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Royal Free Hospital Nutrition Prioritizing Tools (RFH-NPT): Predictor of Malnutrition Risk among Chronic Liver Disease Patients

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ABSTRACT

This study is aimed to investigate the prevalence of malnutrition using Royal Free Hospital Nutrition Prioritizing Tools (RFH-NPT) and the correlation between malnutrition and RFH-NPT with clinical parameters. A total of 80 cirrhosis liver patients without liver cancer were enrolled in this prospective study. This study was conducted at Selayang hospital, which is the national tertiary referral centre for liver disease in Malaysia. We administered the nutrition screening of RFH-NPT to the patients within 24 hours after admission. The utilization of the RFH-NPT resulted in a higher incidence of nutritional risk, at 73%. The RFH-NPT revealed a higher proportion of Child Pugh C patients at risk for malnutrition (46/50 or 92%, p= 0.002) and had superior capability in identifying patients with intermediate and high risk for malnutrition (35/61 or 57.3%, p=0.012) within the subset of patients with Model for End-Stage Liver Disease (MELD) scores below 15. Hence, we propose that the utilization of the RFH-NPT enhances medical professional's capacity for early-stage prediction of malnutrition risk in patients with cirrhosis predominantly attributed to hepatitis virus infection.

Keywords: cirrhosis, liver disease, Nutrition Risk Screening 2002 (NRS 2002), nutrition screening, Royal Free Hospital Nutrition Prioritizing Tools (RFH NPT)

INTRODUCTION

According to available estimates, a significant proportion ranging from 50% to 90% of individuals diagnosed with cirrhosis in Malaysia exhibit indications of advanced liver disease (Rahman *et al.* 2015). Malnutrition is a significant contributing factor to the exacerbation of liver cirrhosis, a condition that affects a substantial portion of the global population, ranging from 60% to 90% (Wu *et al.* 2020). There is a significant correlation between malnutrition and several adverse health outcomes, including increased mortality rates, heightened incidence of portal hypertension complications, prolonged hospitalization periods, and elevated susceptibility to infections (Tandon *et al.* 2017). The positive impacts of nutritional therapy encompass a reduced likelihood of extended hospital stays, diminished severity of systemic inflammatory response, decreased occurrence of infections, and lower mortality rates among malnourished patients admitted collectively. Despite the absence of large-scale, well-designed studies on cirrhosis, nutritional therapy has demonstrated success in certain cases. Individuals with malnutrition should be identified as soon as possible to begin nutritional therapy. Therefore, patients will undergo a brief nutritional assessment to determine if they are at risk of malnutrition. Patients at risk should have a thorough nutritional assessment to determine the presence and severity of malnutrition (Reber *et al.* 2019). Due to the lack of a validated rapid nutritional screening tool, the various definitions of malnutrition, and the difficulty in clarifying body composition and laboratory results in volume overload and liver dysfunction (Purnak & Yilmaz 2013), nutrition screening and assessment are rarely performed in patients with liver disease.

The concept of malnutrition lacks a broadly agreed-upon description; however, it can be conceptualized as the state of nutritional instability resulting from insufficient nutrition. Malnutrition is characterized as an adverse nutritional condition that gives rise to detrimental clinical consequences. Given that malnutrition

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can arise from either a deficiency in essential nutrients or excessive consumption of nutrients, sometimes referred to as overnutrition, it is important to distinguish between the terms 'undernutrition' and 'malnutrition' and avoid using them interchangeably (Cederholm *et al.* 2015).

Individuals suffering from hepatic illnesses face a heightened susceptibility to malnutrition due to the liver's crucial involvement in regulating nutritional status and energy stability. Chronic liver illness may also be accompanied by appetite suppression and decreased absorption of nutrients. Consequently, the etiology of malnutrition in individuals with hepatic diseases is complex and involves multiple factors (Georgiou *et al.* 2019; Skladany *et al.* 2021).

