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Highlights

- Early clinical prognosis remains a challenge in Advanced Chronic Liver Disease (CLD)
- Nutritional Prognostic Index (NPI) shows potential for nutritional assessment in ACLD
- Association between NPI <41 cutoff and mortality were observed in our ACLD population
- 82.1% of the sample below cutoff experienced mortality within 12 months
- NPI is a simple and effective assessment tool which can aid in ACLD early diagnosis

Nutritional risk assessment using the Nutritional Prognostic Index predicts mortality in Advanced Chronic Liver Disease patients.

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Declaration of Interests Statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Running head: Nutritional Prognostic Index in Liver Disease.

Abstract

Introduction: Early clinical prognosis and mortality reduction remains a challenge in Chronic Liver Disease (CLD). The full potential of the Nutritional Prognostic Index (NPI) for nutritional assessment and management in CLD patients remains unexplored.

Aim: To establish an NPI cutoff point for identification of nutritional risk in advanced CLD (ACLD) patients, and to assess the NPI's ability to predict ACLD-associated mortality.

Method: This ethically approved prospective cohort study investigated malnutrition risk using both the NPI and the Royal Free Hospital-Nutritional Prioritizing Tool (RFH-NPT) in patients hospitalized for ACLD. NPI reference values were determined using Receiver Operating Characteristic curve. Associations between nutritional risk identified by RFH-NPT and by NPI were assessed using Fisher's exact test, and agreement between tools assessed using the Kappa index. Association between NPI-defined nutritional risk and 12-month mortality was examined using Pearson Chi-square test.

Results: The sample population consisted of 120 adults, 84 (70%) male and 57 (50.9%) of alcoholic aetiology, presenting Child-Pugh A, B or C at admission. The identified cutoff point for NPI was <41, identifying nutritional risk in 82.5% of patients. NPI presented a statistically significant association with RFH-NPT, with substantial agreement coefficient of 0.34. Association between NPI <41 cutoff and mortality were observed, with 82.1% of the sample below cutoff experiencing mortality within 12 months.

Conclusion: NPI is a valuable nutritional marker for identification of nutritional risk in ACLD. The NPI is a simple and effective assessment tool which can aid in CLD early diagnosis. Validation however remains necessary in other CLD populations of different aetiologies.

Keywords:

Nutritional Prognostic Index; Nutritional screening; Nutritional assessment; Nutritional Risk; Advanced Chronic Liver Disease.

Introduction:

Chronic Liver Disease (CLD) has increased 1.5 to 2 times in the last two decades and is globally responsible for approximately 2 million deaths annually [1]. CLD is characterized by progressive liver fibrosis, resulting in compromised vascular architecture of the liver alongside hepatic parenchymal dysfunction [1].

Metabolic manifestations present in advanced CLD (ACLD) negatively affect the individual's nutritional status. Altered metabolism, associated with malabsorption of macro and micronutrients, leads to reduction in glycogen and branched-chain amino acid (BCAA) stores, alongside abnormalities in lipid metabolism [2].

Liver dysfunction, infections, encephalopathy, ascites, and other clinical complications associated with the progression of ACLD further impact the nutritional status of sufferers. Malnutrition becomes more pronounced in the decompensated phase of the disease, with its prevalence varying between 5% and 92%. Such wide variation in nutritional diagnosis can be partially explained by the utilization of different nutritional assessment methods across various studies [2].

Despite the wide availability of nutritional screening instruments in clinical practice for hospitalised patients, early nutritional therapy in ACLD patients remains a challenge. The European Society for Parenteral and Enteral Nutrition (ESPEN) recommends the Royal Free Hospital-Nutritional Prioritizing (RFH-NPT) tool for nutritional screening in ACLD. However, some inefficiency in the proposed assessment remains due to commonly occurring oedema, which compromises the integrity of anthropometric measurements [2, 3].

The Nutritional Prognostic Index (NPI), initially proposed for nutritional assessment in the perioperative period, utilises albumin serum levels and lymphocyte count to detect nutritional risk [4]. The potentially broader applications of the NPI in clinical practice, with the ability to monitor nutritional status of patients diagnosed with various chronic illnesses [5, 6, 7], has been proposed. However, studies evaluating its performance in relation to recommended tools, such as the RFH-NPT, are lacking to date.

