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Burden of Undernutrition and Associated Factors in Patients with Liver Cirrhosis at a Tertiary Care Center in Ethiopia

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Abstract

Cirrhosis of the liver imposes a substantial health toll, being responsible for upwards of 1 million deaths annually across the world. The trajectory of hepatic illnesses, most notably cirrhosis, is often worsened by nutritional disturbances, and these have been tied to elevated mortality. Despite this heavy disease burden, studies examining the scale of under-nutrition and its determinants among cirrhotic individuals in Ethiopia and the broader sub-Saharan African region remain scarce. The present investigation sought to determine the prevalence of under-nutrition and identify its correlates among adult patients with liver cirrhosis managed on an outpatient basis. A cross-sectional, hospital-based design was employed, enrolling 136 adult outpatients with cirrhosis who presented to the hepatology unit of St. Paul's Hospital Millennium Medical College. Data collection relied on structured checklists and included patient interviews, medical file reviews, anthropometric evaluations, and handgrip strength assessments; analysis was performed using Statistical Package for the Social Sciences (SPSS) version 26.0. Under-nutrition was defined using body mass index thresholds modified for ascites severity. Descriptive statistics, along with binary and multivariable logistic regression, were utilized, adopting a significance level of < 0.05. Participants had a mean age of 39.5 years (standard deviation: ± 11.2), and 62.5% were men. Chronic infection with the hepatitis B virus (57.4%) stood out as the leading etiology of cirrhosis, with alcohol-related liver cirrhosis (12.5%) ranking second. A large proportion (70.6%) of the subjects were classified as undernourished. Variables exhibiting independent statistical links to under-nutrition comprised residing in a rural setting (adjusted odds ratios [AOR]: 5.65, 95% confidence interval [CI]: 1.98–16.1), having ascites (AOR: 2.43, 95% CI: 1.03–5.7), and the extent of hepatic impairment per Child–Pugh categorization (AOR, 1.11; 95% CI: 0.45–2.7). Under-nutrition proved to be a widespread concern among ambulatory cirrhosis patients, with rural dwellers and individuals at advanced disease stages carrying a disproportionate burden. Instituting systematic nutritional screening and developing appropriate intervention strategies for cirrhotic patients is critically needed.

Keywords: Patients, Liver cirrhosis, Tertiary care, Hepatic illnesses

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Introduction

Cirrhosis of the liver constitutes the end-stage, irreversible consequence of chronic hepatic injury, defined by an ongoing loop of parenchymal inflammation, destruction, and regenerative attempts [1]. On a global scale, it ranks as a leading cause of mortality, claiming over a million lives each year [2]. Sub-Saharan Africa bears the second

greatest age-standardized death rate attributable to cirrhosis, with chronic viral hepatitis as the predominant driver [2, 3]. Although regional disparities exist, the primary pathways leading from chronic liver disease to cirrhosis are chronic viral hepatitis (types B and C), alcohol-related liver disease, and nonalcoholic fatty liver disease [3]. From a pathophysiological standpoint, cirrhosis evolves progressively, traversing a comparatively quiescent initial period termed the compensated phase, after which the decompensated phase ensues, marked by numerous adverse events, including nutritional deficits [3, 4]. Given the liver's essential role in orchestrating numerous metabolic processes that maintain nutritional homeostasis, the incremental decline in hepatic function caused by cirrhosis gravely endangers a patient's nutritional status [4, 5]. Nutritional status is modulated by several factors, including the underlying etiology and phase of cirrhosis, ascites volume, and co-existing medical conditions [5, 6]. Beyond the erosion of metabolic capacity, other mechanisms driving malnutrition in cirrhosis include diminished oral intake, disrupted gut motility and nutrient absorption, elevated resting energy expenditure, and dietary protein restriction prescribed by physicians [6, 7]. The clinical course and prognosis of cirrhosis deteriorate substantially when malnutrition supervenes, with evidence pointing to it as an autonomous predictor of illness advancement and fatal outcomes [7-9]. What is more, malnutrition in the context of cirrhosis is particularly worrisome since it largely reflects skeletal muscle depletion (sarcopenia). This condition independently correlates with poorer health-related quality of life, higher complication rates, and higher mortality [8, 9].

