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Research Article

A Practical Approach to Assessing Sarcopenia in Patients with Chronic Liver Disease: Hand-Circle and Finger-O-Ring Tests

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Abstract

Sarcopenia, characterized by a loss of muscle mass, strength, and performance, is prevalent among patients with chronic liver disease. Due to the limitations of current muscle measurement methods in accurately assessing this condition, faster and more reliable alternatives to current muscle measurement methods are necessary.

This analytical cross-sectional study included 58 patients (median age: 60.66 years, 63.8% male) with Chronic Liver Disease (aged 18-90) who visited the Mersin University Faculty of Medicine Gastroenterology outpatient clinic between 01/06/2021 and 01/05/2022. Child-Pugh, MELD, CONUT, eLIFT, and Liver Frailty Index (LFI) were calculated for the patients. The ASMI (Appendicular Skeletal Muscle Mass Index) was measured using Bioelectrical Impedance Analysis, and muscle strength was assessed with hand dynamometry. The Hand-Circle and Finger-O-Ring tests were also performed.

Patients were classified as having low or normal muscle mass based on ASMI, with muscle mass assessed using the Hand-Circle Test. In the low ASMI group, 16.2% were identified as having “low muscle mass,” while none in the normal ASMI group fell into this category. The difference was statistically significant ($p < 0.001$).

Patients were divided into “frail,” “pre-frail,” and “robust” groups according to the LFI and then evaluated using the Finger-O-Ring Test. According to the Finger-O-Ring Test, 55.6% of frail patients were classified as "weak," 17.4% of pre-frail patients were classified as "weak," and 100.0% of robust patients were found to be "normal." This difference was statistically significant ($p = 0.033$).

The Hand-Circle Test revealed that 22.2% of frail patients and 8.7% of pre-frail patients had low muscle mass, while 66.7% of robust patients had sufficient muscle mass and 33.3% had excessive muscle mass ($p = 0.471$).

This study introduces two rapid and effective methods to evaluate sarcopenia in patients with chronic liver disease.

Keywords: Chronic Liver Disease; Sarcopenia; Hand-Circle Test; Finger-O-Ring Test

Abbreviations

MELD: Model for End-Stage Live Disease; CONUT score: Controlling Nutritional Status; eLIFT: easy Liver Fibrosis Test; INR: International Normalised Ratio; LFI: Liver Frailty Index; ASMI: Appendicular Skeletal Muscle Index; BIA: Bioelectricial Impedance Analysis; BDORT: BiDigital O-Ring Test; ALD: Alcohol-Associated Chronic Liver Disease

Introduction

Chronic liver disease is defined as a disorder persisting for 6 months or more and may result from various causes, including hepatotropic viruses, autoimmunity, alcohol, metabolic disorders, and other less common factors [1].

Sarcopenia is a progressive and generalised skeletal muscle disorder that is associated with increased likelihood of adverse outcomes including falls, fractures, physical disability and mortality. According to the updated definition by the European Working Group on Sarcopenia in Older People (EWGSOP2), low muscle strength is considered the primary diagnostic criterion, with low muscle mass and/or low physical performance serving as confirmatory factors [2]. Factors such as endocrine changes, activation of pro-inflammatory cytokines, reduction in alpha motor neurons in the spinal cord, decreased physical activity, and insufficient protein intake may contribute to the pathogenesis of sarcopenia. It is frequently associated with comorbidities, including osteoporosis, obesity, and cancer [3], where sarcopenia may be a secondary effect of an underlying pathological condition.

Chronic liver disease can progress to cirrhosis, which is characterized by extensive hepatic fibrosis [4]. Sarcopenia is a notable complication in cirrhosis, as it is in many conditions associated with the disease. Malnutrition is also frequently observed in cirrhotic patients [5].

Portal hypertension, a consequence of liver disease, contributes to dietary malabsorption, which in turn leads to hepatocellular dysfunction, impaired albumin synthesis, and disrupted amino acid metabolism [6]. Factors contributing to sarcopenia in cirrhosis include hormonal and biochemical changes, endotoxins, ascites, reduced mobility, and decreased nutrient intake. Patients with sarcopenia and cirrhosis demonstrate reduced physical capacity, which significantly limits their ability to perform daily activities. This population also faces a higher mortality risk due to an increased likelihood of falls [7,8].

Several scoring systems are used to assess the severity and prognosis of cirrhosis, including the Child-Pugh and MELD scores. The Child-Pugh score incorporates factors such as ascites, bilirubin, albumin, INR, and encephalopathy [9,10]. The MELD score was developed to prioritize patients awaiting liver transplantation.

Several methods have been proposed for assessing sarcopenia, such as imaging techniques, anthropometric measurements, muscle strength tests, and physical performance tests [11]. Among these, BIA has shown comparable results to CT and MRI, which are considered gold-standard methods for assessing muscle mass [12]. Due to its practicality and accessibility, BIA is widely utilized in current studies as an alternative method for sarcopenia assessment [13,14].

Frailty is a clinical syndrome of aging-related dysregulation of multiple physiologic systems leading to loss of physiologic reserve and thus markedly increased vulnerability to stressors with increased risk of adverse health outcomes [15]. In the aging cirrhosis population, the combination of aging and age-related comorbidities (e.g., diabetes mellitus, sarcopenia, and coronary artery disease) further exacerbates these adverse outcomes. Sarcopenia constitutes a significant component of frailty. Frailty negatively impacts morbidity, length of hospital stay, days in the intensive care unit, and mortality among patients on the liver transplant waiting list [16].

The hand-circle test (also known as Yubi-Wakka test) assesses whether the maximum circumference of the calf on the non-dominant leg, measured while seated, exceeds the circumference of a circle formed by the individual's index fingers and thumbs figure 1. Based on the hand-circle test, patients are categorized into three groups: bigger, just fit, and smaller [17].

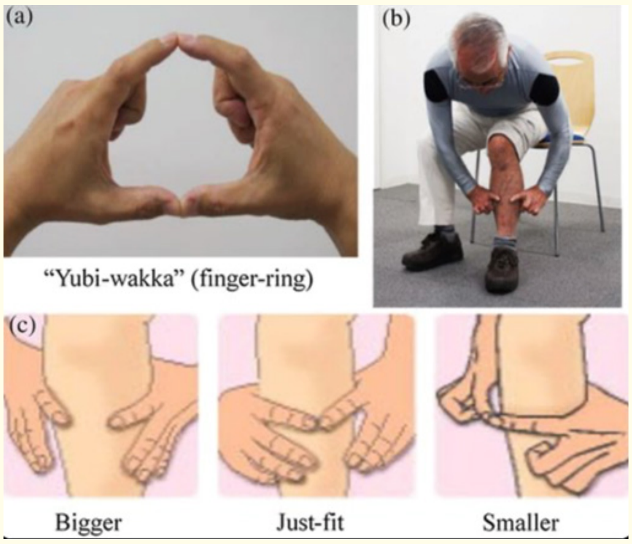

Figure 1: Application of hand-circle test.

The Finger-O-Ring test (also known as Yubi-Wakka test) is a diagnostic method wherein the patient forms a circular ring with their thumb and index finger, which allows the examiner to assess muscle strength reduction within this ring figure 2 [18]. During the test, a different object is placed in the patient's inactive hand [19].

Our primary aim was to compare the efficacy of two simple and rapid physical examination methods, the 'Hand-Circle Test' and the 'Finger-O-Ring Test', with other standardized tests (BIA and hand grip) that have proven their efficacy in assessing muscle strength and muscle mass to determine sarcopenia.

Material and Methods

This study included 58 patients with Chronic Liver Disease who presented to the outpatient clinic of Gastroenterology Department of Mersin University Faculty of Medicine between 01/06/2021 and 01/05/2022. Ethical approval was obtained from the Clinical Research Ethics Committee of Mersin University on June 23, 2021, with approval number 453.

Figure 2: Application of Finger-O-Ring test.

Inclusion criteria for the study were as follows: diagnosis of chronic liver disease, age between 18 and 90 years, presentation to the Gastroenterology Outpatient Clinic of Mersin University Faculty of Medicine Hospital, signing an informed consent form, and absence of pregnancy, edema or conditions that could interfere with BIA measurements, such as the presence of metal implants (e.g., prostheses, pacemakers) or limb amputation. All patients were asked to read and sign the informed consent form.

All participants had their height, weight, body mass index (BMI), and appendicular skletal muscle mass measured using a Tanita BC-418 bioimpedance analysis device (™Tanita BC-418, Japan). In our study, the ASMI (kg/m^2) cutoff values for the Turkish population were set at <10.8 kg/m^2 for men and <8.9 kg/m^2 for women [20]. Participants with ASMI values below these thresholds were classified as having low ASMI. The five-time chair stand test and standing balance tests in three different positions (tandem, semi-tandem, and side-by-side), which are parameters of the Liver Frailty Index, were administered [4]. For the five-time chair stand test, participants were instructed to sit on a standard chair (seat height approximately 43-48 cm), cross their arms over their chest, and rise from the chair to a fully standing position before sitting down again, repeating this movement five times as quickly as possible. The total time required to complete the five repetitions was recorded, with longer durations indicating reduced lower limb strength and impaired physical performance [21]. Hand grip strength was measured using a hand dynamometer (Takei T.K.K 5401, Japan), and the Finger-O-Ring and Hand Circle tests were conducted. In the Finger-O-Ring Test, the patient is asked to encircle the thickest part of their non-dominant calf using the index finger and thumb of their dominant hand. If the fingers overlap, the test is considered positive, indicating possible muscle mass loss. In the Hand-Circle Test, the patient attempts to form a circle around their wrist using the same hand's thumb and index finger. If the fingers overlap, this suggests potential sarcopenia [18,19]. The Appendicular Skeletal Muscle Index (ASMI) was calculated, and the Child-Pugh, MELD, CONUT, and eLIFT scores were determined for each patient.

Data were analysed by using STATISTICA 13 software. The concordance coefficient for the study objective was found to be -0.017. Based on a Type I error rate of 5% and a power of 80%, the sample size was calculated to include 44 individuals. Results were summarized using mean, standard deviation, minimum, maximum, median, first quartile, third quartile, count, and percentage. A significance level of $p < 0.05$ was considered statistically significant.

Results

A total of 58 patients with chronic liver disease who presented to the gastroenterology clinic were included in the study during the specified period. Table 1 shows the general characteristics of the patients. Of these patients, 36% were female (n = 21) and 63.8% were male (n = 37). The mean age of the patients was 60.66 ± 10.8 years.

Among the cirrhotic patients, according to the Child-Pugh classification, 82.8% (n = 48) were classified as Child A, 12.1% (n = 7) as Child B, and 5.2% (n = 3) as Child C.

In terms of the eLIFT score, 60.3% of the patients (n = 35) had a high eLIFT score, while 39.7% (n = 23) had a low eLIFT score.

Based on the muscle mass index calculated using ASMI, 63.8% of the patients (n = 37) were classified as "low ASMI," and 36.2% (n = 21) were classified as "normal ASMI."

According to the Hand Circle Test, 10.3% of the patients (n = 6) were classified as having "low muscle mass," 37.9% (n = 22) as having "adequate muscle mass," and 51.7% (n = 30) as having "high muscle mass."

According to the Finger-O-Ring Test, 22.4% of the patients (n = 13) were classified as having "weak" muscle strength, while 77.6% (n = 45) were classified as having "normal" muscle strength.

In the Liver Frailty Index assessment, 15.5% of the patients (n = 9) were classified as "frail," 79.3% (n = 46) as "pre-frail," and 5.2% (n = 3) as "robust."

Evaluation of the relationship between child-pugh, meld, conut, and elıft with hand grip strength, asmı, and the liver fra-

	Mean + Standard Deviation	Median
Age	60,66 ± 10,883	60,50 [55,00-69,00]
Height	165,84 ± 8,039	166,50 [160,00-170,00]
Weight	75,07 ± 11,564	74,00 [66,00-82,92]
BMI	27,35 ± 4,430	27,05 [23,45-29,90]
MELD	8,45 ± 3,393	7,00 [6,00-10,00]
BIA Muscle Mass (ASMI)	23,19 ± 4,153	22,50 [20,15-25,87]
Etiology of Chronic Liver Disease	Hepatitis B (50%), Hepatitis C (15.5%), ALD (8.6%), Other (25.8%)	

		Number	Percent
Cirrhosis	No	11	19,0
	Yes	47	81,0
Child	A	48	82,8
	B	7	12,1
	C	3	5,2
eLIFT	High	35	60,3
	Low	23	39,7
CONUT score	High	23	39,7
	Low	35	60,3
ASMI Muscle mass index	Low	37	63,8
	Normal	21	36,2
Hand-Circle Test	Low Muscle Mass	6	10,3
	Adequate Muscle Mass	22	37,9
	High Muscle Mass	30	51,7
Finger-O-Ring Test	Deficient	13	22,4
	Normal	45	77,6
Hand grip	Inadequate Muscle Strength	11	19,0
	Adequate Muscle Strength	47	81,0
Gender	Female	21	36,2
	Male	37	63,8
Liver Frailty Index	Frailty (frail)	9	15,5
	Pre-frail	46	79,3
	Robust	3	5,2

Table 1: General Characteristics of Patients.

ilty ındex

Table 2 shows the comparison of ASMI, Hand Grip Strength, and Liver Frailty Index with Child-Pugh Scoring. According to the hand grip test, 47 patients (81.0%) were classified as having "adequate muscle strength," while 11 patients (18.9%) were classified as having "inadequate muscle strength." Among the patients with "adequate muscle strength," 41 (85.4%) were classified as Child A, 3 (6.4%) as Child B, and 3 (6.4%) as Child C. In contrast, among the patients with "inadequate muscle strength," 7 (63.6%) were classified as Child A, and 4 (36.4%) as Child B. No patients with "inadequate muscle strength" were classified as Child C.

According to the Child-Pugh scoring, among those classified as Child A, 30 patients (62.5%) were identified as "low ASMI", while 18 patients (37.5%) were identified as "normal ASMI." Among those classified as Child B, 4 patients (57.1%) were identified as "low ASMI," and 3 patients (42.9%) as "normal ASMI." Among those classified as Child C, all 3 patients (100%) were identified as "low

			Child-Pugh Score			p value
			A	B	C	
ASMI	Low	Numbers	30	4	3	0,239
		Row Percentages (%)	%81,1	%10,8	%8,1	
		Column Percentages (%)	%62,5	%57,1	%100,0	
	Normal	Numbers	18	3	0	
		Row Percentages (%)	%85,7	%14,3	%0,0	
		Column Percentages (%)	%37,5	%42,9	%0,0	
Hand grip dynamometer	Inadequate muscle strength	Numbers	7	4	0	0,032
		Row Percentages (%)	%63,6	%36,4	%0,0	
		Column Percentages (%)	%14,6	%57,1	%0,0	
	Adequate muscle strength	Numbers	41	3	3	
		Row Percentages (%)	%87,2	%6,4	%6,4	
		Column Percentages (%)	%85,4	%42,9	%100,0	
Liver Frailty Index	Frail	Numbers	6	2	1	0,617
		Row Percentages (%)	%66,7	%22,2	%11,1	
		Column Percentages (%)	%12,5	%28,6	%33,3	
	Pre-Frail	Numbers	39	5	2	
		Row Percentages (%)	%84,8	%10,9	%4,3	
		Column Percentages (%)	%81,3	%71,4	%66,7	
	Robust	Numbers	3	0	0	
		Row Percentages (%)	%100,0	%0,0	%0,0	
		Column Percentages (%)	%6,3	%0,0	%0,0	

Table 2: Comparison of ASMI, Hand Grip Strength, and Liver Frailty Index with Child-Pugh Scoring.

ASMI," with no patients classified as "normal ASMI."

We have found a statistically significant difference between hand grip strength and Child-Pugh score (p = 0.032). Among individuals with "inadequate muscle strength," the proportion of those with a Child B score (57.1%) was significantly higher than those with a Child A score (14.6%) (p = 0.0093). In contrast, among individuals with "adequate muscle strength," the proportion of those with a Child A score (85.4%) was higher than those with a Child B score (42.9%) (p = 0.0093). Additionally, within the Child B group, the proportion of individuals with "inadequate muscle strength" (36.4%) was significantly higher than those with "adequate muscle strength" (6.4%) (p = 0.0065).

No significant difference was found between Child-Pugh scoring and ASMI or LFI (p = 0.239 and p = 0.617, respectively).

The MELD score for the 37 patients (63.8%) classified as low ASMI was 8.95 ± 3.651, while the MELD score for the 21 patients

	ASMI Muscle Mass Index						
	Low n = 37			Normal n = 21			
	Mean + Standard Deviation	Median[Q1-Q3]	Min-Max	Mean + Standard Deviation	Median[Q1-Q3]	Min-Max	p
MELD	8,95 ± 3,651	8,00 [6,00-10,50]	6,00-20,00	7,57 ± 2,74	6,00 [6,00-8,50]	6,00-15,00	0,045

Table 3: Comparison of ASMI with MELD.

(36.2%) classified as normal ASMI was 7.57 ± 2.749. A statistically significant difference was observed between the MELD scores of the ASMI groups, with the mean MELD score being higher in the low ASMI group (p = 0.045) (Table 3).

No significant difference was found between the CONUT score and ASMI, hand grip strength, or the Liver Frailty Index (p = 0.855, p = 0.267, and p = 0.203, respectively) (Table 4).

No significant difference was found between MELD score and hand grip strength (p = 0.593) (Table 5).

			CONUT score		p value
			High	Low	
ASMI Muscle Mass Index	Low	Numbers	15	22	0,855
		Row Percentages (%)	%40,5	%59,5	
		Column Percentages (%)	%65,2	%62,9	
	Normal	Numbers	8	13	
		Row Percentages (%)	%38,1	%61,9	
		Column Percentages (%)	%34,8	%37,1	
Hand Grip Dynamometer	Inadequate Muscle Strength	Numbers	6	5	0,267
		Row Percentages (%)	%54,5	%45,5	
		Column Percentages (%)	%26,1	%14,3	
	Adequate Muscle Strength	Numbers	17	30	
		Row Percentages (%)	%36,2	%63,8	
		Column Percentages (%)	%73,9	%85,7	
Liver Frailty Index	Frail	Numbers	6	3	0,203
		Row Percentages (%)	%66,7	%33,3	
		Column Percentages (%)	%26,1	%8,6	
	Pre-Frail	Numbers	16	30	
		Row Percentages (%)	%34,8	%65,2	
		Column Percentages (%)	%69,6	%85,7	
	Robust	Numbers	1	2	
		Row Percentages (%)	%33,3	%66,7	
		Column Percentages (%)	%4,3	%5,7	

Table 4: Comparison of CONUT Score with ASMI, Hand Grip Strength, and Liver Frailty Index.

	Hand Grip Dynamometer						
	Inadequate Muscle Strength n = 11			Adequate Muscle Strength n = 47			
	Mean + Standard Deviation	Median[Q1-Q3]	Min-Max	Mean + Standard Deviation	Median[Q1-Q3]	Min-Max	p Value
MELD	8,73±3,06	8,00[6,00-10,00]	6,00-15,00	8,38±3,493	7,00[6,00-10,00]	6,00-20,00	0,593

Table 5: Comparison of Hand Grip Strength with MELD.

No significant difference was found between MELD score and the Liver Frailty Index score (p = 0.281) (Table 6).

	Liver Frailty Index									
	Frail n = 9			Pre-Frail n = 46			Robust n = 3			
	Mean + Standard Deviation	Median[Q1-Q3]	Min-Max	Mean + Standard Deviation	Median[Q1-Q3]	Min-Max	Mean + Standard Deviation	Median[Q1-Q3]	Min-Max	p
MELD	9,22 ± 2,58	10,0 [6,5-11,5]	6,0-13,0	8,37±3,59	7,00 [6,00-9,00]	6,00-20,00	7,33 ± 2,309	6,0 [6,0-.]	6,0-10,0	0,28

Table 6: Comparison of Liver Frailty Index with MELD.

A statistically significant difference was found between the Liver Frailty Index and eLIFT score (p = 0.019). Among those classified as pre-frail, a higher proportion had a low eLIFT score (22 out of 23, 95.7%) (p = 0.0134). In the group

			eLIFT		p Value
			High	Low	
ASMI Muscle Mass Index	Low	Numbers	25	12	0,137
		Row Percentages (%)	%67,6	%32,4	
		Column Percentages (%)	%71,4	%52,2	
	Normal	Numbers	10	11	
		Row Percentages (%)	%47,6	%52,4	
		Column Percentages (%)	%28,6	%47,8	
Hand Grip Dynamometer	Inadequate Muscle Strength	Numbers	8	3	0,342
		Row Percentages (%)	%72,7	%27,3	
		Column Percentages (%)	%22,9	%13,0	
	Adequate Muscle Strength	Numbers	27	20	
		Row Percentages (%)	%57,4	%42,6	
		Column Percentages (%)	%77,1	%87,0	
Liver Frailty Index	Frail	Numbers	8	1	0,019
		Row Percentages (%)	%88,9	%11,1	
		Column Percentages (%)	%22,9	%4,3	
	Pre-Frail	Numbers	24	22	
		Row Percentages (%)	%52,2	%47,8	
		Column Percentages (%)	%68,6	%95,7	
	Robust	Numbers	3	0	
		Row Percentages (%)	%100,0	%0,0	
		Column Percentages (%)	%8,6	%0,0	

Table 7: Comparison of eLIFT with ASMI, Hand Grip Strength, and Liver Frailty Index.

with a high eLIFT score, the proportion classified as frail (8 out of 9, 88.9%) was higher compared to those classified as pre-frail (24 out of 46, 52.2%) (p = 0.0431). Conversely, among those with a low eLIFT score, the proportion classified as frail (1 out of 9, 11.1%) was lower compared to those classified as pre-frail (22 out of 46, 47.8%) (p = 0.0431).

No significant difference was found between eLIFT and ASMI or hand grip strength (p = 0.137 and p = 0.342, respectively) (Table 7).

Evaluation of the relationship between finger-o-ring test and muscle mass, hand grip strength, asmı, and liver frailty ındex

Table 8 shows that Comparison of Hand Circle Test with ASMI, Hand Grip Strength, and Liver Frailty Index. A statistically significant difference emerged between ASMI (muscle mass index) and the Hand Circle Test (p<0.001) (Figure 1). Among those classified as low ASMI, the proportion with low muscle mass (6 out of 6, 100.0%) was higher compared to the proportion with high muscle mass (12 out of 30, 40.0%) (p = 0.0082). Among those classified as low ASMI, the proportion with adequate muscle mass (19 out of 22, 86.4%) was higher compared to the proportion with high muscle mass (12 out of 30, 40.0%) (p = 0.0008).

Among those classified as normal ASMI, the proportion with adequate muscle mass (3 out of 22, 13.6%) was lower compared to the proportion with high muscle mass (18 out of 30, 60.0%) (p = 0.0008). Among those classified as normal ASMI, the proportion with low muscle mass (0 out of 6, 0.0%) was found to be lower compared to the proportion with high muscle mass (18 out of 30, 60.0%) (p = 0.0082).

Table 8 shows the comparison of the Hand Circle Test with ASMI, Hand Grip Strength, and Liver Frailty Index. A statistically

			Hand-Circle Test			p Value
			Low Muscle Mass	Adequate Muscle Mass	High Muscle Mass	
ASMI Muscle Mass Index	Low	Numbers	6	19	12	<0,001
		Row Percentages (%)	%16,2	%51,4	%32,4	
		Column Percentages (%)	%100,0	%86,4	%40,0	
	Normal	Numbers	0	3	18	
		Row Percentages (%)	%0,0	%14,3	%85,7	
		Column Percentages (%)	%0,0	%13,6	%60,0	
Hand Grip Dynamometer	Inadequate Muscle Strength	Numbers	1	6	4	0,451
		Row Percentages (%)	%9,1	%54,5	%36,4	
		Column Percentages (%)	%16,7	%27,3	%13,3	
	Adequate Muscle Strength	Numbers	5	16	26	
		Row Percentages (%)	%10,6	%34,0	%55,3	
		Column Percentages (%)	%83,3	%72,7	%86,7	
Liver Frailty Index	Frail	Numbers	2	4	3	0,471
		Row Percentages (%)	%22,2	%44,4	%33,3	
		Column Percentages (%)	%33,3	%18,2	%10,0	
	Pre-Frail	Numbers	4	16	26	
		Row Percentages (%)	%8,7	%34,8	%56,5	
		Column Percentages (%)	%66,7	%72,7	%86,7	
	Robust	Numbers	0	2	1	
		Row Percentages (%)	%0,0	%66,7	%33,3	
		Column Percentages (%)	%0,0	%9,1	%3,3	

Table 8: Comparison of Hand Circle Test with ASMI, Hand Grip Strength, and Liver Frailty Index.

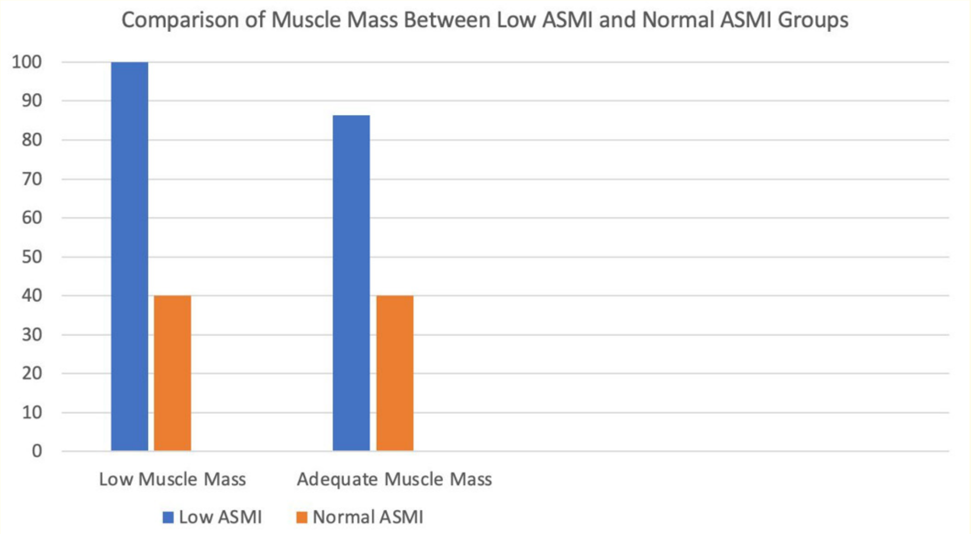

Figure 1: Comparison of Muscle Mass Between Low ASMI and Normal ASMI Groups.

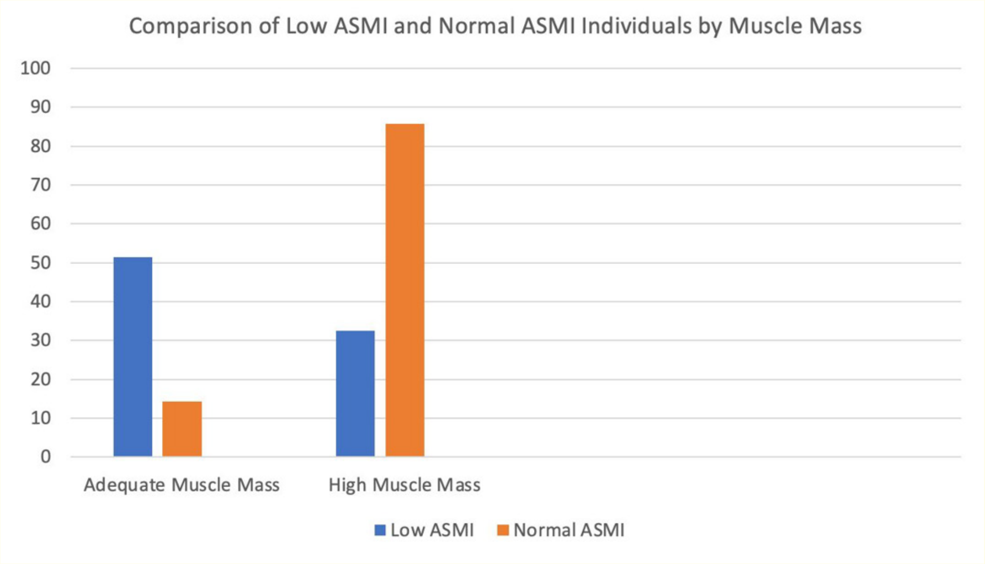

Figure 2: Comparison of Muscle Mass Between Low ASMI and Normal ASMI Groups.

significant difference was found between ASMI (muscle mass index) and the Hand Circle Test ($p < 0.001$) (Figure 1). Among those classified as low ASMI, the proportion with low muscle mass (6 out of 6, 100.0%) was higher compared to the proportion with high muscle mass (12 out of 30, 40.0%) ($p = 0.0082$). Additionally, in the low ASMI group, the proportion with adequate muscle mass (19 out of 22, 86.4%) was higher compared to the proportion with high muscle mass (12 out of 30, 40.0%) ($p = 0.0008$) (Table 8).

In contrast, among those classified as normal ASMI, the proportion with adequate muscle mass (3 out of 22, 13.6%) was lower compared to the proportion with high muscle mass (18 out of 30, 60.0%) ($p = 0.0008$). Furthermore, in the normal ASMI, the proportion with low muscle mass (0 out of 6, 0.0%) was found to be lower compared to the proportion with high muscle mass (18 out of 30, 60.0%) ($p = 0.0082$).

Evaluation of the association between the finger-o-ring test and hand grip strength, asmı, and the liver frailty ındex

No significant difference was found between the Finger-O-Ring Test and ASMI or hand grip strength ($p = 0.640$ and $p = 0.055$, respectively).

A statistically significant difference was found between the Liver Frailty Index and the Finger-O-Ring Test ($p = 0.033$). This difference is attributed to the frail group, where the proportion of individuals with weak performance on the Finger-O-Ring Test (5 out of 13, 38.5%) was higher compared to those with normal performance (4 out of 45, 8.9%) ($p = 0.0101$). Among those with poor performance on the Finger-O-Ring Test, the proportion classified as frail (5 out of 9, 55.6%) was higher compared to those classified as pre-frail (8 out of 46, 17.4%) ($p = 0.0145$). Conversely, among those with normal performance on the Finger-O-Ring Test, the proportion classified as frail (4 out of 9, 44.4%) was lower compared to those classified as pre-frail (38 out of 46, 82.6%) ($p = 0.0145$) (Table 9).

Discussion

Chronic liver disease can progress to cirrhosis, characterized by widespread hepatic fibrosis. Cirrhosis may remain asymptomatic until up to 90% of the liver parenchyma is destroyed or a comorbidity leads to decompensation [4].

Portal hypertension, a common complication of liver disease, leads to malabsorption, while hepatocellular dysfunction impairs albumin synthesis and amino acid metabolism. Liver disease disrupts protein, carbohydrate, and lipid metabolism, with over 50% of patients with decompensated cirrhosis experiencing protein-energy malnutrition [6]. Factors contributing to sarcopenia in cirrhosis include hormonal and chemical alterations, endotoxins, ascites, reduced mobility, and decreased food intake [7,8].

A study by Gaikwad., *et al.* (2016) involving 80 patients found

			Finger-O-Ring Test		p Value
			Weak	Normal	
ASMI Muscle Mass Index	Low	Numbers	9	28	0,640
		Row Percentages (%)	%24,3	%75,7	
		Column Percentages (%)	%69,2	%62,2	
	Normal	Numbers	4	17	
		Row Percentages (%)	%19,0	%81,0	
		Column Percentages (%)	%30,8	%37,8	
Hand Grip Dynamome-ter	Inadequate Muscle Strength	Numbers	5	6	0,055
		Row Percentages (%)	%45,5	%54,5	
		Column Percentages (%)	%38,5	%13,3	
	Adequate Muscle Strength	Numbers	8	39	
		Row Percentages (%)	%17,0	%83,0	
		Column Percentages (%)	%61,5	%86,7	
Liver Frailty Index	Frail	Numbers	5	4	0,033
		Row Percentages (%)	%55,6	%44,4	
		Column Percentages (%)	%38,5	%8,9	
	Pre-Frail	Numbers	8	38	
		Row Percentages (%)	%17,4	%82,6	
		Column Percentages (%)	%61,5	%84,4	
	Robust	Numbers	0	3	
		Row Percentages (%)	%0,0	%100,0	
		Column Percentages (%)	%0,0	%6,7	

Table 9: Comparison of the Finger-O-Ring test with Hand Grip Strength, ASMI, and the Liver Frailty Index.

a strong negative correlation between hand grip dynamometer results and the Child-Pugh score [22]. Similarly, a 2019 study in Japan demonstrated a statistically significant difference in mortality between patients with low and high hand grip strength among those with Child A and B scores [23].

In our study, a statistically significant difference was observed between hand grip strength and the Child score (p = 0.032). Muscle strength was significantly lower in patients with a Child score of B compared to those with a score of A (p = 0.0093). According to the hand grip test, a higher proportion of patients with Child-Pugh score A had sufficient muscle strength compared to those with score B (p = 0.0093). Conversely, the proportion of patients with Child-Pugh score B who had inadequate muscle strength was higher than those with sufficient strength (p = 0.0065). As liver cirrhosis progresses, both muscle mass and strength decrease, and our study shows that these changes can be detected effectively and reliably in a relatively short period.

A study by Sharma., *et al*. (2016) with 700 individuals (352 with cirrhosis, 189 with chronic hepatitis, and 159 healthy controls) evaluated the effectiveness of the hand grip test for determining malnutrition. They demonstrated that the hand grip test is a useful tool for assessing nutritional status at the bedside in cirrhotic patients [24]. Another study conducted in Egypt in 2016 on 76 patients with Child-Pugh C cirrhosis found the hand grip test effective for assessing muscle status [25]. In the literature, aside from a pilot study by Balcı., *et al*. at our center, no other studies have examined the relationship between the hand grip test and the Finger-O-Ring test [25]. The Mersin study obtained statistically significant results regarding muscle strength (measured by dynamometry) between patients with weak and normal Finger-O-Ring test results. In our study, a statistically non-significant relationship was observed between the hand grip and Finger-O-Ring tests (p = 0.055), suggesting that the Finger-O-Ring test can be used to assess muscle strength.

The MELD score is used to prioritize patients awaiting liver transplantation. Patients with a MELD score ≥10 should be referred to a liver transplantation center for evaluation. Bioelectrical Impedance Analysis (BIA) is a cost-effective and available tool for assessing lean body mass [26-28]. In our study, appendicular muscle mass was compared with the MELD score using BIA.

A 2014 study by Durand et al. identified sarcopenia (measured by transverse psoas thickness) as an independent prognostic factor in patients awaiting liver transplantation, regardless of MELD score [29]. In a 2019 study by Sinclair et al., each 1 kg increase in hand grip strength was associated with a 6% decrease in mortality, whereas each 1-point increase in MELD score corresponded to an 11% increase in mortality. Hand grip strength emerged as a numerically stronger predictor of mortality than other factors, including MELD score [30]. In our study, a statistically significant difference was found between MELD score and ASMI (Appendicular Skeletal Muscle Index) groups ($p = 0.045$), with a higher mean MELD score observed in the low ASMI group. This finding demonstrates that a high MELD score, which is used for liver transplant candidates, can be predicted using a rapid and simple method.

Predicting advanced liver fibrosis in patients with chronic liver disease is crucial for prognosis. The Easy Liver Fibrosis Test (eLIFT) algorithm has been developed for this purpose, which calculates a score from routine clinical parameters, including age, gender, GGT, AST, platelet count, and prothrombin time. To assess frailty in cirrhotic patients, the Liver Frailty Index has been developed [31].

A 2018 study by Wang et al. comparing the Liver Frailty Index between individuals with and without chronic liver disease suggested a higher predisposition to pre-frailty among those with chronic liver disease [32]. In our study, a statistically significant relationship was found between the Liver Frailty Index and the eLIFT score ($p = 0.019$). Among the 46 pre-frail patients based on the Liver Frailty Index, 22 (47.8%) had a low eLIFT score, while 24 (52.2%) had a high eLIFT score ($p = 0.0134$). Of the 35 patients with a high eLIFT score, 8 (22.9%) were classified as "frail," and 24 (68.6%) as "pre-frail," with a higher frailty rate than pre-frailty rate among those with a high eLIFT score ($p = 0.0431$). Our study demonstrated that an increase in frailty score in patients with chronic liver disease could serve as an indicator of advanced liver fibrosis, confirmed by rapid and effective methods.

The Hand-Circle Test and Finger-O-Ring Test are among the methods used to assess muscle strength in chronic liver disease patients [33]. In a precursor study conducted by Balcı et al. involving 16 patients with cirrhosis, muscle strength was measured using a hand dynamometer, and the muscle atrophy index was calculated by normalizing the psoas muscle area at the L3 vertebral level to the square of the patient's height [25]. These values were compared with the Hand-Circle Test and the Finger-O-Ring Test, yielding statistically significant results for both methods. A 2019 study by Hiraoka with 358 chronic liver disease patients found a significant difference between the Hand-Circle Test and the psoas muscle area at the L3 vertebral level [33]. In our study, the Appendicular Skeletal Muscle Index (assessed via BIA) was compared with the Hand-Circle Test, revealing a statistically significant relationship ($p < 0.001$). This finding supports the effectiveness of the Hand-Circle Test as a simple and rapid method for assessing muscle mass in patients with chronic liver disease.

In studies comparing the Liver Frailty Index and Hand Grip Test for detecting muscle atrophy in chronic liver disease, statistically significant results were obtained from both tests [34]. The Finger-O-Ring test (BDORT), developed by Y. Omura in 1978, is a diagnostic tool for detecting muscle weakness [18]. No research to date has investigated the relationship between the Finger-O-Ring Test and frailty, making this study the first to demonstrate this relationship. In our study, a statistically significant relationship was found between the Liver Frailty Index and the Finger-O-Ring Test ($p = 0.033$).

The limitations of our study include conducting statistical analysis on the total sample without gender-based separation, the small number of Child C patients, and the potential impact of ascites and lower limb edema on sarcopenia assessment in cirrhotic patients.

Further research with larger sample sizes is recommended to evaluate the effectiveness of these methods for assessing sarcopenia.

Conclusion

This study investigated the effectiveness of the Hand-Circle Test and the Finger-O-Ring Test as methods for assessing sarcopenia in patients with chronic liver disease. A statistically significant correlation was identified between the Hand-Circle Test and the Appendicular Skeletal Muscle Index (ASMI), as well as between the Finger-O-Ring Test and the Liver Frailty Index ($p < 0.001$ and $p = 0.033$, respectively). Additionally, no significant relationship was found between the Finger-O-Ring Test and the Hand Grip Test ($p = 0.055$), which underscores the need for further studies with larger sample sizes.

In conclusion, this study demonstrates that sarcopenia can be practically and quickly predicted using the Hand-Circle Test and the Finger-O-Ring Test. Therefore, these two tests are recommended for use in the assessment of sarcopenia.

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Conflıct of Interest

No potential conflicts of interest were disclosed.

Statement of Authorship

EA designed the research. KK was responsible for the management and data acquisition. KK analysed data and wrote the manuscript. EA revised the manuscript for important intellectual content. KK had primary responsibility for final content. All authors read and approved the version submitted.

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