The present study aimed to identify a NPI cutoff reference value accurate enough to detect nutritional risk in ACLD patients, alongside its association with 12-month mortality. The utilisation of a simple and effective index such as the NPI for early nutritional screening of ACLD patients affords the identification of patients at greater risk, allowing for early nutritional interventions which improve clinical prognosis and reduce mortality.

Materials and Methods

Study Design, Sample, and Population

Our study was conducted at the Gastroenterology and Hepatology ward of the University Teaching Hospital, Federal University of Bahia, Salvador, Brazil, from April 2018 to November 2020. Ethical approval was granted by the Federal University of Bahia Research Ethics Committee (Approvals 3.380.156 and 5.780.638). All consenting patients signed a consent form, and the research team answered all their questions to their full satisfaction prior to signing. All patients were reassured that not participating in the study would not interfere with the healthcare provided to them. Patients unable to give informed consent were not included in the study.

Our study utilized a prospective cohort design with a non-probabilistic sample. ACLD patients at different stages of the disease (Child-Pugh A, B and C) [8] were included. All ACLD cases were diagnosed by a lead Hepatologist consultant, based on information provided by liver biopsy, or a combination of laboratory, clinical and imaging data, or clinical signs of liver disease decompensation, found in Child-Pugh B and C patients. Patients aged 18 years old or older of both sexes were included. Patients with other decompensated chronic diseases, acquired immunodeficiency syndrome, tuberculosis, muscular disease, and rheumatological disease, were not included in the study. Additionally, inability to undergo anthropometric assessment or lack of updated biochemical parameters were non-inclusion criteria [9].

Data Collection

Patients were initially assessed by a registered nutritionist from the research team. The nutritionist had received training on the standardised forms and on demographic and clinical data collection prior to the beginning of the study. The initial patient assessment occurred within the first 48 hours of hospital admission. Consenting patients were followed for 12 months.

Clinical Data

ACLD aetiology, time of diagnosis, presence of ascites, hepatic encephalopathy, evidence of portal hypertension syndrome, and laboratory test results, were collected from medical records. ACLD severity was assessed using the Child-Pugh classification and the Model for End-stage Liver Disease (MELD). The Child-Pugh classification categorises liver dysfunction as mild (A), moderate (B), and severe (C), while the MELD classification indicates that scores ≥ 15 present a higher risk of death within three months if not transplanted [10, 11].

Nutritional Risk Assessment

Nutritional status screening was conducted at the time of admission using both the Nutritional Prognostic Index (NPI) and the Royal Free Hospital-Nutritional Prioritizing Tool (RFH-NPT). The RFH-NPT is a validated instrument with excellent intra- and inter-observer reproducibility, comprising three main steps: a) patients with alcoholic hepatitis or those on tube feeding are immediately assessed as high nutritional risk, and do not proceed to the next step; b) patients without alcoholic hepatitis or tube feeding are assessed for water overload, assessing its impact on food intake and weight loss; c) patients without water overload are assessed using nutritional status indicators such as Body Mass Index (BMI), unplanned weight loss, and daily food intake. The RFH-NPT provides a score stratifying nutritional risk into low risk (score 0), moderate risk (score 1), and high risk (score ranging from 2 to 7) [12].

Completing the RFH-NPT requires BMI calculation [13], which was performed in our study using height measured with a stadiometer and weight measured with a digital scale. For patients presenting ascites and or oedema, dry weight was calculated as recommended by the European Association for the Study of the Liver [8]. Weight loss was calculated based on the patient's reported usual weight at the time of assessment. NPI calculation involves total lymphocyte count and serum albumin concentration using the formula [10 × albumin (g/dL)] + [0.005 × absolute lymphocyte count (mm^3)] [4].

Survival at 12 Months

Survival information was obtained through medical and consultation records, and integration into the hospital's digital information system and the official State Death Registration Records. In cases where information could not be found in our databases, the research team contacted patients or their families by telephone to assess their clinical condition.

Statistical Analysis

A qualified statistician conducted the power analysis for the study using G*Power version 3.1.9.7. For the chi-square test results, the analysis indicated a statistical power (1-β) of 0.90. Additionally, the power of the test was 0.96 based on the Receiver operating characteristic (ROC) curve analysis. These findings demonstrate that the sample size calculation in our study was sufficiently robust to ensure a reliable identification of a significant cutoff point in the ROC curve.