Based on a body of evidence, the stage of disease emerges as the single most powerful factor governing the extent of malnutrition; consequently, investigations have documented prevalence figures of 50% to 90% in decompensated or advanced stages of cirrhosis [10-13]. Owing to these strikingly high rates, expert bodies advocate for universal nutritional screening of cirrhotic individuals; however, conducting nutritional evaluations in this population is complex, as conventional biochemical markers are predominantly hepatic products, and the coexistence of ascites and pedal edema undermines standard anthropometric measurements [14, 15].

Of the various anthropometric indices, body mass index (BMI) offers the greatest simplicity and lowest expense; yet, its dependence on total body weight renders its utility suspect in the setting of fluid overload [15, 16]. To address this specific shortcoming, elevated BMI cutoffs that account for the extent of ascites and peripheral edema have been validated [17]. Alternative modalities less confounded by total body water include mid-arm muscle circumference and triceps skinfold measurement, although achieving satisfactory inter- and intra-rater concordance demands trained examiners, thereby curtailing their feasibility in high-volume outpatient settings [17].

Moreover, as pressured clinicians continually seek straightforward, trustworthy, and economical tools, functional metrics such as handgrip strength (HG) are increasingly adopted [18]. HG is quantified in kilograms of force using a portable hydraulic dynamometer sized for the patient's hand, and a wealth of evidence substantiates its role as a highly discriminating marker of functional decline, indicative of protein-energy malnutrition, and closely aligned with robust clinical endpoints [19-21].

To summarize, while scholarly output on the burden of malnutrition among this patient group is expanding, inquiry remains heavily concentrated in middle- and high-income nations, leaving a substantial knowledge gap regarding the prevalence of malnutrition in cirrhotic cohorts residing in low-income settings.

Within Ethiopia, investigations into cirrhosis and its origins are sparse, and existing evidence suggests that chronic liver disease represents a frequent indication for inpatient care, with viral hepatitis predominating [22, 23]. Of equal note, malnutrition-focused studies are still remarkably absent in the Ethiopian landscape; accordingly, the present work was undertaken to establish the frequency of undernutrition and its associated factors among patients with liver cirrhosis followed at the Hepatology outpatient department of St. Paul's Hospital Millennium Medical College (SPHMMC).

Materials and Methods

Study design, setting, and population

A cross-sectional, hospital-based methodology was adopted for this research, spanning the period from May 18 to October 16, 2020, at the hepatology clinic of SPHMMC in Addis Ababa, Ethiopia. SPHMMC functions as one of the country's foremost government-operated tertiary and teaching hospitals, receiving referrals from every region of the nation [24].

Sample size computation relied on a single-population proportion formula. As no Ethiopian study was identified that examined the prevalence of under-nutrition in the cirrhotic population, a 50% P value was assumed. A 95% confidence level was set alongside a margin of error of 5.5%, producing an initial sample of (n = 318).

Attendance estimates were derived from patient flow patterns during the equivalent timeframe one year prior (May 1–October 30, 2019), which totaled fewer than 10,000 visits. Hence, the originally calculated sample (n = 318) underwent correction via the Slovin equation—a procedure designed for finite population sample size adjustment—and yielded a final sample of (n = 135).

Successive patients who were at least 18 years old, had an established diagnosis of liver cirrhosis, and attended the outpatient clinic throughout the study window were taken into the study. A cirrhosis diagnosis was confirmed when the medical record contained a constellation of clinical, laboratory, and imaging features consistent with the condition.

To prevent distortion of nutritional status findings, individuals who carried additional diagnoses of malignancies—including hepatocellular carcinoma, inflammatory bowel disease, or chronic diarrhea were ruled ineligible. Likewise, any participant whose physical limitations precluded proper anthropometric evaluation was not considered.

