ORIGINAL ARTICLE

The Nutritional Profile and Quality of Life of Cirrhosis Patients without Encephalopathy at Hospital Selayang

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Abstract:

Prevalence of malnutrition was 63.0% and 18.3% in cirrhotic and non-cirrhotic patients, respectively and is correlated with the increased of mortality and morbidity among cirrhotic patients. This study aimed to investigate the relationship between nutritional profile and quality of life of cirrhosis patients without encephalopathy at Hospital Selayang. 28 cirrhosis patients without encephalopathy were recruited in this cross-sectional study. Descriptive analysis was deployed to evaluate the nutritional profile and quality of life. The mean age, BMI, calorie and protein intake, and albumin of the patients were 53.14 ± 8.51 years, 22.19 ± 4.60 kg/m², 19.21 ± 7.84 kcal/kg/day, 0.60 ± 0.32 g/kg/day and 2.45 ± 0.52 mg/dL respectively. 78.6% of them were in SGA score B. Quality of life of the patients was poor as presented on most domains. There was a significant ($p<0.05$) with negative fair correlation ($r= -0.417$) between SGA score and physical functioning. There also a significant ($p<0.05$) with negative fair correlation ($r= -0.389$) was found between SGA score and vitality. The nutrient intake and quality of life of the patients was poor. Further research is needed on the development of nutrition screening tool and updated nutritional recommendation for cirrhosis patients without encephalopathy for the improvement in nutritional status and quality of life.

Keywords: cirrhosis, encephalopathy, nutritional profile, quality of life

1. INTRODUCTION

Liver is the largest gland in the body which plays various roles in carbohydrate, protein and fat metabolism, vitamins and minerals storage and activation, bile formation and excretion, conversion of ammonia to urea, steroids metabolism, removal of substances such as drug, alcohol and organic compounds, and also filter and flood chamber [1]. In fact, the liver has the capability to regenerate itself and even only requires 10% to 20% of functioning liver to support life [2]. Cirrhosis is a complication of liver disease which involves damage of liver cells and irreversible scarring of the liver. It is caused by many types of liver diseases and conditions such as chronic alcoholism and hepatitis. Besides, cirrhosis has become a major concern in public health as globally, it was the 12th leading cause of death which responsible for 1 million deaths in 2010 [3]. Meanwhile, a syndrome observed in patients with cirrhosis is known as hepatic encephalopathy. The risk of developing hepatic encephalopathy in individual with liver cirrhosis is 20% per year and in any time about 30 - 45 % of people with cirrhosis show sign of covert encephalopathy [4].

Patients with liver disorders are unexpectedly at risk in developing malnutrition as the liver responsible in the regulation of nutritional state and energy balance. The existence of chronic liver diseases might reduce the appetite and thus affecting the nutrient intake. Moreover, the poor nutritional status becomes more prominent among different groups of patient with liver diseases especially in patients with alcoholic cirrhosis who are at high nutritional risk. It is also well-known that malnourished patients with liver diseases will have a high risk of developing unfavorable clinical outcomes and rise the medical cost [5]. Malnutrition is prominent in patients with cirrhosis, notably those with advanced disease. The malnutrition rate in patients with cirrhosis is ranging from 50% to 90% [6]. The cause of malnutrition in patients with cirrhosis is multifactorial including anorexia, inefficient digestion/absorption and impaired metabolism [7]. Malnutrition is one of the most prominent complications in the growing number of patients suffering from chronic liver disease (CLD) and is a leading cause of morbidity and mortality [8].

Naturally, cirrhosis has a lengthy history with significant symptomatic impacts, particularly in more severe condition [9]. The quality of life of cirrhotic patients is significantly correlated with the disease severity [10]. There are many factors that affect Health-Related Quality of Life (HRQoL) and impact the patients with cirrhosis in term of the overall health of a person, their support system and access to the health care. A patient who is having compensated cirrhosis may have appropriate liver function but also can experience

various symptoms that can inversely impact their functioning level and HRQoL [10]. Without being influenced by the severity of liver disease, symptoms such as depression, state and trait of anxiety and alexithymia are most commonly to occur in c patient with cirrhosis and also the major source of altered HRQoL [11].

It is suggested that measuring HRQoL in liver disease provides a detail about the nature and extent of its effects on individuals. Apart from that, comprehension of the contributory factors of impaired HRQoL may be benefited in identifying targets for improvement through new treatments or health system service delivery [12]. The aims of this study were to evaluate the nutritional profile and quality of life, and to investigate the relationship between nutritional profile and quality of life of cirrhosis patients without encephalopathy at Hospital Selayang.