Data analysis was conducted using SPSS® Statistical Package version 21.0. Data distribution normality was assessed through visual analysis of the normal curve and confirmed by the Shapiro-Wilk and Kolmogorov-Smirnov tests. For descriptive analysis of the variables of interest, the median and interquartile range (25^{th} and 75^{th} percentiles) were used for most variables, along with absolute and relative frequencies, depending on the characteristics of the variable analysed. Notably, among the continuous quantitative variables, only the NPI met the assumptions of normality, with its results presented as mean ± standard deviation.

The Areas Under the Curve (AUC) of different NPI values were explored using high nutritional risk identified by the RFH-NPT (score >2) as reference. Sensitivity and specificity were calculated for different NPI scores. The Youden Index (YI) (sensitivity + specificity – 100) was employed to identify the optimal discriminative threshold. The cutoff point with the highest accuracy was identified as the one with the highest YI and highest AUC. The AUC provided a measure of overall test accuracy, with values interpreted as follows: 0.5-0.6 (poor), 0.6-0.7 (fair), 0.7-0.8 (good), 0.8-0.9 (very good), >0.9 (excellent) [14].

Associations of nutritional risk diagnosis according to NPI and RFH-NPT were investigated using the Fisher Exact Test. Fisher Exact Test and chi-square test were employed to assess associations between nutritional risk classification according to NPI and clinical variables, and mortality. Agreement between methods was investigated using the Kappa Index, with the following interpretation criteria: 0.0-0.20 (no agreement), 0.21-0.40 (considerable agreement), 0.41-0.60 (moderate agreement), 0.61-0.80 (substantial agreement), and 0.81-1.0 (perfect agreement). Statistical tests were considered significant where *p*-values < 0.05 [15].

Results

One-hundred twenty ACLD patients were included in the present investigation. The majority of patients were male (n = 84; 70%), and the median age was 56 years (IQR 50-63). Concerning disease severity, 59.2% (n = 71) of patients were classified as Child-Pugh B, and 32.5% (n = 39) as Child-Pugh C, while the median MELD score was 14 (IQR: 11-18). Alcohol-related liver disease was the most common aetiology in our population (n = 57; 50.9%). Among the most significant ACLD complications, ascites (n = 97; 81.5%) and portal hypertension syndrome (n = 100; 87%) were identified. Hepatocellular Carcinoma (HCC) was diagnosed in 12.5% (n = 15) of patients (Table 1).

Nutritional risk assessment using RFH-NPT revealed high risk of malnutrition in 84.2% of patients (n = 101). The mean NPI was 34.6 ± 6.8 (Table 1). NPI data assessed according to disease severity showed that higher scores – an indicative of lower nutritional risk – were observed in patients with better clinical condition assessed by Child-Pugh (45.1 vs. 33.75, p<0.001), and in those who survived the 12 months period (36.52 vs. 33.03, p=0.04). The Meld score assessment showed that the NPI did not differ significantly (34.48 vs. 33.4, p=0.17) (figure 1).

Laboratory data showed total bilirubin median level at 1.8 mg/dL (IQR 1.1-3.9), lymphocyte count at 1093.6 / mm^3 (IQR 725.2-1728.3), C-Reactive protein level at 16.5 mg/dL (IQR 6.3-37.6), International Normalised Ratio (INR) at 1.3 (IQR 1.1-1.6), and serum albumin, urea, and creatinine levels at 2.8 mg/dL (IQR 2.4-3.2), 35 mg/dL (IQR 31.5-48.5), and 0.9 mg/dL (IQR 0.7-1.3), respectively (Table 1).

A NPI cutoff point of 41 was identified for nutritional risk, with a sensitivity of 88% and specificity of 47%, utilizing the highest IY value (0.35), which presents the lowest sum of classification error proportions, in addition to the highest AUC value (Figure 2). The complete data for sensitivity, specificity, YI, and AUC for the NPI reference value analyses are presented in Supplementary Table 1.

Using the proposed NPI reference value of 41, we noted that 82.5% of patients were diagnosed as nutritionally at risk (NPI < 41), while 17.5% were not (NPI ≥ 41). As anticipated, Fisher's exact test revealed a significant association between nutritional risk classification determined by NPI and by RFH-NPT (X^2 (1) = 29.51; p < 0.05) (Table 2).