Operational definitions

The following working definitions were applied:

Ascites severity: the grading system put forth by the International Ascites Club served as the standard, delineated as follows [25]:

• Mild ascites (grade 1): detectable only through ultrasonography, without overt clinical signs.

• Moderate ascites (grade 2): visible, moderate abdominal enlargement.

• Large/tense ascites (grade 3): severe, unmistakable abdominal distention.

Under-nutrition among cirrhotic patients: this was determined by applying BMI thresholds that incorporate correction for the magnitude of fluid retention (ascites), in accordance with cutoff values that were previously authenticated and put forward in an earlier report [17]; these threshold values were drawn from that work and displayed in a structured table **(Table 1)**.

Table 1. Modified body mass index cutoff points to define malnutrition in patients with cirrhosis.

Nutritional status	BMI threshold (severe ascites)	BMI threshold (moderate ascites)	BMI threshold (mild ascites)
Preserved nutrition	≥ 23	≥ 23	≥ 22
Mild malnutrition	< 25	< 23	< 22
Moderate malnutrition	< 22	< 20	< 19
Severe malnutrition	< 18	< 17	< 16

Data collection procedures and quality management

Information was gathered using a structured abstraction form developed after consulting a range of published works. The coronavirus disease 2019 outbreak, which led to a sharp decline in outpatient visits, meant the piloting phase could only be conducted with 10 liver cirrhosis patients at the SPHMMC outpatient unit. The data-gathering workflow unfolded across three stages: a standardized face-to-face interview; recording weight, height, handgrip strength, and ascites severity; and extracting details from participants' medical files. Dietary diversity data were collected using the Food and Agriculture Organization Guidelines for evaluating household and individual dietary diversity, based on a 24-hour recall [26]. A single trained general practitioner performed all anthropometric measurements to minimize intra-observer variability. A digital scale supplied body weight in kilograms, while a stadiometer provided height in centimeters. Handgrip strength was assessed with a mechanical dynamometer (CAMRY EH101), using the non-dominant arm. Three separate readings were obtained, with rest periods exceeding 30 seconds between each, and the average of these three values was carried forward for analysis. Normal reference ranges for handgrip were sourced from datasets matched by age and sex [27]. All results were logged in kilograms.

Data processing and analysis

Statistical analyses were conducted using Statistical Package for the Social Sciences (SPSS) version 26.0 (SPSS Inc., Chicago, IL). Descriptive measures—covering means, medians, standard deviations, and percentage frequencies—were generated, and logistic regression was used to explore associations between under-nutrition and potential contributing factors. Covariates with P values below .2 in univariable screening were carried forward into the multivariable logistic regression. Within that multivariable framework, a P value under .05 was adopted as the threshold for statistical significance across all covariates. The strength of associations is reported as adjusted odds ratios (AOR) with accompanying 95% confidence intervals (CI).

Ethical consideration

The entire study was conducted in compliance with the Declaration of Helsinki and received Institutional Review Board clearance from St. Paul's Hospital Millennium Medical College under reference number P.M.23/740. Respecting participants' self-determination, written informed consent was obtained from each individual before enrollment, and all data were collected using an anonymized instrument.

Results and Discussion

Socio-demographic characters

The cohort comprised 136 liver cirrhosis patients; men constituted the larger subset at 85 (62.5%). Ages ranged broadly from 18 to 85 years, centering around a mean of 39.5 years (standard deviation [SD]: ± 11.2). Marriage was reported by most (93, 68.4%), and formal schooling was noted in an overwhelming majority (111, 81.6%). Urban residency applied to 84 (61.8%) of those enrolled **(Table 2)**.

Table 2. Participants' socio-demographic characteristics (n = 136), SPHMMC, Addis Ababa, Ethiopia, 2020.