2. METHODOLOGY

2.1 Study design

A cross-sectional study of 28 cirrhotic patients without encephalopathy who are aged 18 years old and above, and admitted in Hepatology ward, Hospital Selayang for the reason of decompensation of cirrhosis more than 2 days will be included. Patients with fever, human immunodeficiency virus (HIV) infection, overt infectious disease such as septicemia, pneumonia, tuberculosis and urinary tract infection, under immunomodulatory therapy and diagnosed with chronic diseases such as diabetes mellitus, renal and cardiac insufficiency, neoplasia and acquired immunodeficiency syndrome will be excluded.

2.2 Nutritional Assessment

Anthropometry

For anthropometric measurements, body weight, height, skinfold thickness [chest skinfold thickness (CST), triceps skinfold thickness (TST) and subscapular skinfold thickness (SST)], knee height (KH) and mid-upper arm circumference (MUAC) were collected. Participants who were able to stand erectly, the body weight and height were measured using weighing scale and stadiometer. For those who were unable to stand to be measured using weighing scale, the estimation of weight was made using knee height and mid-upper arm circumference [men: weight = (1.10 x KH) + (3.07 x MUAC) – 75.81; women: (1.01 x KH) + (2.81 x MUAC) – 66.04] [13]. Meanwhile, for those who were unable to stand to be measured using a stadiometer, the estimation of height measurement was made using knee height [men: height = 69.38 + (1.924 x KH); women: height = 50.25 + (2.225 x KH)] [14]. The body mass index (BMI) was calculated from weight/estimated weight and height/estimated height [BMI = weight/height² (kg/m²)]. The measurement of skinfold thickness was done using skinfold caliper. Fat mass calculation [fat mass= current body weight x (BF %/100 %)] will be made prior to the calculation of fat free mass will be made [FFM= body weight (kg) – fat mass (kg)]. Prior to the calculation of BF % [body fat percentage= (4.95/body density – 4.50) x 100], the calculation of body density using skinfold measurement [men: 1.1125025 - 0.0013125(X3) + 0.0000055(X3)² – 0.0002440(X2); women: 1.089733 – 0.0009245(X3) + 0.0000025(X3)² – 0.0000979(X2); (X3 = sums of CST, TST and SST; X2 = age in years)] will be made [15-16].

Biochemical Data

The value of albumin, total bilirubin, alanine aminotransferase (ALT) and alkaline phosphatase (ALP) was used to measure the nutritional status. ALT and ALT increased with liver cell damage.

Nutrition-Focused Physical Findings

The nutritional profile was determined by using a nutrition assessment tool which is Subjective Global Assessment (SGA). The SGA is a validated assessment tool in a variety of patient population. The severity of liver disease was determined using the Child-Pugh score with grades A (mild) to C (severe) indicating degree of liver reserve and function.

Food/Nutrition-Related History

The dietary intake was measured using weighed food record for 3 days which is two days on weekdays and one day on weekend. The leftover was reported as well. This is a gold-standard method which gives an accurate measurement and can provide detailed food intake data of patient's intake. It also does not depend on patient's memory because the food and beverage consumption is recorded at the time of eating. Hence, weighing scale and diary were needed to perform this method.

2.3 Quality of Life

The Health-Related Quality of Life questionnaire (SF-36) was used to assess the quality of life of the patients. Both validated Malay and English version of SF-36 were used in this study. This questionnaire consists of eight (8) main domains which are physical functioning, role limitations due to physical health, role limitations due to emotional problems, vitality, emotional well-being, social functioning, pain and general health perception. The higher score correspond to better HRQoL, vice versa [17, 12].

2.4 Statistical Analysis

Data analysis will be analysed by using Statistical Package for Social Science (SPSS) version 21.0. A descriptive analysis of the nutritional profile and quality of life was performed. Numerical value was expressed as mean and standard deviation while for the categorical variable, frequency and percentage were reported. The association between the nutritional profile and quality of life was measured by using correlation and p-value of less than 0.05 was set as statistically significant.

3. RESULT

The average age of the participants was 53 years old with standard deviation of 8.51. With regard to gender, 22 (78.6%) of the participants were male while the other 6 (21.4%) were female. There were wide variety of races that had participated in this study in which 12 (42.9%) of the participants were Malay, followed by 10 (35.7%) Chinese, 4 (14.3%) Indian, and 2 (7.1%) from others. For the status of the participants, most of them 25 (89.3%) have been married

while only a small number of participants 3 (10.7%) were single.

3.1 Nutritional Profile

The nutritional profile of the participants in term of anthropometric data, biochemical data, nutrition-focused physical findings and food/nutrition related history is presented in Table 1.0 below:

Table 1: Descriptive statistics of anthropometric data, biochemical data, nutrition-focused physical findings and food/nutrition related history (N=28)

Variable	Mean ± SD
Anthropometric data	
BMI (kg/m²)	22.19 ± 4.60
Body fat percentage (%)	15.48 ± 5.47
Fat free mass (kg)	49.52 ± 11.20
Biochemical data	
Albumin (g/dL)	2.45 ± 0.52
Total bilirubin (mg/dL)	6.81 ± 9.00
Alanine aminotransferase (IU/L)	50.64 ± 63.07
Alkaline phosphatase (IU/L)	165.00 ± 143.39
Child-Pugh score (N/%)	
A	3 (10.70)
B	14 (50.00)
C	11 (39.30)
SGA score (N/%)	
A	6 (21.40)
B	22 (78.60)
C	-
Food/nutrition related history	
Calorie intake (kcal/kg/day)	19.21 ± 7.84
Protein intake (g/kg/day)	0.60 ± 0.32

The anthropometric data in the table above shows the mean BMI of the participants was 22.19 ± 4.60 kg/m². Meanwhile, the mean body fat percentage and fat free mass were 15.48 ± 5.47 and 49.52 ± 11.20 respectively.

Besides, the biochemical data that had been obtained from this study were albumin (g/dL) with the mean 2.45 ± 0.52 which below than normal range, total bilirubin (mg/dL) 6.81 ± 9.00 which above than normal range, alanine aminotransferase (IU/L) 50.64 ± 63.07 and alkaline phosphatase (IU/L) 165.00 ± 143.39 which both also above than normal range.

Normal values range for albumin is from 3.5 g/dL to 4.5 g/dL. Chronic liver disease such as cirrhosis usually accompanied with albumin levels low than 3.0 g/dL. It also may occur in protein malnutrition, nephrotic syndrome and chronic protein losing enteropathies [18]. For total bilirubin, the normal values range is from 0.3 mg/dL to 1.7 mg/dL with increased level above than normal value indicates liver disease, biliary obstruction and cirrhosis. On the other hand, normal values range for alanine aminotransferase and alkaline phosphatase are 8.0 U/L to 45.0 U/L and 30.0 to 130.0 U/L respectively. An individual with liver cirrhosis may have elevated values of alanine aminotransferase and alkaline phosphatase [19].

When being classified according to the Child-Pugh score, half of the participants, 14 (50%) were at class B and followed by class C, 11 (39.30). The least number of participants were in class A, 3 (10.7%). Class A indicates 100% and 85% of survival in one year and two years respectively. Meanwhile, Class B indicates 81% of survival in one year and 57% of survival in two years. Class C represents 45% and 35% of survival in one year and two years respectively [20].

As the participants being categorised according to SGA score, more than three quarter of the participants, 22 (78.6%) were grade B while the rest of the participants were at grade A, 6 (21.4%). Grade A indicates the participants were in a well-nourished state while grade B indicates the participants were in a mildly-moderately malnourished. Grade C indicates the participants were in a severely malnourished state.

Nevertheless, the mean calorie intake of the participants was 19.21 ± 9.84 kcal/kg/day which below than recommended. The recommended energy intake for cirrhosis patients without encephalopathy is 25 to 35 kcal/kg/day [6,21-23]. Besides, the mean protein intake of the participants was 0.60 ± 0.32 g/kg/day which are far below than recommended. The recommendation of protein intake for cirrhosis patients without encephalopathy is 1.0 to 1.5 g/kg/day [23].

3.2 Quality of Life

The quality of life of the participants was evaluated by using the Health-Related Quality of Life questionnaire (SF-36). This questionnaire contains eight domains which are physical functioning, role limitations due to physical health, role limitations due to emotional problems, vitality, emotional well-being, social functioning, bodily pain and general health. All questions are scored on a scale from 0 to 100 representing the highest level of functioning possible. Using the RAND scoring table, the total score are compiled as a percentage of the total points possible. All the eight domains of SF-36 questionnaire are shown in the Table 2 below.

Table 2: Descriptive statistics of health-related quality of life of cirrhosis patients without encephalopathy (N=28).

Variable	Mean ± SD
Domains (%)	
Physical functioning	33.57 ± 29.47
Role limitations due to physical health	18.75 ± 38.86
Role limitations due to emotional problems	
Vitality	41.67 ± 49.38
Emotional well-being	
Social functioning	44.82 ± 28.72
Bodily pain	62.00 ± 24.11
General health perceptions	81.70 ± 23.44
	50.36 ± 32.66
	46.68 ± 23.63

Referring to Table 2 above, the mean physical functioning was 33.57 ± 29.47, suggests that the participants is experiencing about 66% loss of physical functioning. Meanwhile, the participants faced the severe role limitation due to physical health with mean 18.75 ± 38.86. However, the mean role limitations due to emotional problems faced by the participants were 41.67 ± 49.38. With regards to vitality, the participants experienced about 55% loss of energy with mean 44.82 ± 28.72. The participants also losses about 38% of emotional well-being with mean 62.00 ± 24.11. Even though the bodily pain experienced by the participants quite significant with mean 50.36 ± 32.66, but the participants still have a good social functioning with

mean 81.70 ± 23.44. Overall, the general health perceptions of the participants are quiet low with mean 46.68 ± 23.63.

3.3 Association between the Nutritional Profile and Quality of Life

For biochemical data, there was a significant ($p<0.05$) with positive fair correlation ($r=0.386$) between alkaline aminotransferase value and emotional well-being. Nevertheless, there is no significant with positive fair correlation between albumin value and social functioning ($p>0.05$, $r=0.357$), general health perception and albumin value ($p>0.05$, $r=0.274$), alkaline aminotransferase value and role limitations due to physical health ($p>0.05$, $r=0.368$), alkaline aminotransferase value and role limitations due to emotional health ($p>0.05$, $r=0.287$), alkaline aminotransferase value and vitality ($p>0.05$, $r=0.268$), alkaline aminotransferase value and social functioning ($p>0.05$, $r=0.269$), alkaline aminotransferase value and bodily pain ($p>0.05$, $r=0.290$), alkaline phosphatase value and role limitations due to physical health ($p>0.05$, $r=0.308$), and alkaline phosphatase value and social functioning ($p>0.05$, $r=0.308$). Total bilirubin value was no significant with negative correlation with general health perceptions ($p>0.05$, $r=-0.283$).

Regarding nutrition-focused physical findings, the correlation analysis revealed that there was a significant ($p<0.05$) with negative fair correlation ($r=-0.417$) between SGA score and physical functioning. There also a significant ($p<0.05$) with negative fair correlation ($r=-0.389$) was found between SGA score and vitality. However, there was no significant with negative fair correlation between SGA score and bodily pain ($p>0.05$, $r=-0.266$), CP score and emotional well-being ($p>0.05$, $r=-0.317$), and between CP score and general health perceptions ($p>0.05$, $r= -0.365$).

4. DISCUSSION

4.1 The Nutritional Profile

Nutritional status is a predictor of morbidity and mortality in patients with advanced hepatic disease [24]. In this study, the nutritional profile of cirrhosis patients without encephalopathy at Hospital Selayang was assessed by using anthropometric data, biochemical data, nutrition-focused physical findings and food/nutrition related history.

Anthropometric evaluation is a must in any nutritional assessment [25]. Among the anthropometric data used was body mass index (BMI), body fat percentage (BF %) and fat free mass (FFM). In previous study, normal BMI range was also found among Malaysian patients with advanced cirrhosis, Japanese, and Thailandese patients [10,26-27]. WHO nominates BMI <18.5 kg/m² as a general cut-off point for underweight. Relatively, due to the strong global acceptance of the WHO cut-off point of 18.5 kg/m², it was decided without exception to accept the WHO recommended cut-off of as a criterion that in its own right will be enough to diagnose malnutrition [28].

Body composition status such as FFM and BF % reflects nutritional intakes, losses and needs over time along with the prevalence of undernutrition [29]. Low FFM and BF% commonly found in older individuals [30-33]. With regard to the biochemical assessment of nutrition, albumin is one of the most common and useful indicator to measure of malnutrition. However, it is synthesized in the liver, and therefore, albumin value as indicator of nutrition status in the cirrhotic patient is poor [25,34-37].

SGA is a non-anthropometric method that uses parameters such as the clinical history and physical conditions of an individual, which focusing on the nutritional aspects and provides a score for the nutritional diagnosis [38]. Previous study reported that SGA was a reliable in the evaluation in patients with cirrhosis and revealed that the prevalence of malnutrition was increased in patients with more advanced stages of liver disease [39]. The SGA is a well-validated, bedside tool for recognizing malnutrition. The SGA assesses nutritional status based on features of the history and physical examination and scores patients on a scale ranging from well-nourished to severely malnourished [37,40-42].

The calorie requirements vary according to the severity of cirrhosis. Appropriate calorie intake is crucial to promote anabolism and preventing endogenous proteolysis [25]. Glucose is not readily available from carbohydrate sources in the body when the liver is unable to synthesize and store adequate amounts of glycogen. This will eventually lead to an early occurrence of the "fasting state" which utilizes body sources of glycerol and amino acids, the compounds needed for gluconeogenesis or the production of glucose from non-carbohydrate sources (e.g., protein and fat) [43].

Meanwhile, protein requirement for patients with advanced liver disease have changed. Previously, protein restriction was recommended for patients with advanced liver disease to reduce the ammonia level and risk of developing hepatic encephalopathy. However, recent studies have shown that high protein diets are more helpful in cirrhosis as regard to prognosis due to the improvement of overall nutrition status without aggravating hepatic encephalopathy [6,23,44]. Adequate protein intake is an important building block to provide with the amino acids that are required for the maintenance of muscle mass and function. In a retrospective study among 630 adults with cirrhosis who were started on liver transplant waiting list between January 2000 and October 2009, very low protein intake was ubiquitous and independently associated with malnutrition and mortality [45].

Previous studies have shown that nutritional status declines during hospitalization and the nutritional intake is suboptimal. It has also become clear that malnutrition on admission does not necessarily predict a poor nutritional intake during hospitalization among elderly patients [46-47]. Decline of appetite is a common complaint among cirrhosis patients and is believed to be regarded as being caused by upregulation of various cytokines such as tumor necrosis factor α (TNF-α) and leptin. TNF-α influence appetite and metabolism by altering the function of neurotransmitter on the central nervous system while notably, leptin is increased two-fold in patients with cirrhosis [44,48].

4.2 The Quality of Life

In this study, SF-36 was used to determine the quality of life of the participants. The SF-36 is a universal instrument

that aims to assess the quality of life from the patient's point of view. It is made up of 36 items divided into eight domains which purpose is to evaluate the various aspects related to the patient's health and thereby, it serves as a global assessment of the patient's mental and physical well-being [49]. On the other hand, SF-36 is available in multiple foreign language versions and allows comparison with other diseases. However, United States norm used in scoring may differ from normative data from other populations [12].

Based on the previous study, the quality of life in cirrhosis patients is significantly lower than in controls group [50-53]. The mean quality of life was significantly poor on the domain physical functioning, role limitations due to physical health, role limitations due to emotional problems, vitality and general health perceptions.

On the other hand, the mean quality of life on the domain bodily pain was slightly improved followed by emotional well-being. Surprisingly, the mean quality of life on the domain social functioning was significantly good compared to other domains. However, other study has shown a significantly poor mean of quality of life on all domains [10].

Quality of life is a term that reflects the positive and negative aspects of an individual's life. The term "HRQoL" specifically addresses the impact of health on patients' wellbeing. There are many factors that affect the outcome of quality of life in patients with cirrhosis. However impaired liver function clearly plays a major role affecting the quality of life of patients with cirrhosis [54].

4.3 The Association between the Nutritional Profile and Quality of Life

This study found some significant correlation between the nutritional profile and quality of life among cirrhosis patients without encephalopathy. There was a significant with negative fair correlation between SGA score and physical functioning. Similarly, a significant with negative fair correlation was also found between SGA score and vitality. In term of biochemical data, there was a significant with positive fair correlation between alkaline aminotransferase value and emotional well-being. In contrast, previous study found that albumin levels were significantly associated with positive fair correlation on the role limitation due to physical functioning, physical health and emotional well-being domains [53,55].

A low quality of life in elderly people represents the presence of invisible health problems related to malnutrition and disability while the risk of malnutrition and energy intake are correlated with poor quality of life in elderly people [56-57]. Quality of life scores are influenced by socioeconomic characteristics. Being in a conjugal life and living with relatives were associated with increased scores in the emotional well-being and social functioning [58].

5. CONCLUSION

This study found that the calorie and protein intake of the patients was significantly low with mean 19.21 ± 7.84 kcal/kg/day and 0.60 ± 0.32 g/kg/day respectively. The nutrition-focused physical finding assessment with the SGA demonstrated a trend to mildly-moderately malnourished with most of the participants at Child-Pugh class B. The quality of life of cirrhotic patients also illustrated poor quality of life as presented in most domains with the exception of emotional well-being and social functioning domains.

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REFERENCES

[1] Duncombe, J. U. "Infrared navigation—Part I: An assessment of feasibility." *IEEE Trans. Electron Devices* 11, no. 1 (1959): 34-39.

[2] Nishikawa, Hiroki, and Yukio Osaki. "Liver cirrhosis: evaluation, nutritional status, and prognosis." *Mediators of inflammation* 2015 (2015).

[3] Mahan, L. Kathleen, and Janice L. Raymond. *Krause's food & the nutrition care process-e-book*. Elsevier Health Sciences, 2016.

[4] Muir, Andrew J. "Understanding the complexities of cirrhosis." *Clinical Therapeutics* 37, no. 8 (2015): 1822-1836.

[5] Husain, S. S., and S. H. M. Arif. "Hepatic Encephalopathy: Diagnosis and Current Therapies."

[6] Purnak, Tugrul, and Yusuf Yilmaz. "Liver disease and malnutrition." *Best practice & research Clinical gastroenterology* 27, no. 4 (2013): 619-629.

[7] Juakiem, Wassem, Dawn M. Torres, and Stephen A. Harrison. "Nutrition in cirrhosis and chronic liver disease." *Clinics in liver disease* 18, no. 1 (2014): 179-190.

[8] Silva, Marco, Sara Gomes, Armando Peixoto, Paulo Torres-Ramalho, Hélder Cardoso, Rosa Azevedo, Carla Cunha, and Guilherme Macedo. "Nutrition in chronic liver disease." *GE Portuguese journal of gastroenterology* 22, no. 6 (2015): 268-276.

[9] Picinbono-Larose, Cassandra, Annie Lamoussenerie, Mélanie Tremblay, Catherine Vincent, Geneviève Huard, Christopher F. Rose, and Chantal Bémeur. "Impact of Nutritional Status on Hepatic Encephalopathy and Quality of Life in Patients with Chronic Liver Disease: Preliminary Results of a Prospective Study." *Journal of Clinical and Experimental Hepatology* 7 (2017): S63-S64.

[10] Loria, Anthony, Carey Escheik, N. Lynn Gerber, and Zobair M. Younossi. "Quality of life in cirrhosis." *Current gastroenterology reports* 15, no. 1 (2013): 301.

[11] Shiraki, Makoto, Shuhei Nishiguchi, Masaki Saito, Yoshitaka Fukuzawa, Toshihiko Mizuta, Masaki Kaibori, Tatsunori Hanai et al. "Nutritional status and quality of life in current patients with liver cirrhosis as assessed in 2007–2011." *Hepatology Research* 43, no. 2 (2013): 106-112.

[12] Nardelli, Silvia, Ilaria Pentassuglio, Chiara Pasquale, Lorenzo Ridola, Federica Moscucci, Manuela Merli, Concetta Mina et al. "Depression, anxiety and alexithymia symptoms are major determinants of health related quality of life (HRQoL) in cirrhotic patients." *Metabolic brain disease* 28, no. 2 (2013): 239-243.

[13] Orr, James G., Tara Homer, Laura Ternent, Julia Newton, Calum J. McNeil, Mark Hudson, and David EJ Jones. "Health related quality of life in people with advanced chronic liver disease." *Journal of hepatology* 61, no. 5 (2014): 1158-1165.

[14] Lin, Brian W., Douglas Yoshida, James Quinn, and Matthew Strehlow. "A better way to estimate adult patients' weights." *The American journal of emergency medicine* 27,

no. 9 (2009): 1060-1064.

[15] Shahar, Suzana, and Ng See Pooy. "Predictive equations for estimation of stature in Malaysian elderly people." *Asia Pacific journal of clinical nutrition* 12, no. 1 (2003).

[16] Jackson, Andrew S., and Michael L. Pollock. "Practical assessment of body composition." *The Physician and Sportsmedicine* 13, no. 5 (1985): 76-90.

[17] Siri, W. E. "In advances in biological and medical physics." *London and New York, Academic press Inc.* 4 (1956): 239-280.

[18] Sararaks, S., A. B. Azman, L. L. Low, B. Rugayah, A. M. Aziah, L. N. Hooi, M. Abdul Razak, M. R. Norhaya, K. B. Lim, and A. A. Azian. "Validity and reliability of the SF-36: the Malaysian context." *Medical Journal of Malaysia* 60, no. 2 (2005): 163.

[19] Thapa, B. R., and Anuj Walia. "Liver function tests and their interpretation." *The Indian Journal of Pediatrics* 74, no. 7 (2007): 663-671.

[20] Limdi, J. K., and G. M. Hyde. "Evaluation of abnormal liver function tests." *Postgraduate medical journal* 79, no. 932 (2003): 307-312.

[21] Child III, C. G. "Surgery and portal hypertension. Child III CG, editor. The Liver and Portal Hypertension." (1964).

[22] Plauth, M1, E. Cabre, O. Riggio, M. Assis-Camilo, M. Pirlich, Jens Kondrup, P. Ferenci et al. "ESPEN guidelines on enteral nutrition: liver disease." *Clinical nutrition* 25, no. 2 (2006): 285-294.

[23] Cheung, Kally, Samuel S. Lee, and Maitreyi Raman. "Prevalence and mechanisms of malnutrition in patients with advanced liver disease, and nutrition management strategies." *Clinical Gastroenterology and Hepatology* 10, no. 2 (2012): 117-125.

[24] Johnson, Tammy M., Erin B. Overgard, Ashley E. Cohen, and John K. DiBaise. "Nutrition assessment and management in advanced liver disease." *Nutrition in Clinical Practice* 28, no. 1 (2013): 15-29.

[25] Balbino, Vanessa, and Orlando de Castro e Silva. "Nutritional assessment of Nutritional assessment of cirrhotic patients: A new approach based on h based on electrical bioimpedance." *Medicina (Ribeirão Preto)* 45, no. 1 (2012): 1-4.

[26] Moctezuma-Velázquez, Carlos, Ignacio García-Juárez, Rodrigo Soto-Solís, Juan Hernández-Cortés, and Aldo Torre. "Nutritional assessment and treatment of patients with liver cirrhosis." *Nutrition* 29, no. 11-12 (2013): 1279-1285.

[27] Tai, Mei-Ling S., Khean-Lee Goh, Siti Hawa Mohd-Taib, Sanjay Rampal, and Sanjiv Mahadeva. "Anthropometric, biochemical and clinical assessment of malnutrition in Malaysian patients with advanced cirrhosis." *Nutrition journal* 9, no. 1 (2010): 27.

[28] Bunchorntavakul, Chalermrat, Ruamthip Supanun, and Amporn Atsawarungruangkit. "Nutritional status and its impact on clinical outcomes for patients admitted to hospital with cirrhosis." *J Med Assoc Thai* 99, no. suppl 2 (2016): S47-S55.

[29] Cederholm, Tommy, Ingvar Bosaeus, Rocco Barazzoni, J. Bauer, Andre Van Gossum, S. Klek, Maurizio Muscaritoli et al. "Diagnostic criteria for malnutrition–an ESPEN consensus statement." *Clinical nutrition* 34, no. 3 (2015): 335-340.

[30] Debnath, Sampriti, Nitish Mondal, and Jaydip Sen. "Percent of body fat, fat-mass, fat-free mass and assessment of body composition among rural school-going children of Eastern-India." *AnthropologicAl review* 81, no. 2 (2018): 158-173.

[31] Schutz, Y., U. U. G. Kyle, and C. Pichard. "Fat-free mass index and fat mass index percentiles in Caucasians aged 18–98 y." *International journal of obesity* 26, no. 7 (2002): 953.

[32] Kyle, Ursula G., Laurence Genton, and Claude Pichard. "Body composition: what's new?." *Current Opinion in Clinical Nutrition & Metabolic Care* 5, no. 4 (2002): 427-433.

[33] Kyle, Ursula G., Yves Schutz, Yves M. Dupertuis, and Claude Pichard. "Body composition interpretation: contributions of the fat-free mass index and the body fat mass index." *Nutrition* 19, no. 7-8 (2003): 597-604.

[34] Böhm, A1, and B. L. Heitmann. "The use of bioelectrical impedance analysis for body composition in epidemiological studies." *European journal of clinical nutrition* 67, no. S1 (2013): S79.

[35] Kuzuya, Masafumi, Sachiko Izawa, Hiromi Enoki, Kiwako Okada, and Akihisa Iguchi. "Is serum albumin a good marker for malnutrition in the physically impaired elderly?." *Clinical Nutrition* 26, no. 1 (2007): 84-90.

[36] Lee, Jessica L., Esther S. Oh, Rebecca W. Lee, and Thomas E. Finucane. "Serum albumin and prealbumin in calorically restricted, nondiseased individuals: a systematic review." *The American journal of medicine* 128, no. 9 (2015): 1023-e1.

[37] Cabrerizo, Sonia, Daniel Cuadras, Fernando Gomez-Busto, Inaki Artaza-Artabe, Fernando Marín-Ciancas, and Vincenzo Malafarina. "Serum albumin and health in older people: review and meta analysis." *Maturitas* 81, no. 1 (2015): 17-27.

[38] Bharadwaj, Shishira, Shaiva Ginoya, Parul Tandon, Tushar D. Gohel, John Guirguis, Hiren Vallabh, Andrea Jevenn, and Ibrahim Hanouneh. "Malnutrition: laboratory markers vs nutritional assessment." *Gastroenterology report* 4, no. 4 (2016): 272-280.

[39] Detsky, Allan S., J. P. Baker, N. Johnston, S. Whittaker, R. A. Mendelson, and K. N. Jeejeebhoy. "What is subjective global assessment of nutritional status?." *Journal of parenteral and enteral nutrition* 11, no. 1 (1987): 8-13.

[40] Ferreira, Lívia G., Lucilene R. Anastácio, Agnaldo S. Lima, and Maria ITD Correia. "Assessment of nutritional status of patients waiting for liver transplantation." *Clinical transplantation* 25, no. 2 (2011): 248-254.

[41] Tamura, Bruce K., Christina L. Bell, Kamal H. Masaki, and Elaine J. Amella. "Factors associated with weight loss, low BMI, and malnutrition among nursing home patients: a systematic review of the literature." *Journal of the American Medical Directors Association* 14, no. 9 (2013): 649-655.

[42] Young, Adrienne M., Sarah Kidston, Merrilyn D. Banks, Alison M. Mudge, and Elisabeth A. Isenring. "Malnutrition screening tools: comparison against two validated nutrition assessment methods in older medical inpatients." *Nutrition* 29, no. 1 (2013): 101-106.

[43] Shaw, Clare, Catherine Fleuret, Jennifer M. Pickard, Kabir Mohammed, Gayle Black, and Linda Wedlake. "Comparison of a novel, simple nutrition screening tool for adult oncology inpatients and the Malnutrition Screening Tool (MST) against the Patient-Generated Subjective Global Assessment (PG-SGA)." *Supportive Care in Cancer* 23, no. 1 (2015): 47-54.

[44] Eghtesad, Sareh, Hossein Poustchi, and Reza Malekzadeh. "Malnutrition in liver cirrhosis: the influence of protein and sodium." *Middle East journal of digestive diseases* 5, no. 2 (2013): 65.

[45] Plauth, Mathias, and Elke-Tatjana Schütz. "Cachexia in liver cirrhosis." *International journal of cardiology* 85, no. 1 (2002): 83-87.

[46] Ney, Michael, Juan G. Abraldes, Mang Ma, Dawn Belland, Andrea Harvey, Sarah Robbins, Vanessa Den Heyer, and Puneeta Tandon. "Insufficient protein intake is associated with increased mortality in 630 patients with cirrhosis awaiting liver transplantation." *Nutrition in Clinical Practice* 30, no. 4 (2015): 530-536.

[47] Almeida, Ana Isabel, Marta Correia, Maria Camilo, and Paula Ravasco. "Length of stay in surgical patients: nutritional predictive parameters revisited." *British journal of nutrition* 109, no. 2 (2013): 322-328.

[48] Allard, Johane P., Heather Keller, Khursheed N. Jeejeebhoy,

Manon Laporte, Don R. Duerksen, Leah Gramlich, Helene Payette et al. "Malnutrition at hospital admission—contributors and effect on length of stay: a prospective cohort study from the Canadian Malnutrition Task Force." *Journal of Parenteral and Enteral Nutrition* 40, no. 4 (2016): 487-497.

[49] Kwarta, Elizabeth, Sadie Nagle, and Lori Welstead. "Update on malnutrition in liver cirrhosis: assessment and treatment." *Current Hepatology Reports* 13, no. 1 (2014): 24-34.

[50] Bianco, Tonino, Umberto Cillo, Piero Amodio, Giacomo Zanus, Annalisa Salari, Daniele Neri, Giancarlo Bombonato et al. "Gender differences in the quality of life of patients with liver cirrhosis related to hepatitis C after liver transplantation." *Blood purification* 36, no. 3-4 (2013): 231-236.

[51] Poupon, Renée Eugénie, Yves Chrétien, Olivier Chazouillères, Raoul Poupon, Judith Chwalow, and French-PBC Study Group. "Quality of life in patients with primary biliary cirrhosis." *Hepatology* 40, no. 2 (2004): 489-494.

[52] Kalaitzakis, Evangelos, Magnus Simrén, Rolf Olsson, Pia Henfridsson, Irene Hugosson, Maria Bengtsson, and Einar Björnsson. "Gastrointestinal symptoms in patients with liver cirrhosis: associations with nutritional status and health-related quality of life." *Scandinavian journal of gastroenterology* 41, no. 12 (2006): 1464-1472.

[53] Norman, Kristina, Henriette Kirchner, Herbert Lochs, and Matthias Pirlich. "Malnutrition affects quality of life in gastroenterology patients." *World journal of gastroenterology: WJG* 12, no. 21 (2006): 3380.

[54] Les, Iñigo, Eduardo Doval, Montserrat Flavià, Carlos Jacas, Guillermo Cárdenas, Rafael Esteban, Jaime Guardia, and Juan Córdoba. "Quality of life in cirrhosis is related to potentially treatable factors." *European journal of gastroenterology & hepatology* 22, no. 2 (2010): 221-227.

[55] Rojas-Loureiro, Gabriela, Alfredo Servín-Caamaño, Elizabeth Pérez-Reyes, Luis Servín-Abad, and Fátima Higuera-de la Tijera. "Malnutrition negatively impacts the quality of life of patients with cirrhosis: An observational study." *World journal of hepatology* 9, no. 5 (2017): 263.

[56] Yepes Barreto, Ismael, Lourdes Lepesqueur Guillen, and Sergio Cadavid Asis. "Quality of life predictors in patients with chronic liver disease in Colombia." *Revista Colombiana de Gastroenterologia* 30, no. 4 (2015): 390-398.

[57] Jiménez-Redondo, Susana, B. Beltran De Miguel, J. Gavidia Banegas, L. Guzmán Mercedes, J. Gomez-Pavon, and C. Cuadrado Vives. "Influence of nutritional status on health-related quality of life of non-institutionalized older people." *The journal of nutrition, health & aging* 18, no. 4 (2014): 359-364.

[58] Donini, Lorenzo M., Eleonora Poggiogalle, Alessandro Pinto, Anna Maria Giusti, and Valeria del Balzo. "Malnutrition in the Elderly." In *Diet and Nutrition in Dementia and Cognitive Decline*, pp. 211-222. Academic Press, 2015.