Within 12 months, 48 patients (40%) did not survive, and 8 underwent liver transplantation. Total mortality analysis at 12 months was significantly higher in the group presenting NPI < 41 compared to the NPI ≥ 41 group (p = 0.023). Among the patients who did not survive during the evaluated period, 91.7% (n = 44) were identified with a NPI < 41 (Table 3).

Discussion

Our study has identified a NPI reference value that was accurate enough to detect nutritional risk in a sample population of ACLD patients, using the validated RFH-NPT tool as reference. The NPI calculation involves lymphocyte count and serum albumin concentration and does not require BMI, which can be challenging to assess when ACLD patients experience oedema and ascites. We have also examined 12-month mortality in our sample population and observed that patients with a NPI < 41 at admission showed a statistically significant association with mortality 12 months later, as compared to patients with a NPI ≥ 41. Our results are novel and add to the portfolio of strategies for ACLD management.

Our sample population consisted of predominantly ACLD males at high nutritional risk, and complications including ascites and portal hypertension syndrome were common. Alcoholic liver disease emerged as the most common aetiology in the sample population. Our study identified a high prevalence of the most severe forms of ACLD, including Child-Pugh B (significant functional compromise) and Child-Pugh C (decompensated disease). It is well-established that the progression of liver dysfunction directly impacts nutritional status, with alcoholic aetiology and the presence of complications such as ascites and portal hypertension syndrome closely associated with the development of malnutrition in liver disease patients [16, 17]. Alcoholic aetiology, as the predominant causative agent of liver disease in our sample population, limits the generalisability of our findings to the broader population of CLD patients. Clinical studies show that patients suffering with Alcohol-related Liver Disease experience more severe nutritional impairment, with a higher

prevalence of low body weight, reduced muscle mass, and deficiencies in vitamins and minerals [11, 18, 19].

A high prevalence of patients at nutritional risk was observed in our study, as identified by both the NPI and the RFH-NPT. We noted that a NPI < 41 cutoff point exhibited greater accuracy in measuring high nutritional risk with good sensitivity, suggesting its effectiveness in nutritional risk screening. Furthermore, a NPI < 41 was associated with higher 12-month mortality in our patients. Previous studies have utilised the NPI in the context of HCC patients [13, 21, 22], but to the best of our knowledge our study is the first to investigate associations between NPI and mortality in ACLD patients, specifically.

The study conducted by García-Rodríguez *et al* [22] was the only prior investigation that we could find to evaluate NPI in liver transplantation scenarios, identifying a score below 40 as nutritional risk, very close to what we have identified in our study. García-Rodríguez also noted a high prevalence of nutritional risk (87.27%) in their population and found that NPI < 40 was an indicator with good sensitivity for nutritional screening of patients with advanced liver disease [23].

The NPI was originally validated for the identification of malnutrition risk in surgical cancer patients [4], and also used as predictor of clinical outcomes in hospitalised elderly patients [6]. More recently, the NPI has emerged as a reliable predictive marker for adverse clinical outcomes in a broader range of conditions, including Severe Acute Respiratory Syndrome Coronavirus 2 [5], chronic kidney disease [24, 25], and cancer [7, 26].

Currently, the NPI stands as an important predictor of negative clinical outcomes and can serve as a practical tool for guiding therapeutic decisions in clinical practice. Garcia-Rodriguez et al. (2017) showed that the NPI had the highest overall agreement with other screening methods, such as the Controlling Nutritional Status score, Nutritional Risk Index, Spanish Society of Parenteral and Enteral Nutrition criteria, and Subjective Global Assessment, in patients awaiting liver transplantation.

The NPI is an easy-to-obtain index with good sensitivity for identifying nutritional risk in patients with compensated liver disease. However, it may demonstrate higher specificity in the more advanced stages of the disease, where nutritional impairment is already evident. This makes early nutritional intervention more feasible, ultimately supporting better clinical outcomes.

Acute or chronic nutritional deficiencies are frequently overlooked, predisposing sufferers to infections and hindering wound healing due to compromised immunity and inflammation resolution response. Nutritional deficiencies are known to extend hospitalisation and to escalate mortality risk. The hospital environment exacerbates malnutrition due to extended periods of fasting for blood tests and procedures, and also due to important changes in dietary habits and unappetising diets [11, 16].