The American Society for Parenteral and Enteral Nutrition (ASPEN) (Reber *et al.* 2019) defines nutritional screening as identifying people at risk or already malnourished. Identifying malnourished hospital patients is critical. A simple and effective dietary risk screening tool is essential. This approach would enable early nutrition assessment and intervention, reducing cirrhosis patient mortality and morbidity (Borhofen *et al.* 2016). This screening aids nutritional assessment and diet therapy development. The European Society for Clinical Nutrition and Metabolism (ESPEN) recommends quick and easy screening by community healthcare or admission teams (Lochs *et al.* 2016). An ideal screening instrument has sufficient sensitivity and specificity (Jeejeebhoy *et al.* 2015), can be used by unskilled healthcare personnel, and can be used by patients.

Performing daily system-wide nutritional monitoring for high-risk patient groups is not a common practice. Moreover, the disregard for preventive measures leads to a rise in the economic burden of cirrhosis as a result of malnutrition (Rahman *et al.* 2015). Consequently, individuals who experience malnourishment or are susceptible to it are frequently disregarded until they manifest severe malnutrition or encounter a health issue that poses a threat to their lives. The assessment of nutritional risk factors involves considering the interplay between inflammation and malnutrition, which is influenced by both the individual's nutritional status and the severity of their underlying disease (Heyland *et al.* 2013). According to the European Society for Nutrition and Surgical Outcomes Network (ESPEN), nutrition risk can be defined as the probability of experiencing either a favorable or unfavorable outcome about a disease or surgical procedure, which is determined by an individual's nutritional and metabolic condition (McClave *et al.* 2016).

Patients with liver cirrhosis face many nutritional issues due to the disease, including Protein-Energy Malnutrition (PEM). This condition is observed in a significant proportion of cases, ranging from 65% to 90%, but it is often not adequately recorded (Palmer *et al.* 2019). Malnutrition poses a significant concern for hospitalized patients across several medical conditions, extending beyond the scope of liver cirrhosis. Identifying malnutrition in individuals with liver disease poses challenges when fluid excesses, such as ascites and edema, are present. Moreover, the presence of ascites-induced intra-abdominal pressure has been linked to symptoms such as nausea, vomiting, and an early sensation of satiety. Hence, it is recommended that the Royal Free Hospital Nutritional Prioritising Tool (RFH-NPT), originally designed as a nutritional screening tool for liver disease (Tandon *et al.* 2017), be employed in evaluating the nutritional status of all individuals diagnosed with liver illness.

This study aims to investigate the prevalence of malnutrition using RFH-NPT and the correlation between malnutrition and RFH-NPT with clinical parameters. The RFH-NPT screening test has been established as the primary and exclusive validated method for identifying malnutrition among this particular demographic. The routine utilization of RFH-NPT as a nutrition screening method in the hepatology department has proven to be an effective means of identifying patients at risk of malnutrition and requiring early nutritional intervention.

METHODS

Design, location, and time

The present investigation is characterized as a cross-sectional study. This study recruited individuals who had been pathologically diagnosed with liver cirrhosis and met the inclusion criteria from Malaysia's national tertiary referral center for liver disease. The estimated sample size for this phase was 80 samples using Raosoft, 2004 formula. After written informed consent was acquired from patients, RFH-

NPT was assessed by nurses within 24 hours after patient admission. The present study was initiated from January 2019 to January 2021. The present investigation employed inclusion criteria that encompassed patients who were 18 years of age or older, individual has been diagnosed with Chronic Liver Disease (CLD) for a minimum of six months, is vigilant, capable of effective communication, and the hospitalization duration must exceed 48 hours. The study implemented several exclusion criteria, including individuals under the age of 18 who were in an acute state, individuals with neurological problems, disorders, or dementia, patients who were admitted to the Intensive Care Unit (ICU) and were in a critical condition, and individuals who declined to participate. This procedure was authorized by the Malaysian Medical Research Ethics Committee (MREC)-NMRR-19-1659-47627, prior to the commencement of recruiting.