Variable	Category	Percentage (%)	Frequency (n)
Age distribution	18–29 years	21.3	29
	30–49 years	56.6	77
	≥ 50 years	22.1	30
Gender	Male	62.5	85
	Female	37.5	51
Marital status	Married	68.4	93
	Single	22.8	31
	Divorced/Widowed	8.8	12
Educational level	Primary education	30.9	42
	Secondary education	30.1	41
	College and above	20.6	28
	Unable to read and write	13.2	18
	Literate (can read and write)	5.1	7
Occupation	Farmer	14.0	19
	Government employee	15.4	21
	Merchant	5.1	7
	Other (self-employed/daily laborer)	46.3	63
	Unemployed	18.4	25
Monthly income (ETB)	< 500	19.9	27
	500–1499	33.8	46
	1500–2999	18.4	25
	3000–4499	15.4	21
	5000–10,000	12.5	17
Residence	Urban	61.8	84
	Rural	38.2	52

Abbreviation: SPHMMC = St. Paul's Hospital Millennium Medical College.

Dietary diversity

Over the 24 hours immediately before questioning, patients overwhelmingly described eating carbohydrate-dense staples (71%–85%), dark leafy greens and vegetables rich in vitamin A (80%), or other produce such as onions, carrots, and tomatoes (94%).

By contrast, the ingestion of protein- and lipid-based foods fell well short of adequacy; any flesh was consumed by 29.4% of the sample, poultry and dairy items by 26.5%, and a mere 24 (17.6%) individuals reported eating fat-containing foods, like oil or butter **(Table 3)**.

Table 3. Nutritional diversity (n = 136), SPHMMC, Addis Ababa, Ethiopia, 2020.

Food group / dietary item	Percentage (%)	Number (n = 136)
Cereals (e.g., bread, rice, noodles, biscuits, millet-, sorghum-, maize-, rice-, or wheat-based foods)	85	116
Potatoes	71	97
Dark green leafy vegetables and vitamin A–rich vegetables	80	109

Other vegetables (carrot, tomato, onion)	94	128
Vitamin A–rich fruits	56.6	77
Organ meats (liver, kidney, heart)	5.1	7
Flesh foods (beef, lamb, goat, sheep, chicken)	29.4	40
Eggs	26.5	36
Legumes, nuts, and seeds (beans, peas, lentils, nuts)	64	87
Dairy products	26.4	40
Foods prepared with oil, fat, or butter	17.6	24

Abbreviation: SPHMMC = St. Paul's Hospital Millennium Medical College.

Medical factors

The single most frequently identified cause of liver cirrhosis was chronic hepatitis B virus infection, seen in 78 (57.4%) instances; alcohol-related liver cirrhosis trailed next at 17 (12.5%), and chronic hepatitis C infection was implicated in 13 (9.6%). Ascites of at least moderate grade was found in more than two-thirds of the study group (107, 78.6%). When overall disease severity was appraised, decompensated cirrhosis was present in a striking 120 (88.2%) participants, of whom 86 (63.2%) and 34 (25%) fell into Child–Pugh classes B and C, respectively **(Table 4)**.

Table 4. Summary of medical factors in liver cirrhosis patients (n = 136), SPHMMC, Addis Ababa, Ethiopia, 2020.

Clinical factor	Category	Percentage (%)	Frequency (n)
Etiology of cirrhosis	Chronic hepatitis B virus (HBV) infection	57.4	78
	Alcohol-associated liver disease	12.5	17
	Chronic hepatitis C virus (HCV) infection	9.6	13
	Other causes	20.6	28
Degree of ascites	Mild ascites	21.3	29
	Moderate ascites	61.0	83
	Severe (tense) ascites	17.6	24
Severity of cirrhosis (Child–Pugh class)	Class A	11.8	16
	Class B	63.2	86
	Class C	25.0	34

Abbreviations: CP = Child–Pugh, HBV = hepatitis B virus, HCV = hepatitis C virus, and SPHMMC = St. Paul's Hospital Millennium Medical College.

Nutritional status of patients with cirrhosis

The BMI values recorded across the sample ranged from 15.57 kg/m² to 33.08 kg/m², with a mean of 21.9 kg/m² (SD ± 3.244). In relation to the adapted BMI thresholds tailored to cirrhotic patients with ascites—where preserved nutritional state corresponds to values of ≥ 22, ≥ 23, and ≥ 25 for mild, moderate, and tense ascites, respectively—a striking majority of the cohort, 96 (70.6%), posted figures beneath the requisite cutoff. Delving further into these 96 undernourished individuals, mild malnutrition was identified in 55 (40.4%), moderate malnutrition in 37 (27.2%), and severe malnutrition in 4 (2.9%).

Handgrip strength measurement

Handgrip force among the study subjects averaged 25.1 kg (SD ± 8.4), with the extremities of the distribution touching 5.4 kg at the lower end and 50.7 kg at the upper end. Compared against reference norms stratified by both sex and age, poor grip strength was detected in a sizeable fraction—86 (63.2%)—of those assessed. A closer examination uncovered a stepwise association with the severity of under-nutrition: weak grip was universal in severely malnourished patients, present in three-quarters of those with moderate malnutrition, and observed in just over half (56%) of those with mild malnutrition. Grip performance was likewise scrutinized by cirrhosis stage, with the proportion of patients with weak grip rising from 56% in Child–Pugh A to 61% in Child–Pugh B, and reaching 70% in Child–Pugh C. It is worth underscoring, however, that even among participants whose nutritional state was classified as intact, a weak grip was still registered in 23 (57.5%) of cases.

Factors associated with under-nutrition

Originating from a rural locale was associated with odds of under-nutrition more than 5 times those seen among city-dwelling patients (AOR: 5.65, 95% CI: 1.98–16.1). No other socio-demographic characteristics reached independent statistical significance. The presence of ascites graded moderate or beyond independently more than doubled the probability of being undernourished, as contrasted with the ascites-free group (AOR: 2.43, 95% CI: 1.03–5.75).

In parallel, the severity of liver impairment, as stratified by the Child–Pugh system, remained statistically significantly associated with nutritional status. In this connection, patients classified as Child–Pugh C had somewhat higher odds of under-nutrition than those in Child–Pugh A (AOR: 1.11, 95% CI: 0.45–2.7). None of the remaining medical characteristics emerged as independently predictive of nutritional standing **(Table 5)**.

Table 5. Logistic regression analysis of associated factors of patients with liver cirrhosis (n = 136), SPHMMC, Addis Ababa, Ethiopia, 2020.

Independent variable	P-value	Crude odds ratio (COR) (95% CI)	Adjusted odds ratio (AOR) (95% CI)
Gender	0.698	0.861 (0.404–1.855)	—
Place of residence	< 0.001	6.71 (2.42–18.6)	5.65 (1.98–16.1)
Educational level	0.059	8.05 (0.922–70)	—
Monthly income	0.191	0.321 (0.86–1.98)	—
Serum albumin	0.260	1.318 (0.815–2.131)	—
Presence of ascites	0.001	3.16 (1.609–6.195)	2.44 (1.03–5.75)
Child–Pugh class	0.018	1.11 (0.45–2.7)	1.07 (0.48–2.54)

Abbreviations: AOR = adjusted odds ratio, COR = crude odds ratio, and SPHMMC = St. Paul's Hospital Millennium Medical College.

The present study revealed that undernutrition affected 70.6% of the enrolled individuals. Rural versus urban dwelling, ascites, and Child–Pugh category each demonstrated an independent association with patients' nutritional state.

The average age of those taking part was 39.51 years (SD ± 11.2), a figure notably lower than that reported in earlier investigations, where mean ages of 50.9 ± 11.1 [28] and 57.41 ± 10 years [29] were recorded. One plausible reason is that, within our sample, chronic viral hepatitis served as the dominant etiology of liver cirrhosis (67%), an entity known to precipitate cirrhosis at an earlier age. This stands in contrast to alcohol-related liver disease—the leading cause in the comparator studies—which tends to manifest later in life.

