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ORIGINAL ARTICLE

Correlation of Sarcopenia with Etiologies of Liver Cirrhosis and Its Association with Child-Pugh and MELD Scores

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Abstract

Background: Sarcopenia, defined by the progressive decline in muscle mass and strength, is a common yet often overlooked complication in individuals with liver cirrhosis. The extent of muscle loss varies based on the underlying cause of cirrhosis and may impact overall disease progression. While the Child-Pugh (CPS) and Model for End-Stage Liver Disease (MELD) scores are standard tools for assessing liver disease severity, their relationship with sarcopenia remains uncertain. **Aim:** This study aims to investigate the correlation between sarcopenia and various etiologies of liver cirrhosis and examine its association with CPS and MELD scores. **Discussion:** The prevalence of sarcopenia varies among different causes of cirrhosis, with alcohol-related and viral cirrhosis frequently linked to greater muscle depletion. A higher CPS and MELD score is often associated with severe sarcopenia, indicating poorer clinical outcomes and increased disease burden. **Conclusion:** Recognizing sarcopenia in cirrhotic patients can improve risk assessment and treatment strategies. Early identification and targeted interventions, including nutritional support and physical rehabilitation, may help mitigate its impact and improve patient outcomes.

Keywords: CPS, MELD, Sarcopenia, cirrhosis.

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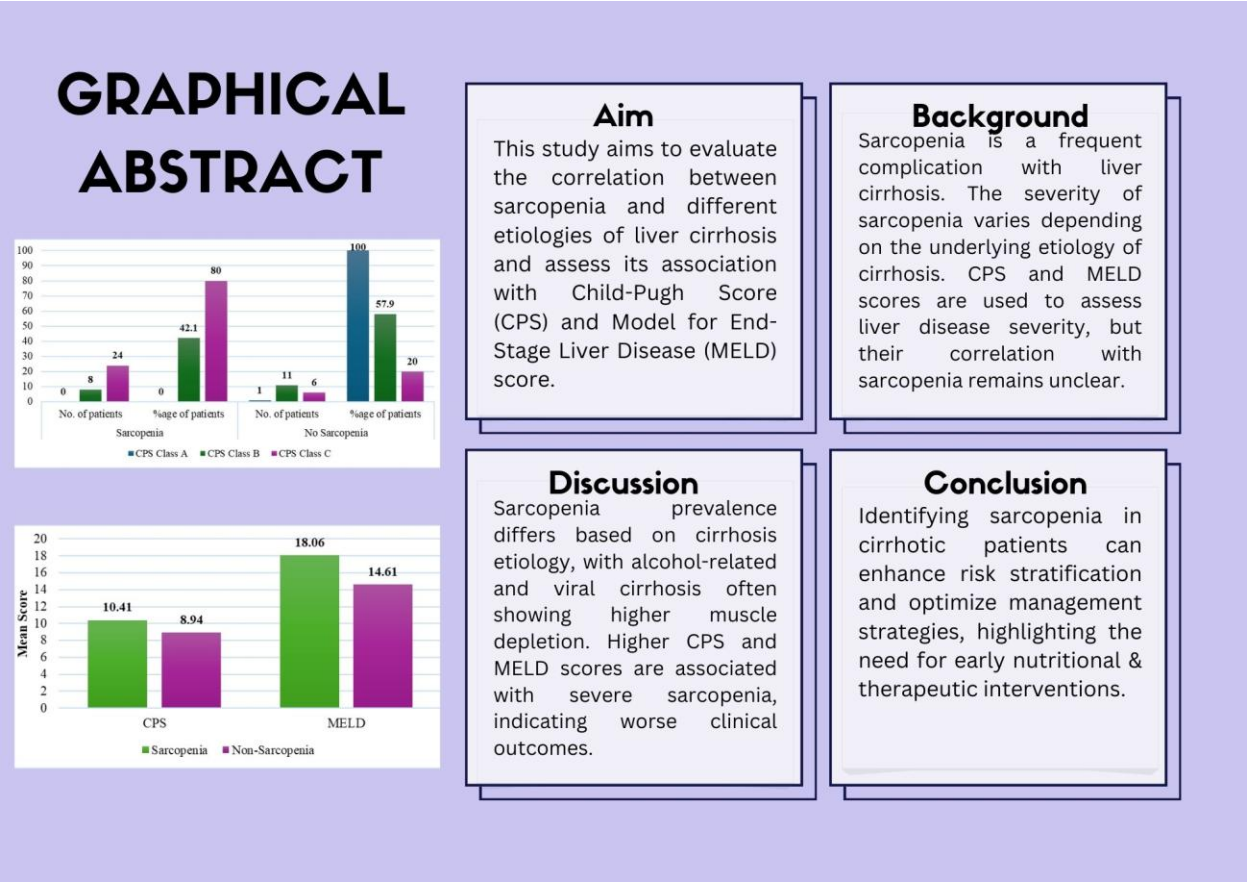
Abbreviations