The diagnosis of malnutrition serves as prognostic indicator for negative clinical outcomes, with its delayed detection impeding timely implementation of appropriate nutritional therapy. Therefore, all ACLD patients or those with decompensated CLD should be assessed for nutritional risk within 48 hours of hospital admission [2, 16, 17].

Serum albumin, whilst not a valid index of nutritional status in liver patients, can serve as a useful auxiliary biomarker in nutritional assessment when interpreted alongside other biomarkers. Its usefulness is particularly evident when interpreted alongside lymphocyte counts [23, 27]. In the clinical conditions referred earlier, intense catabolism and acute-phase protein production divert

amino acids away from albumin synthesis, yet the NPI has still proven reliable as both a prognostic and nutritional marker.

In hospital settings, the challenge lies in selecting the most suitable instrument from the portfolio available for nutritional screening of CLD patients. Commonly utilised nutritional screening instruments include the Nutritional Risk Screening 2002 (NRS 2002), Nutrition Risk in the Critically Ill (NUTRIC Score), Mini Nutritional Assessment Short Form (MNA-SF), and the Malnutrition Universal Screening Test (MUST). However, these instruments possess some limitations such as inter-observer variability, reproducibility challenges, necessitate technical expertise, and some are either not recommended for monitoring or lack validation for CLD patients [28].

The challenges of nutritional screening in CLD individuals are particularly daunting, primarily due to fluid accumulation in extracellular spaces. For that reason, the RFH-NPT categorises patients into low, medium, and high nutritional risk groups taking into account the presence or not of ascites and oedema, unintentional weight loss, and alterations in food intake [28, 29, 30]. Alongside the RFH-NPT, Booi *et al* [30] proposed a version of MUST tailored for ACLD patients, known as the Liver Disease Universal Screening Test (LDUST). Containing 6 questions, LDUST demonstrated good sensitivity in identifying nutritional risk among outpatients, but lacks validation for hospitalised individuals [31, 32].

The NPI index facilitates rapid, straightforward, and effective assessment, aiding in clinical decisions [4, 32]. Over the past 5 years, studies have examined NPI's usefulness and reliability in various health conditions, including hepatocellular [22] and gastrointestinal cancer [33,34]. Research on NPI extends to cardiology [35] and neurology [36], as well as patients diagnosed with coronavirus disease [37]. The aforementioned studies show a correlation between lower NPI scores and worsened disease prognosis, along with higher mortality rates [22, 34-37]. Given the scientific evidence available to date, we propose the use of NPI to detect nutritional risk in CLD patients, with the RFH-NPT serving as a reference parameter, if necessary.

NPI cutoff points have been identified across various health conditions. For instance, in HCC a cutoff of 50.25 has been identified [16], while for cerebral venous sinus thrombosis it has been identified as 44.2 [30], and 33.41 for coronavirus infection [37]. In patients diagnosed with heart failure a NPI cutoff of 39.3 was identified, with 50% of the sample population classified as malnourished, and 15% suffering from cachexia [35]. Similarly, in a study involving patients with gastrointestinal tract cancer, an NPI cutoff of 43.9 was determined in a sample mostly composed of eutrophic patients, based on average BMI [34].

The NPI can simultaneously assess the inflammatory process and nutritional risk [38]. Chronic inflammation induces metabolic stress, thereby facilitating the onset of malnutrition [39]. Additionally, the detection of anti-albumin antibodies in CLD patients warrants consideration, with the potential role of naturally occurring antibodies in albumin biological clearance [40].

Despite the varied applications of NPI in disease progression, its role as indicator of nutritional risk in CLD patients specifically remains largely unexplored, alongside the underlying mechanisms governing this relationship. Immunological processes in CLD evolution encompass immune response, inflammation, and partial or total cellular repair, which may vary depending on the disease's aetiology [41, 42]. In the early stages of liver disease progression, the immune response in the liver is activated, subsequently triggering immunological elements mediated by immune cells, leading to exacerbated inflammation and hepatocyte apoptosis. Chronically, this process leads to cellular necrosis and hepatocyte proliferation, potentially culminating in liver fibrosis [42, 43].