Sampling

Royal Free Hospital-Nutritional Prioritizing Tool (RFH- NPT). The RFH-NPT is a developed nutrition screening tool from the United Kingdom (Amodio *et al.* 2013). Its score has been found to have significant associations with various clinical factors, including clinical deterioration, disease severity, the Child-Pugh score, the Model for End-stage Liver Disease (MELD) score, as well as clinical complications such as ascites, hepatorenal syndrome, and episodes of Hepatic Encephalopathy (HE) (Rajab *et al.* 2023). The RFH-NPT steps consist of three primary steps: 1) Individuals presenting with alcoholic hepatitis or undergoing tube feeding are promptly identified as being at a heightened risk, thereby bypassing subsequent evaluation steps. 2) Individuals lacking alcoholic hepatitis and not undergoing tube feeding are subjected to an assessment targeting fluid overload, its potential influence on food consumption, and associated weight reduction. 3) Individuals devoid of fluid overload are subjected to an evaluation of their nutritional status, encompassing parameters such as Body Mass Index (BMI), unintentional weight loss, and daily dietary intake. Patients are categorized into different risk groups based on the scores: low risk (score of 0), moderate risk (score of 1), and high risk (score of 2–7). Furthermore, an increased RFH-NPT score (Wu *et al.* 2020) was associated with improved survival outcomes. The complete procedure requires less than three minutes and can be executed by individuals without specialized expertise (Wu *et al.* 2020). RFH-NPT has been validated in Malaysia with a moderate specificity of 74% and a high sensitivity of 97% respectively (Borhofen *et al.* 2016). The study concluded that RFH-NPT demonstrates positive and fair agreement between gold standard SGA and RFH-NPT to be used as a routine nutrition screening protocol for identifying patients at risk of malnutrition.

Data collection

The study gathered all individuals' demographic, anthropometric, and clinical data within 48 hours of admission. This data included information on gender, age, weight, height, BMI, lifestyle habits such as alcohol consumption and smoking, diagnosis, Child Pugh Score, and MELD score. Fasting blood samples were obtained within 48 hours of admission using normal laboratory techniques to measure serum albumin and total serum protein levels.

Data analysis

Statistical analysis was conducted using Statistical Package for the Social Sciences (SPSS) version 26 for Windows. Descriptive statistics were used to assess the baseline parameters. Categorical data are shown as frequencies and percentages and as for numerical data, means with Standard Deviations (SD) are given for normally distributed variables. The continuous variables are described as mean values and standard deviations or medians with ranges. The differences between means were analyzed using independent Student's t-tests. Nominal variables are described as numbers or percentages, and their differences were analyzed with Pearson's $\chi 2$ test, Fisher's exact test, or the McNemar test.

RESULTS AND DISCUSSION

Table 1 shows key patient features. This study included 80 participants with a mean age of 54.0 years and an SD of 8.2 years. Participants were 33–61. The most common liver diseases were hepatitis C (26%), and Non-Alcoholic Liver Disease (NASH) (22%). Thirty individuals (38% of the sample) had Child Pugh class C cirrhosis. Decompensated cirrhosis was found in 68.4% of patients and compensated in 31.6%. Nine percent

Table 1. Patients overall characteristic (n=80) and fundamental clinical indicator

Index	n (%)	Mean**	SD**
Age (years)		54.0	8.2
Sex			
Female	50 (62)		
Male	30 (37)		
BMI (kg/m²)		21.4	1.31
Dry weight BMI (kg/m²)		20.4	2.71
Ethnicity			
Malay	40 (50)		
Chinese	21 (26)		
Indian	15 (19)		
Other	4 (5)		
Aetiology of cirrhosis			
Hepatitis C	21 (26)		
Alcohol	15 (19)		
NASH	18 (22)		
Hepatitis C/ETOH	12 (15)		
Others	14 (18)		
Total serum protein (g/L)		79.8	2.65
Albumin (g/L)		35.16	2.41
Child Pugh Score		7.40	0.93
MELD score		6.80	3.02
Cirrhosis			
Compensated		26 (31.6)	
Decompensated		54 (68.4)	
NRS 2002		2.58	0.56
No to low risk	42 (52)		
No to high risk	38 (48)		
RFH-NPT		1.40	0.75
Low risk	30 (37)		
Moderate to high risk	50 (63)		
Hepatic encephalopathy			
Absent	72 (90)		
Present	8 (10)		
Ascitess			
Absent	43 (54)		
Present	37 (46)		