ALD	:	Alcoholic Liver Disease
CPS	:	Child Pugh Score
NAFLD	:	Non-Alcoholic Fatty Liver Disease
HCV	:	Hepatitis C Virus
INR	:	International Normalized Ratio
HBV	:	Hepatitis B Virus
MELD	:	Model for End-Stage Liver Disease

Graphical Abstract



Introduction

Liver cirrhosis is a progressive condition leading to the result of fibrosis, hepatocellular dysfunction, and portal hypertension. Causative factors are like viral hepatitis, alcohol-related liver disease, autoimmune liver disorders and non-alcoholic fatty liver disease (NAFLD). Among the numerous complications of cirrhosis, sarcopenia—defined as the loss of skeletal muscle mass and strength—has emerged as a critical determinant of disease progression and patient outcomes. Sarcopenia not only contributes to increased morbidity and mortality but also influences

liver transplant eligibility and post-transplant prognosis [1].

The severity of cirrhosis is commonly assessed using Child-Pugh Score (CPS) and Model for End-Stage Liver Disease (MELD) Score, both of which help in predicting survival and guiding treatment decisions. However, their correlation with sarcopenia remains an area of growing clinical interest. Evidence suggests that sarcopenia is more prevalent in advanced liver disease, and its severity may vary depending on the underlying etiology of cirrhosis [2].

Understanding the relationship between sarcopenia, different causes of cirrhosis, and liver disease severity scores can aid in better risk stratification and management of cirrhotic patients. Early identification and intervention for sarcopenia could potentially improve functional status, reduce complications, and enhance overall survival in this vulnerable patient population.

Liver cirrhosis and Sarcopenia

Cirrhosis is the end-stage of liver damage characterized by progressive fibrosis, hepatocellular dysfunction, and altered hepatic architecture, leading to portal hypertension and liver failure. It occurs due to persistent liver injury caused by various etiologies, like viral infections (HBV and HCV), alcohol-related liver disease, NAFLD, autoimmune hepatitis, and metabolic disorders [3]. It disrupts metabolic processes, often leading to muscle wasting and malnutrition, which together contribute to sarcopenia [4]. Sarcopenia is characterized by a decline in skeletal muscle mass, strength, and function and is now recognized as a significant complication in patients with cirrhosis. Its presence is associated with poorer clinical outcomes, reduced quality of life, and increased mortality risk in affected individuals [5]. The prevalence of sarcopenia in cirrhosis is influenced by the underlying etiology. The pathogenesis of sarcopenia in cirrhosis is multifactorial. Chronic inflammation, hypermetabolism, impaired protein synthesis, and hormonal imbalances contribute to progressive muscle loss [6]. Additionally, insulin resistance, reduced physical activity, and malabsorption of essential nutrients exacerbate sarcopenia in these patients. The severity of cirrhosis, often assessed using CPS and MELD scores, correlates with worsening sarcopenia, as higher scores indicate more advanced liver dysfunction and nutritional deficits [7].

Identifying sarcopenia in cirrhotic patients is crucial, as it is associated with increased risk of infections, prolonged hospital stays, and higher mortality rates. Early nutritional interventions, physical therapy, and targeted therapies aimed at preserving muscle mass may help improve clinical outcomes and quality of life [8].

Methodology

This observational study was conducted on 50 patients diagnosed with liver cirrhosis, including both outpatients and inpatients admitted to the medical wards of the Department of Medicine at Adesh medical college and hospital. The selection of patients was made irrespective of the underlying cause of cirrhosis.

Inclusion Criteria:

- Age: 18-65 years
- Confirmed liver cirrhosis

- Written informed consent given

Exclusion Criteria:

- <18 years or >65 years
- Malignancy
- Thyroid disorders
- Retrovirus positive
- Malabsorption syndromes
- Advanced heart, lung, neuromuscular diseases or kidney failure

CPS and MELD scores

The CPS and MELD scores are widely used tools to assess the severity and prognosis of liver cirrhosis. These scoring systems help guide clinical decision-making, including treatment strategies, liver transplant eligibility, and risk stratification.

The Child-Pugh Score has five parameters:

- Presence of ascites
- Hepatic encephalopathy.
- Serum total bilirubin
- Serum albumin
- INR

Each parameter is scored between 1 to 3, and the total score categorizes patients into:

- Class A (score 5–6): **MILD**
- Class B (score 7–9): **MODERATE**
- Class C (score 10–15): **SEVERE**

with higher scores indicating worse liver function [9].

The MELD Score is a more objective tool used primarily for prioritizing liver transplant candidates. Higher MELD scores indicate a greater risk of mortality within three months, making it crucial for transplant allocation. While both scoring systems provide valuable prognostic information, MELD is more accurate for predicting short-term survival, whereas Child-Pugh helps in assessing overall liver function and clinical management [10].

MRI-Based Sarcopenia Assessment

Magnetic Resonance Imaging is a highly precise method for evaluating muscle mass in sarcopenia. Using a 1.5 Tesla Siemens Magnetom Aera, the third lumbar vertebral (L3) level is identified as the standard site for muscle mass measurement [11]. At this level, various muscles, including the psoas, paraspinals, transversus abdominis, rectus abdominis, and internal and external obliques, are assessed. The cross-sectional area of these muscles is measured and normalized to height squared to provide a standardized value. Sarcopenia is diagnosed when the L3 muscle area falls below 52.4 cm^2/m^2 in males and 38.5 cm^2/m^2 in females.

Handgrip Strength Based Sarcopenia Measurement

Handgrip strength is a functional measure of muscle strength, assessed using a mechanical handgrip dynamometer. Patients were seated comfortably, and the dynamometer handle was adjusted accordingly. They were instructed to hold the device away from their body and, using their non-dominant hand, squeeze the handle with maximum effort.

Three separate measurements were taken, with at least 30 seconds between each attempt, and the average value in kilograms is recorded [12].

Results

The age distribution of patients with liver cirrhosis is shown in Table 1**,** with ages ranging from 21 to 70 years**.** The highest prevalence was in the 41–50 years group (40%)**,** followed by 31–40 years (22%) and 51–60 years (18%)**.** The 21–30 years group had the lowest prevalence (6%).

The mean age was 47.22 ± 10.845 years, indicating that middle-aged individuals are most affected**,** highlighting the need for targeted screening and preventive measures in this population.

Table 1. Age distribution

Age Group	No. of patients	%age
21 – 30 years	3	6
31 – 40 years	11	22
41 – 50 years	20	40
51 – 60 years	9	18
61 – 70 years	7	14

Table 2. Association of Alcoholic liver disease with sarcopenia

Alcoholic liver disease	Total	Sarcopenia		No Sarcopenia		p-value
	No. of patients	No. of patients	%age of patients	No. of patients	%age of patients	
ALD	32	23	71.9%	9	28.1%	0.007
No ALD	18	9	50%	9	50%	
Total	50	32	64%	18	36%	

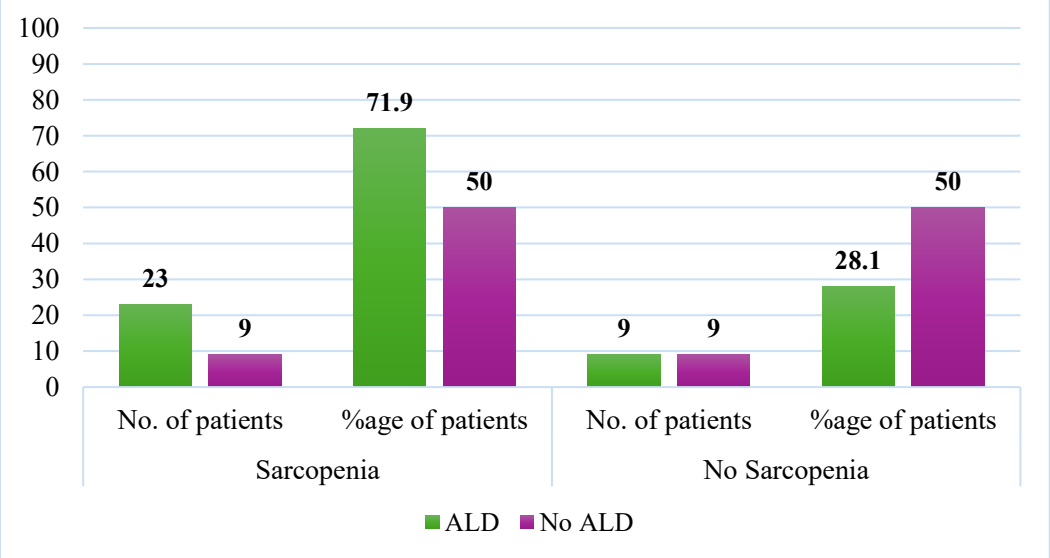


Figure 1. Bar chart showing prevalence of sarcopenia in alcoholic liver disease

Table 2 and Figure 1 presents data on the prevalence of sarcopenia among patients with liver cirrhosis, categorized based on the presence or absence of ALD. A total of 50 patients, 32 diagnosed with ALD and 18 without ALD were included. Among the ALD group (n=32), 23 patients (71.9%) were found to have sarcopenia, while 9 patients (28.1%) did not exhibit sarcopenia. In contrast, among the non-ALD group (n=18),

sarcopenia was observed in 9 patients (50%), while the remaining 9 patients (50%) did not have sarcopenia. The overall prevalence of sarcopenia in the study population was 64% (32 out of 50 patients), whereas 36% (18 out of 50 patients) did not have sarcopenia. The p-value (0.007) indicates a statistically significant association.

Table 3. Association of HBV with sarcopenia

HBV	Total	Sarcopenia		No Sarcopenia		p-value
	No. of patients	No. of patients	%age of patients	No. of patients	%age of patients	
Non-reactive	46	31	67.4%	15	32.6%	0.09
Reactive	4	1	25%	3	75%	
Total	50	32	64%	18	36%	

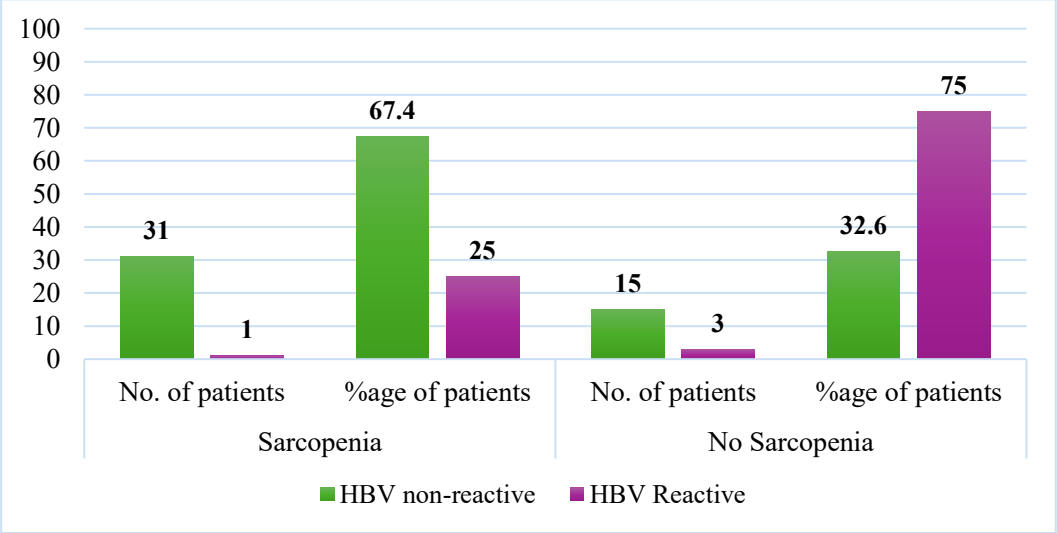


Figure 2. Bar chart showing prevalence of sarcopenia in chronic HBV infection

Table 3 and figure 2 presents the correlation between HBV status and sarcopenia in patients with liver cirrhosis. The study categorized patients based on their HBV reactivity. Among 46 non-reactive patients, 31 (67.4%) had sarcopenia, while 15 (32.6%) did not. In contrast, among the 4 HBV-reactive patients, only 1 (25%) had sarcopenia, whereas 3 (75%) did not. The statistical analysis revealed a p-value of 0.03, indicating a significant association.

Table 4. Distribution of patients according to HCV reactivity

HCV	Total	Sarcopenia		No Sarcopenia		p-value
	No. of patients	No. of patients	%age of patients	No. of patients	%age of patients	
Non-reactive	36	24	66.7%	12	33.3%	0.02
Reactive	14	9	64.3%	5	35.7%	
Total	50	33	66%	17	34%	

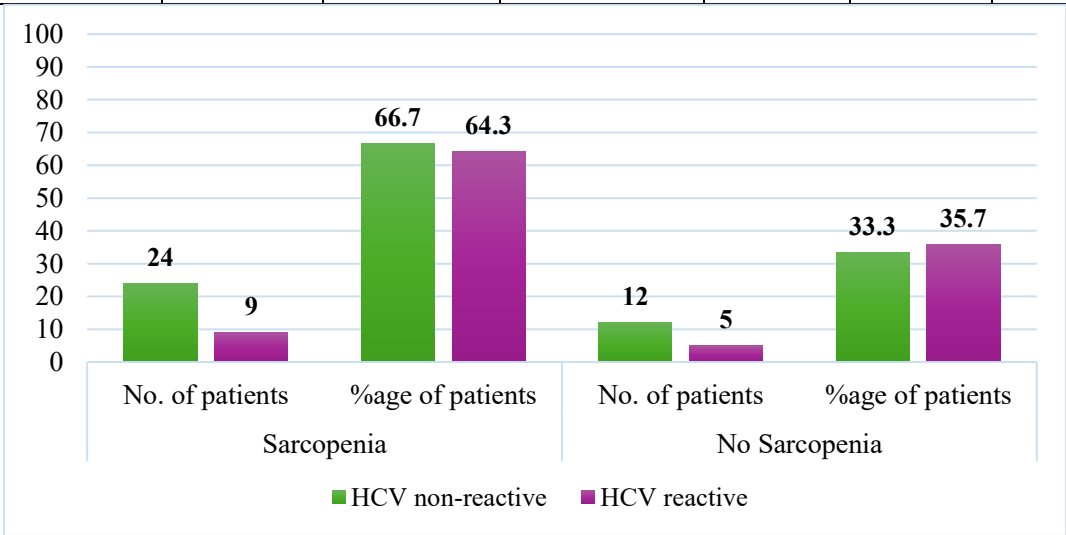


Figure 3. Bar chart showing prevalence of sarcopenia in chronic HCV infection

Table 4 and figure 3 present the correlation between HCV status and sarcopenia among with liver cirrhosis. The cohort was divided into HCV reactive and non-reactive groups, with their respective sarcopenia prevalence analyzed. Among 36 HCV non-reactive patients, 24 (66.7%) had sarcopenia, while 12 (33.3%) did not. In contrast, out of 14 HCV reactive patients, 9 (64.3%) were sarcopenic, and 5 (35.7%) were not. The overall sarcopenia prevalence in the study population was 66% (33 patients), while 34% (17 patients) did not have sarcopenia. The p-value of 0.02 suggests a statistically significant association, indicating that HCV may contribute to muscle loss in cirrhotic patients.

Table 5: Association of Sarcopenia with Child Pugh score

Child Pugh Score	Total	Sarcopenia		No Sarcopenia		p-value
	No. of patients	No. of patients	%age of patients	No. of patients	%age of patients	
Class A	1	0	.0%	1	100%	0.01
Class B	19	8	42.1%	11	57.9%	
Class C	30	24	80%	6	20%	

Total	50	32	64%	18	36%	

Table 5 and figure 4 presents the distribution of sarcopenia among patients with different Child-Pugh classifications. Out of 50 cirrhotic patients, 32 (64%) had sarcopenia, while 18 (36%) did not. The prevalence of sarcopenia increased with worsening liver function.

- In Class A (mild cirrhosis), only one patient was included, who did not have sarcopenia (0% prevalence).
- In Class B (moderate cirrhosis), 19 patients were analyzed, with 8 (42.1%) having sarcopenia, while 11 (57.9%) did not.
- In Class C (severe cirrhosis), 30 patients were assessed, with 24 (80%) diagnosed with sarcopenia, and only 6 (20%) without it.

A statistically significant association (p-value = 0.01) was observed, indicating that sarcopenia is more prevalent in advanced cirrhosis (Class C) compared to milder forms.

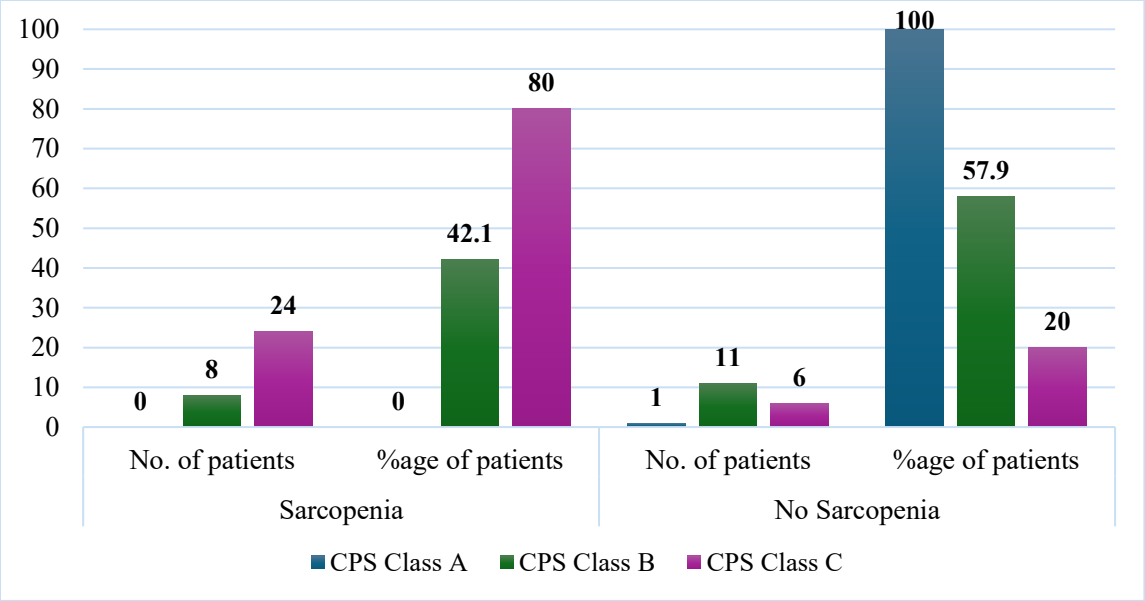


Figure 4. Bar chart showing correlation of sarcopenia with Child-Pugh score

Table 6: Comparing CPS and MELD scores with sarcopenia

	Total	Sarcopenia	Non-Sarcopenia	p-value
CPS	9.88±1.7	10.41±1.58	8.94±1.69	0.004
MELD	16.82±6.19	18.06±5.358	14.61±7.08	0.05