The NPI is calculated using lymphocyte count and serum albumin concentration. Both biomarkers are useful in the context of CLD and worth of determination request by the clinician in charge of the hospitalised patient. In decompensated CLD, albumin levels are decreased, and structural abnormalities can be detected, compromising its antioxidant, immunomodulatory, and endothelium-protective functions [43]. Hypoalbuminemia in CLD can stem from increased catabolism and from reduced hepatic synthesis due to hepatocellular dysfunction, resulting in shorter half-life and greater dilution in plasma [44, 45]. Hypoalbuminemia is associated with negative outcomes in a range of diseases [45] and is known to detrimentally affect the immune system. Lymphocyte count assessment in conjunction with serum albumin can assist in clinical prognosis, offering greater prognostic power than either component alone [45].

Conclusion

Our study identifies the Nutritional Prognostic Index as a promising biomarker for identification of nutritional risk in ACLD patients. We have found that a NPI value below 41 is significantly associated with increased 12-month mortality in our population. Therefore, the application of NPI in ACLD enables early and targeted nutritional intervention, mitigating adverse clinical outcomes. Larger scale multi-centre studies recruiting a more diverse CLD population are recommended to validate and extrapolate our findings.

Declaration of competing interest

The authors declare no conflict of interest.

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CRediT authorship contribution statement

Ketsia Meneses Souza Santos: Conceptualization, Investigation, Formal analysis, Visualization, Writing - Original Draft, Writing - Review & Editing.

Ramona Souza da Silva Baqueiro Boulhosa: Conceptualization, Methodology, Investigation, Formal analysis, Writing - Review & Editing.

Laís Spindola Garcêz: Writing - Review & Editing.

André Castro Lyra: Project administration, Writing - Review & Editing.

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Figure 1: Distribution of Nutritional Prognostic Index (NPI) scores in patients with advanced Chronic Liver Disease (ACLD), according to (a) Child-Pugh classification, (b) Meld score, and (c) survival at 12 months.

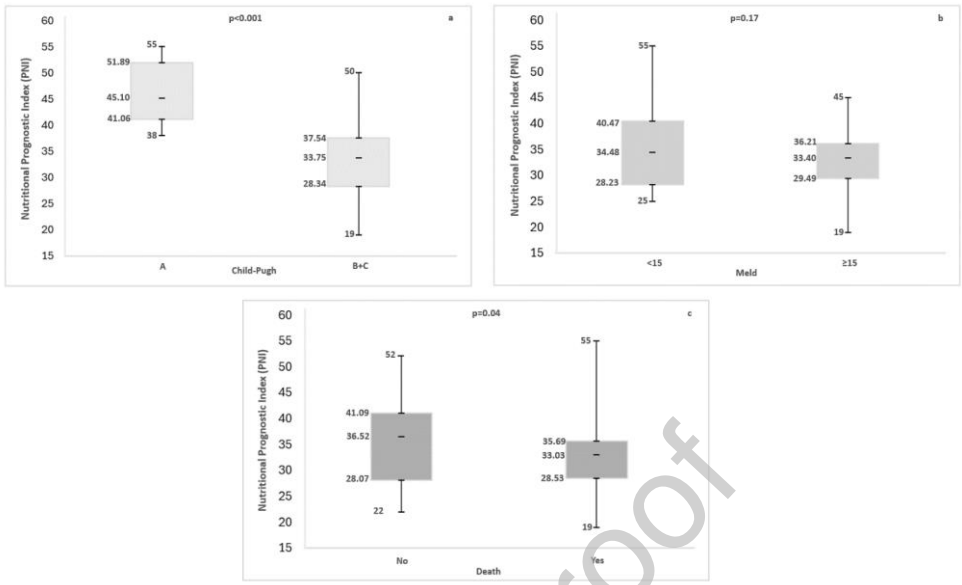
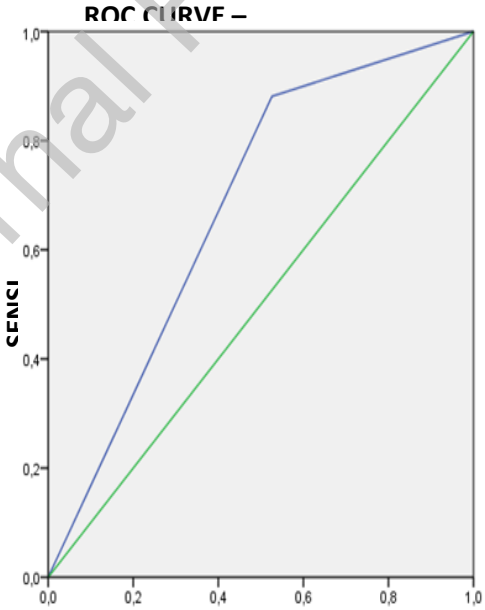