Our data showed that the prevalence of under-nutrition among cirrhotic patients was 70.6%. While this proportion is exceedingly high, it aligns well with much of the published literature, which has consistently documented rates ranging from 65% to 90% [10-13]. A credible contributing factor in this cohort may be the strikingly poor dietary diversity described by participants, the vast majority of whom subsisted heavily on carbohydrate-laden fare while consuming scant amounts of protein and fat. Whether this pattern stems from a genuine lack of access or from a perceived apprehension that animal-derived foods might worsen hepatic illness warrants deeper investigation. Merely 29.6% of our subjects retained an intact nutritional status, a finding that mirrors reports from Brazil [28], the Netherlands [30], and Tunisia [31]. Such concordance reinforces the robust, well-recognized interplay between cirrhosis and malnutrition, as already underscored in prior work [29-31].

Ascites exerted a clear detrimental impact on nutritional standing in this cohort; 83.3% of individuals with tense ascites and 77.1% of those with moderate ascites were classified as undernourished, compared against only 41.3% among ascites-free patients. Comparable observations have been reported elsewhere [29-32]. The marked rates of under-nutrition seen with tense ascites could plausibly be explained by direct gastric compression brought about by the ascitic fluid, which provokes early satiety, by concomitant bowel wall edema, or simply by the fact that ascites acts as a barometer of advancing hepatic decompensation. Studies of more robust design are needed to disentangle the precise cause-and-effect dynamics.

A parallel pattern emerged with disease severity: the depth of under-nutrition climbed in tandem with the Child–Pugh class. This graded relationship has been reproduced across numerous studies [28–31], though it diverges from an earlier report [33]. Possible drivers behind the nutritional decline observed in decompensated cirrhosis (Child–Pugh B and C) include unduly restrictive dietary prescriptions handed down by clinicians, anorexia directly attributable to the disease, and the sustained hypermetabolic milieu that characterizes advanced liver failure [28].

Chronic viral hepatitis (67%) constituted the predominant etiology of cirrhosis in this investigation. Yet, the underlying cause did not surface as a statistically significant determinant of nutritional status—an outcome that echoes work from France [17], Brazil [28], and the Netherlands [30]. This uniformity likely reflects the convergence of malnutrition pathways irrespective of the initiating hepatic insult. One study [30] previously suggested that under-nutrition in cirrhosis disproportionately burdens older individuals; however, our data failed to corroborate this association.

A distinctive observation, not featured in other published accounts, was the disproportionate burden of under-nutrition borne by patients from rural settings compared with their urban-residing peers. This rural–urban gap may

be attributable to the comparatively limited availability of processed foods and nutritional supplements in the countryside, to widespread misapprehension of dietary guidance, or to other sociocultural factors. Confirmatory studies designed specifically to probe this finding are warranted.

Turning to handgrip strength, our results affirmed that weaker grip force paralleled worsening degrees of under-nutrition, consistent with earlier reports [18, 20, 21]. At the same time, it is worth noting that a substantial subset—23 (57.5%)—of individuals whose nutritional status was deemed preserved nonetheless exhibited diminished grip strength. This discordance may arise because the normative grip strength cutoffs have not been validated for an Ethiopian reference population, a hypothesis that calls for appropriately constructed future research.

To the best of our understanding, this study represents the first effort to systematically gauge the magnitude of under-nutrition and its correlates among cirrhotic patients in this particular setting. A validated instrument was used to classify nutritional status, and, notably, this is the inaugural study in the Ethiopian context to use a handgrip dynamometer to explore interrelationships among grip force, nutritional status, and cirrhosis severity.

Several caveats must nonetheless be acknowledged. The cross-sectional design of the study precluded firm causal inferences regarding associated factors. Furthermore, the reference standards adopted to define normal handgrip strength lack validation in Ethiopian populations, a limitation that may have influenced the grip strength results.

Conclusion

This study demonstrates that well over two-thirds (70.6%) of liver cirrhosis patients harbor at least some degree of under-nutrition. Rural residence, ascites, and the extent of hepatic impairment, as gauged by Child–Pugh class, emerged as independent correlates. Clinicians managing cirrhotic individuals must remain alert to the enormous toll exacted by under-nutrition and should devise appropriate nutritional rehabilitation strategies. Future investigations that are rigorously controlled and specifically designed to address the limitations identified here are strongly encouraged.

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