**Mean values and standard deviations; median values and ranges numbers and percentages
BMI: Body Mass Index; MELD: Model for End-stage Liver Disease; NRS: Nutrition Risk Screening; RFH-NPT: Royal Free Hospital Nutrition Prioritizing Tools; SD: Standard Deviation

(8 patients) had hepatic encephalopathy, and 46.5% (37 patients) had ascites.

RFH-NPT showed that 73% (95% CI: 60%–95%) of patients were sensitive to malnutrition. The whole sample had a median BMI of 21.4 kg/m², ranging from 19.8 to 26.41 kg/m². Table 1 shows basic clinical markers in decompensated and non-decompensated cirrhosis patients. There was no significant gender or age difference between decompensated cirrhosis groups and those without. BMI and blood total protein levels did not differ between compensated and decompensated cirrhosis groups. Decompensated cirrhosis significantly reduced the remaining clinical indices compared to the control group. In the 80 decompensated cirrhosis patients, 10%

(8/80) had hepatic encephalopathy and 37% (46/80) had ascites. Decompensated cirrhosis patients had worse anthropometric measurements and laboratory indicators.

Association of malnutrition risk identified by RFH-NPT with poor clinical parameters

There was no significant difference in the distribution of genders between patients categorized as having a low risk of malnutrition and those classified as having a moderate to high risk, p=0.08. There were no significant differences in age distributions between the risk of malnutrition and the RFH-NPT tool, p=0.06. This study found that the patients classified as moderate to high risk of malnutrition group indicated by the RFH-NPT exhibited considerably lower levels of total serum protein and albumin.

In Table 2, the RFH-NPT technique found a greater probability of malnutrition in Child Pugh class C patients (46/50 or 92%, p=0.002). In the subset of MELD scores below 15, RFH-NPT identified intermediate and high-risk malnutrition patients (35/61 or 57.3%, p=0.012). There was no statistically significant difference in malnutrition risk identification among patients with MELD scores greater than 15 using RFH-NPT evaluation techniques. No ascites patients had a low risk of malnutrition according to the Royal Free Hospital-Nutritional Prioritising Tool. The RFH-NPT also detected probable malnutrition in 43 of 72 individuals (60%) without hepatic encephalopathy (p=0.001).

The implementation of an effective and straightforward nutrition risk screening method is of paramount significance. The implementation of such a tool will enhance the process of early nutrition assessment and timely intervention, ultimately leading to a reduction in mortality and morbidity rates among patients who have been diagnosed with cirrhosis (Borhofen *et al.* 2016).

Prior research conducted in Europe has indicated that the RFH-NPT exhibits more sensitivity compared to the standard screening tool used, NRS 2002 (Nutritional Risk Screening) when evaluating the likelihood of malnutrition and forecasting disease progression and outcomes in individuals diagnosed with chronic liver disease (Ney *et al.* 2017; Plauth *et al.* 2019). A study conducted in Europe revealed a higher incidence of malnutrition among individuals diagnosed with alcoholic cirrhosis compared to those diagnosed with viral cirrhosis (Georgiou *et al.* 2019). This could be due to alcohol intake in Europe is well recognized as the predominant factor contributing to the development of liver cirrhosis. The RFH-NPT specifically incorporates variables relating to alcohol consumption. Hence, it can be inferred that the utilization of the RFH-NPT leads to a higher estimation of malnutrition risk in cirrhosis patients compared to the application of standard nutrition screening techniques. On the other hand, a significant proportion of liver cirrhosis cases in Asia can be attributed to viral hepatitis, obviating the need for assessing alcohol usage. The RFH-NPT assessments revealed an overall

Table 2. Nutrition risk screening RFH-NPT with different child pugh classes and MELD score

Child pugh class	RFH-NPT		Total	*p*
	Low risk	Moderate to high risk		
A	19	1	20	1
B	7	3	10	0.055
C	4	46	50	0.002*
Total	30	50	80	
MELD score				
<15	26	35	61	0.012*
≥15	4	15	19	0.065
Total	30	50	80	

*Statistically significant $p<^{0.05}$; A: Child-pugh class A (well-compensated disease) [5–6]; B: Child-pugh class B (significant functional compromise) [7–9]; C: Child-pugh class C (decompensated disease) [10–15]

MELD: Model for End-stage Liver Disease; RFH-NPT: Royal Free Hospital Nutrition Prioritizing Tools

prevalence of malnutrition of 73% and 48% in patients diagnosed with cirrhosis, respectively. The findings of our study revealed a comparable prevalence of malnutrition, consistent with previous research, which demonstrated rates ranging from 55% to 70% as evaluated using the RFH-NPT and from 31% to 45% as evaluated using the NRS 2002 (Wu *et al.* 2020).

The occurrence of malnutrition is widespread across many types of liver illness, with rates ranging from 20% in individuals with compensated liver disease to over 80% in people experiencing decompensated liver disease (Sharma *et al.* 2017). The findings of this study indicate that the RFH-NPT method revealed a range of malnutrition prevalence rates, with 31.6% observed in patients with compensated cirrhosis and 68.4% observed in patients with decompensated cirrhosis. Similarly, the NRS 2002 method identified malnutrition prevalence rates of 22.4% and 64.2% in patients with compensated and decompensated cirrhosis, respectively. The substantial consensus regarding the occurrence of malnutrition in individuals with compensated cirrhosis provides strong evidence for the reliability of the RFH-NPT.

This study showed that the RFH-NPT method demonstrated a higher efficacy in detecting the danger of malnutrition (46 out of 50 cases, or 92%) among patients diagnosed with Child-Pugh class C condition, hence supporting the aforementioned hypothesis. It is recommended that patients diagnosed with Child-Pugh class B and C disease receive nutritional interventions promptly, even before any clinical indication of malnutrition becomes apparent. Conversely, patients with Child-Pugh class A disease should undergo thorough evaluations to facilitate the timely implementation of necessary support (Mendenhall *et al.* 1995). Hence, the utilization of the RFH-NPT by clinical personnel offers a convenient and expeditious means of identifying patients who may be susceptible to malnutrition, obviating the need to await the evaluation of the Child Pugh class prior to doing a comprehensive nutritional assessment.

The present study is subject to constraints due to its reliance on data obtained only from a single center. Initially, a limited number of participants were included in the assessment of the RFH-NPT's sensitivity and specificity. Consequently, further prospective investigations are necessary. Nevertheless, the inclusion of anthropometric and biochemical data that indicate various facets of malnutrition has enhanced our capacity to distinguish between these instruments. Furthermore, specific data points were based on subjective evaluations conducted by patients and clinical staff, which introduces the possibility of recall and observer bias.

CONCLUSION

The objective of this study was to evaluate the efficacy of employing the RFH-NPT as a screening tool for identifying nutritional risk in individuals with cirrhosis, primarily caused by hepatitis virus infection, in the context of Malaysia. The RFH-NPT has demonstrated improved capacity in predicting the probability of malnutrition in persons diagnosed with cirrhosis, hence displaying a higher level of prognostic effectiveness. The RFH-NPT has demonstrated a reduced rate of misclassification for individuals in the first stages of cirrhosis who are susceptible to malnutrition. Therefore, the RFH-NPT can serve as a valuable instrument in rapidly identifying persons in need of nutritional therapy, thus reducing the occurrence of complications. Additional investigation is necessary to assess the prognostic effectiveness of the RFH-NPT in larger study populations.

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DECLARATION OF CONFLICT OF INTERESTS

The authors declare that there are no conflicts of interest.

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