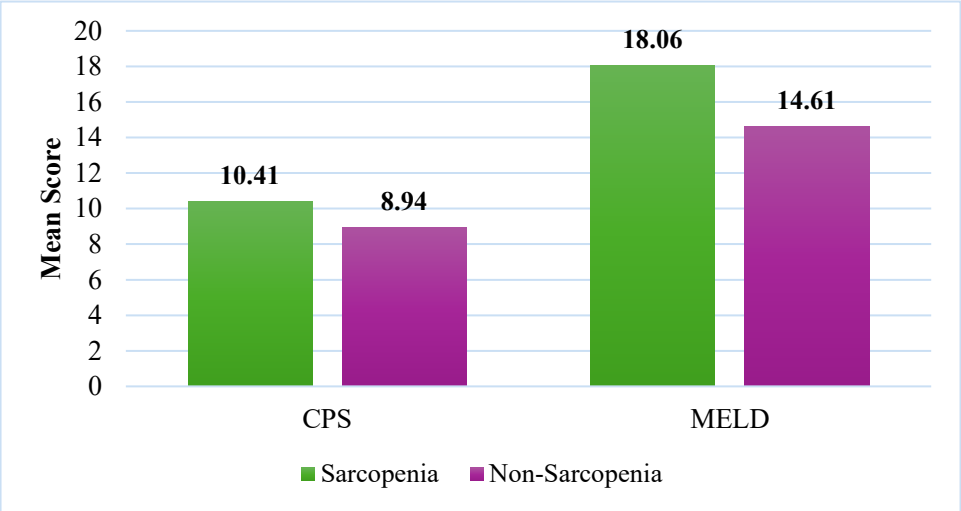


Figure 5. Bar chart showing correlation of mean CPS and MELD scores with sarcopenia

Table 6 and figure 5 compares CPS and MELD scores between patients with and without sarcopenia.

- The mean CPS was higher in sarcopenic patients (10.41 ± 1.58) compared to non-sarcopenic patients (8.94 ± 1.69), with a statistically significant p-value of 0.004, indicating a strong correlation between worsening liver function and sarcopenia.
- Similarly, the mean MELD score was higher in the sarcopenia group (18.06 ± 5.358) compared to the non-sarcopenia group (14.61 ± 7.08), with a p-value of 0.05, suggesting a significant association.

Discussion

This study highlights a strong correlation between sarcopenia and liver cirrhosis severity. The highest prevalence was seen in middle-aged individuals (41–50 years), emphasizing the need for early screening.

Alcoholic liver disease (ALD) showed a significant association with sarcopenia (71.9% vs. 50%, p = 0.007), consistent with studies linking ALD to malnutrition and muscle loss. HCV-reactive patients also had a higher prevalence of sarcopenia (64.3%), with a significant p-value (0.02), while HBV showed a weaker correlation (p = 0.09).

Sarcopenia's prevalence increased with worsening CPS class, from 0% in Class A to 80% in Class C (p = 0.01), reflecting disease progression. Higher CPS (10.41 vs.

8.94, p = 0.004) and MELD scores (18.06 vs. 14.61, p = 0.05) in sarcopenic patients further confirm this trend.

Conclusion

This study highlights a significant correlation between sarcopenia and liver cirrhosis, with its prevalence increasing as liver function deteriorates. Patients with higher Child-Pugh and MELD scores showed a greater incidence of sarcopenia, emphasizing the role of liver dysfunction in muscle loss. The findings suggest that early identification and management of sarcopenia in cirrhotic patients could improve clinical outcomes and quality of life.

Strengths and limitations

This study highlights the clinically significant association between sarcopenia and the severity of liver cirrhosis, as evaluated through Child-Pugh and MELD scores, and further explores its correlation with different etiologies. A major strength of the study lies in its use of objective tools for sarcopenia assessment, allowing for more accurate stratification. Additionally, the inclusion of multiple cirrhotic etiologies adds depth to the findings. However, the study is limited by its relatively small sample size and cross-sectional design, which restrict causal inferences. Moreover, potential confounding factors such as dietary intake, physical activity, and comorbid conditions were not fully controlled.

Future Scope

Further research is needed to explore the underlying mechanisms linking sarcopenia and liver disease across different etiologies. Future longitudinal studies exploring the effects of nutritional strategies, physical rehabilitation, and pharmacological treatments on muscle preservation and liver disease progression could offer significant insights. Furthermore, incorporating advanced imaging modalities for muscle mass evaluation and establishing standardized screening protocols may facilitate early identification and targeted management of sarcopenia in patients with liver cirrhosis.

Statements and Declarations

Conflicts of interest

The authors declare that they do not have conflict of interest.

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