascites-related complications, and

reduced tolerance to acute illness. Although mortality was higher among sarcopenic patients in the present study (17.1% vs 5.5%), the difference did not reach statistical significance (p=0.074), likely due to the limited sample size and follow-up duration. However, the observed trend supports previous evidence. Tantai et al. [12] reported that sarcopenia was independently associated with increased mortality among cirrhotic patients, with a pooled adjusted hazard ratio of 2.30 (95% CI: 2.01–2.63). Li et al. [15] further emphasized the prognostic importance of CT-based muscle assessment, reporting sarcopenia in 55.6% of 171 patients with acute-on-chronic liver failure using L3-SMI measurement. The present study highlights that sarcopenia is not merely a marker of malnutrition but an important determinant of disease severity and prognosis in chronic liver disease. Incorporating skeletal muscle assessment into routine CLD evaluation may improve identification of high-risk patients and facilitate early nutritional and rehabilitative interventions. Overall, sarcopenia was common among patients with chronic liver disease and was significantly associated with higher CTP and MELD scores, increased hepatic complications, hospitalization, and adverse clinical outcomes. Early recognition and management of sarcopenia may improve risk stratification and clinical care in patients with CLD.

Conclusion

Sarcopenia was a common finding among patients with chronic liver disease and was significantly associated with advanced liver disease severity, higher CTP and MELD scores, and increased frequency of hepatic complications. Patients with sarcopenia demonstrated higher rates of hospitalization and adverse clinical outcomes compared with non-sarcopenic patients. Assessment of skeletal muscle mass using CT-based SMI provides valuable prognostic information beyond conventional liver disease scoring systems. Early identification and management of sarcopenia may help improve risk stratification and guide nutritional and rehabilitative interventions in patients with chronic liver disease.

Limitations

The study was limited by its single-center design and relatively small sample size, which may restrict the generalizability of the findings. The follow-up duration was limited, preventing assessment of long-term outcomes and survival. Although CT-based skeletal muscle assessment provides objective evaluation of sarcopenia, functional parameters such as muscle strength and physical performance were not evaluated. Further multicentric studies with larger cohorts and longer follow-up are required to validate these findings.

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