Figure 2: Receiver operating characteristic (ROC) area under the curve (AUC) for the assessment of nutritional risk utilising the Nutritional Prognostic Index (NPI) in the patients with advanced chronic liver disease (ACLD) included in the present investigation, considering the Royal Free Hospital-Nutritional Prioritizing (RFH-NPT) as reference.



REFERENCE-VALUE: 41

AUC: 0.68; 95% CI: 0.53-0.82

Table 1: Demographic and clinical characterization of patients with advanced chronic liver disease (ACLD) included in the present investigation.

Variable	Total (n= 120)
Age (years) (median/IQR)*	56 (50-63)
Male sex (n/%)	84 (70)
Child-Pugh A (n/%)	10 (8.3)
Child-Pugh B & C (n/%)	110 (91.7)
Child-Pugh score (median/IQR)*	9 (7-10)
Model for End-stage Liver Disease (median/IQR)*	14 (11-18)
< 15 (n/%)	65 (57.02)
≥ 15 (n/%)	49 (42.98)
Aetiology (n/%)	
Alcoholic	57 (50.9)
Viral	22 (19.6)
Other	33 (29.5)
Complications (n/%)	
Portal Hypertension Syndrome	100 (87)
Ascites	97 (81.5)
Hepatic Encephalopathy	27 (22.5)
Hepatocellular Carcinoma	15 (12.5)
RFH-NPT Classification (n/%)	
High nutritional risk	101 (84.2)
Moderate nutritional risk	10 (8.3)
Low nutritional risk	9 (7.5)
Nutritional Prognostic Index (mean ± SD)**	34.6 ± 6.8
Total Bilirubin (mg/dL)*	1.8 (1.1-3.9)
Lymphocyte (mm^3)*	1093.6 (725.2-1728.3)
Albumin (mg/dL) (median/IQR)*	2.8 (2.4-3.2)
C-Reactive Protein (mg/dL)*	16.5 (6.3-37.6)
International Normalized Ratio (INR)*	1.3 (1.1-1.6)
Urea (mg/dL)*	35 (31.5-48.5)
Creatinine (mg/dL)*	0.9 (0.7-1.3)

*median and interquartile range (IQR P25th-P75th); **mean ± standard deviation of the mean. Other data were expressed in absolute (n) and relative (%) numbers. Abbreviations: RFH-NPT - Royal Free Hospital Nutrition Prioritizing Tool; NPI - Nutritional Prognostic Index.

Table 2: Agreement analysis of nutritional risk classification between the Nutritional Prognostic Index (NPI) and the Royal Free Hospital-Nutritional Prioritizing Tool (RFH-NPT) in the patients with advanced chronic liver disease (ACLD included in the present investigation.

NPI	**RFH-NPT**				
	Low and medium risk	**High risk**	**Total**	**Kappa (K)***	***p*-value****
< 41	10 (8.3%)	89 (74.2%)	99 (82.5%)		
≥ 41	9 (7.5%)	12 (10.0%)	21 (17.5%)	0.34	0.000
Total	19	101	120		

* Cohen's Kappa Index; ** Kappa significance test. NPI: Nutritional Prognostic Index; RFH-NPT: Royal Free Hospital Nutrition Prioritizing Tool.

Table 3: Association between the Nutritional Prognostic Index (NPI) and 12-month mortality in the patients with advanced chronic liver disease (ACLD) included in the present investigation.

NPI	**Mortality**			
	Yes	**No**	**Total***	***p*-value****
< 41	**44 (91.7%)**	48 (75%)	92 (82.1%)	
≥ 41	**4 (8.3%)**	16 (25%)	20 (17.5%)	0.023
Total	48	64	112	

NPI- Nutritional Prognostic Index; *excludes transplanted individuals (n=8); **chi-square test.

Declaration of interests

☒The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: