The Effectiveness of High-Protein Liquid Dietary Supplementation in Improving Nutritional Status of Malnourished Patients in Hospital Care: a Preliminary Study

Marcellus Simadibrata, Murdani Abdullah*, Fiastuti Witjaksono**, Virly Nanda Muzellina*, Amanda Pitarini Utari*, Yohannessa Wulandari**, Ari Wijayanti***, Dewi Mustikarani*, Raja Mangatur Haloho*, Aditya Rachman*, Daniel Martin Simadibrata*, Rizka Mutiara*, Kaka Renaldi**

*Division of Gastroenterology, Pancreatobiliary, and Digestive Endoscopy, Department of Internal Medicine, Faculty of Medicine, Universitas Indonesia/Dr. Cipto Mangunkusumo National General Hospital, Jakarta

**Department of Nutrition, Faculty of Medicine, Universitas Indonesia/Dr. Cipto Mangunkusumo National General Hospital, Jakarta

***Nutrition and Food Production Unit, Dr. Cipto Mangunkusumo National General Hospital, Jakarta

Corresponding author:
Marcellus Simadibrata. Division of Gastroenterology, Department of Internal Medicine, Dr. Cipto Mangunkusumo National General Hospital. Jl. Diponegoro No. 71 Jakarta Indonesia. Phone: +62-21-3153957; facsimile: +62-21-3142454. E-mail: prof.marcellus.s@gmail.com.

ABSTRACT

Background: *Malnutrition is a very common problem in hospitalized patients. Nutrition is the basis for the healing process as it requires good nutrients through various enzymatic reactions. To improve nutritional status, a high-protein diet can be given. Liquid diet is one of the alternative forms of nutrition because it is easier to swallow.*

Method: *This study was a double-blind randomized controlled trial conducted to assess the effectiveness of high protein liquid dietary supplementation in malnourished hospitalized patients. Inclusion criterias were: hospitalized malnourished patient age ≥18 years old, malnourished patients. Exclusion criterias were: patients with gastrointestinal malignancy and obstruction, chronic kidney disease stage III-IV, decompensated liver cirrhosis, and had history of milk allergy or lactose intolerance. The patients were assessed for their nutritional status based on ESPEN 2015 criteria. Patients who experienced malnutrition will be divided into 2 groups, namely the control group which was given normal protein liquid diet, while the intervention group was given high protein liquid diet supplementation as much as 2 bottles (200 mL) per day for 7-10 days. Furthermore, the nutritional status of the patient was assessed.*

Results: *By administering high-protein liquid diet supplementation, there was a tendency to increase the strength of the right handgrip in 3 subjects (50%), the tendency to increase body mass index (BMI) in 3 subjects (50%), Subjective Global Assessment (SGA) score improved in 2 subjects with mild/moderate malnutrition (33.3%) and 1 subject with normal nutrition (16.7%), and the tendency to increase the fat-free mass in 3 subjects (50%).*

Conclusion: *The administration of high protein liquid dietary supplementation tended to increase the strength of the right handgrip, BMI, SGA score, and body fat-free mass index.*

Keywords: *Malnutrition, high-protein diet, nutritional status, hospitals, hand strength, body mass index, nutrition assessment, preliminary data*

ABSTRAK

Latar belakang: *Malnutrisi merupakan masalah yang sangat umum pada pasien rawat inap. Nutrisi merupakan dasar dari proses penyembuhan karena membutuhkan nutrisi yang baik melalui berbagai reaksi enzimatik. Untuk meningkatkan status gizi dapat diberikan diet tinggi protein. Diet cair merupakan salah satu bentuk nutrisi alternatif karena lebih mudah ditelan.*

Metode: *Penelitian ini merupakan uji coba terkontrol acak tersamar ganda yang dilakukan untuk menilai efektivitas suplementasi makanan cair berprotein tinggi pada pasien rawat inap malnutrisi. Kriteria inklusi yaitu pasien malnutrisi usia ≥ 18 tahun, pasien malnutrisi. Kriteria eksklusi yaitu pasien dengan keganasan dan obstruksi gastrointestinal, penyakit ginjal kronis stadium III-IV, sirosis hati dekompensasi, dan pasien yang memiliki riwayat alergi susu atau intoleransi laktosa. Pasien dinilai status gizinya berdasarkan kriteria ESPEN 2015. Pasien yang mengalami malnutrisi akan dibagi menjadi 2 kelompok yaitu kelompok kontrol yang diberikan diet cair protein normal, sedangkan kelompok intervensi diberikan suplementasi diet cair protein tinggi sebanyak 2 botol (200 mL) per hari selama 7-10 hari. Selanjutnya, status gizi pasien dinilai.*

Hasil: *Dengan pemberian suplementasi diet cair tinggi protein terdapat kecenderungan peningkatan kekuatan genggaman tangan kanan pada 3 subjek (50%), kecenderungan peningkatan indeks massa tubuh (IMT) pada 3 subjek (50%), Subjective Global Skor Assessment (SGA) meningkat pada 2 subjek dengan gizi buruk ringan/ sedang (33,3%) dan 1 subjek dengan gizi normal (16,7%), dan kecenderungan peningkatan massa bebas lemak pada 3 subjek (50%).*

Simpulan: *Pemberian suplemen makanan cair berprotein tinggi cenderung meningkatkan kekuatan genggaman tangan kanan, IMT, skor SGA, dan indeks massa bebas lemak tubuh.*

Kata kunci: *Gizi buruk, diet tinggi protein, status gizi, rumah sakit,, kekuatan tangan, indeks massa tubuh, pengkajian gizi, data awal*

INTRODUCTION

Malnutrition is defined as a condition of deficiency, excess, or imbalance of energy, protein, and other nutrients. In general, malnutrition can be classified into malnutrition or overnutrition (obesity).[1] Assessment of malnutrition can be done through history taking regarding nutrient intake, anthropometric measurement, and laboratory examinations related to nutritional status.

Malnutrition is common in hospitalized patients. A study in Canada showed that the prevalence of hospital malnutrition was 45%.[2] In Europe, there was a 20-30% prevalence of hospital malnutrition with higher prevalence found in the elderly and patients with malignancy.[3,4] Meanwhile in Asia, the prevalence of hospital malnutrition is 27-39%.[5] This prevalence variation of hospital malnutrition is due to differences in the study population and malnutrition screening methods.

Nutrition is needed to reduce morbidity and mortality, to improve treatment efficacy, shorten the length of stay in the hospital, and to improve quality of life. Food supplementation can be given to improve nutritional status. Liquid diet is an alternative form of nutrition because of its liquid consistency so that it is easier to swallow.[6-12] Currently, there are various formulations of liquid diet supplementation made by both commercial parties and hospitals. Therefore, this study was conducted to assess the effectiveness of high protein liquid dietary supplementation in malnourished hospitalized patients.

METHOD

This study is a double-blind randomized controlled trial. Randomization of subjects was performed accordingly by the statistical unit using the simple randomization in the statistical unit. The independent variables examined in this study are hospital formula of normal-protein liquid diet supplementation and hospital formula of high-protein liquid diet supplementation. The dependent variables in this study are body mass index (BMI), Subjective Global Assessment (SGA) score, handgrip strength, fat-free mass, blood urea nitrogen (BUN), hemoglobin, and albumin levels.

Table 1 shows the Composition of normal protein (CLLM 40 g) and high protein (CLLM 60 g) liquid dietary formula used at Cipto Mangunkusumo Hospital in Jakarta. The liquid dietary formula was produced The liquid dietary formula was produced and manufacturedand manufactured by by Nutrition and

Table 1. Composition of normal protein (CLLM 40 g) and high protein (CLLM 60 g) liquid dietary formula used at Cipto Mangunkusumo Hospital in Jakarta

The content of CLLM 40g	Per 1000 cal	The content of CLLM 60g	Per 1000 cal
Carbohydrates	143 g	Carbohydrates	126 g
Protein	40,7 g	Protein	60,3 g
Total fat	31,7 g	Total fat	32,7 g
Cholesterol	275 mg	Cholesterol	330 mg
Vitamin		Vitamin	
Vitamin A	2190 RE	Vitamin A	2209 RE
Vitamin E	6,2 mg	Vitamin E	5,89 g
Vitamin B1 (thiamin)	715 mg	Vitamin B1 (thiamin)	680 mg
Vitamin B2 (riboflavin)	892 mg	Vitamin B2 (riboflavin)	847 mg
Vitamin B3 (Niacin)	4,5 mg	Vitamin B3 (Niacin)	4,27 mg
Vitamin B5 (panto authentic acid)	2,8 mg	Vitamin B5 (panto authentic acid)	2,66 mg
Vitamin B6 (pyridoxine)	534 mg	Vitamin B6 (pyridoxine)	508 mg
Vitamin B9 (folic acid)	50 µg	Vitamin B9 (folic acid)	47,5µg
Vitamin B12 (cobalamin)	1,4 µg	Vitamin B12 (cobalamin)	1,22µg
Vitamin C	59,2 mg	Vitamin C	57,5 mg
Mineral		Mineral	
Calcium	1210 mg	Calcium	1435 mg
Phosphorus	326 mg	Phosphorus	1143 mg
Magnesium	45mg	Magnesium	43,1 mg
Zinc	3 mg	Zinc	2,85 mg
Iron	8 mg	Iron	11,2 mg
Copper	300 µg	Copper	285 mg
Selenium	-	Selenium	0,03 µg
Sodium	79 mg	Sodium	482 mg
Potassium	88 mg	Potassium	106 mg

*CLLM: cair low lactose milk

Food Nutrition and Food Production Unit Production Unit, Dr. Cipto Mangunkusumo National Dr. Cipto Mangunkusumo National General Hospital, Jakarta General Hospital, Jakarta.

There are no significant composition differences between normal protein and high protein liquid dietary formula except the protein itself.

Table 2. Normal values of blood test in adults[7]

Test	Sex	Unit	Reference value
Blood sugar	Male	mg/dL	60 - 140
	Female	mg/dL	60 - 140
Albumin	Male	g/dL	3.5 - 5.2
	Female	g/dL	3.2 - 4.6
Hemoglobin	Male	g/dL	13 -17
	Female	g/dL	12 -15
Urea	Male	mg/dL	19 - 44
	Female	mg/dL	21 - 43
BUN		mg/dL	Urea/2.14

Table 2 shows Normal values of blood test in adults for the subject in this study. The laboratory includes blood sugar, albumin, hemoglobin, urea, BUN.

Table 3 shows Handgrip strength in kg based on sex and age, if the result of the measurement is under the reference value in Table 3 then the result is considered abnormal.

Table 4. Adult malnutrition classification according to the WHO[9]

Body mass index (kg/m^2)	Classification
17,00–18,49	Mild malnutrition
16,00–16,99	Moderate malnutrition
< 16,00	Severe malnutrition

Table 4 shows the classification of Adult malnutrition according to the WHO. BMI of 17,00-18,49 classified as mild malnutrition, BMI of 16,00-16,99 classified as moderate malnutrition, and BMI < 16,00 classified as severe malnutrition.

Table 5 shows There are two ways to diagnose malnutrition according to the ESPEN consensus (2015). The first one is if the BMI under 18,5 kg/m^2 and the second one is if patient meet these two following criteria as shown in Table 5.

Table 3. Handgrip strength in kg based on sex and age[8]

Male				Female			
Age	Right	Left	BMI	Age	Right	Left	BMI
20-29	47 (9.5)	45 (8.8)	26.4 (5.1)	20-29	30 (7)	28 (6.1)	25 (15.8)
30-39	47 (9.7)	47 (9.8)	28.3 (5.2)	30-39	31 (6.4)	29 (6)	27.3 (6.8)
40-49	47 (9.5)	45 (9.3)	28.4 (4.6)	40-49	29 (5.7)	28 (5.7)	27.7 (7.7)
50-59	45 (8.4)	43 (8.3)	28.7 (4.3)	50-59	28 (6.3)	26 (5.7)	29.1 (6.4)
60-69	40 (8.3)	38 (8)	28.6 (4.4)	60-69	24 (5.3)	23 (5)	28.1 (5.1)
70+	33 (7.8)	32 (7.5)	27.2 (3.9)	70+	20 (5.8)	19 (5.5)	27 (4.7)

BMI: body mass index

Table 5. Malnutrition diagnosis criteria according to the ESPEN consensus (2015)[10]

Alternative 1	Alternative 2
BMI < 18,5 kg/m^2	Unintentional weight loss of more than 10% within an unspecified time frame or,
	Unintentional weight loss of more than 5% within 3 months, accompanied by at least one of the following options: (1) BMI < 20 kg/m^2 for under 70 years of age or BMI <22 kg/m^2 for over 70 years of age; or (2) Fat free mass index (FFMI) < 15 kg/m^2 for women or FFMI < 17 kg/m^2 for men

Note: Before using the ESPEN 2015 criteria for diagnosing malnutrition, patients must have fulfilled the malnutrition risk criteria according to a validated screening tool.

Table 6. Nutritional status based on subjective global assessment (SGA)[11]

Group	Nutrition value
A	Normal/ well-nourished
B	Mild-moderate nutrition
C	Severe malnutrition

Table 6 shows The nutritional status based on subjective global assessment (SGA). Group A is classified as normal/well-nourished. Group B is classified as mild-moderate nutrition. Group C is classified as severe malnutrition.

This study is a double-blind randomized controlled trial conducted to assess the effectiveness of the administration of hospital formula liquid diet supplementation to malnourished hospitalized patients at Dr. Cipto Mangunkusumo Hospital in Jakarta including the patients on the 5th, 7th, and 8th floor of building A. Patients were assessed for their nutritional status based on ESPEN 2015 criteria. Patients who are malnourished will be divided into 2 groups namely group 1 (control group) who will get a hospital formula of normal protein liquid diet supplementation (40 grams per 1000 mL), while group 2 (intervention group) will get a hospital formula of high protein liquid food supplementation (60 grams per 1000 mL) as much as 2 bottles (each bottle contains 200 mL) per day for a maximum of 10 days. Furthermore, an assessment of the patient's nutritional status will be carried out.

A total of 6 patients were examined as a sample that met inclusion criteria of age ≥18 years old, malnourished patients who were treated on the 5th, 7th and, 8th-floor of building A Cipto Mangunkusumo Hospital, nutritional status assessment was conducted based on ESPEN 2015 criteria, patients agreed to participate in the study and signed informed consent. Exclusion criteria are patients with gastrointestinal malignancy and obstruction, chronic kidney diseasestage III-IV, decompensated liver cirrhosis, patients who are considered by clinicians not able to participate in the research, patients with a history of milk allergy or lactose intolerance, patients who cannot stand (bedridden), patients with severe diarrhea (WHO criteria). The drop out criteria are patients who have signed informed consent but decided to quit participating before the study is completed, patients whose condition are worsening during treatment, patients who cannot take nutrition orally or use a nasogastric tube (NGT), and patients who experience allergic reactions or lactose intolerance.

The assessment was conducted to compare body mass index (BMI), subjective global assessment (SGA) score, handgrip strength, fat-free mass index, blood urea nitrogen (BUN), hemoglobin levels between before and after 7-10 days of supplementation. The measurement was carried out by a team of researchers in collaboration with Department of Nutrition of Faculty of Medicine, Universitas Indonesia and Cipto Mangunkusumo Hospital Nutrition-Food Production Installation. The numerical data were obtained for the assessment of hemoglobin levels, albumin levels, BUN, blood sugar, and handgrip. Categorical data were obtained for BMI and SGA score. BMI measurements use weight and height calculations and are grouped based on WHO Asia Pacific criteria. The SGA score was obtained from filling out the SGA questionnaire. Hemoglobin, albumin, BUN, and blood sugar levels were assessed from blood tests. The handgrip strength is measured by using a hydraulic hand dynamometer. Tool used to measure body composition, fat-free mass index, and BMI is using bio-impedance analyzer (BIA) Tanita scales, for handgrip using Jamar hydraulic hand dynamometer products in 2017, and for blood laboratory examination using The ARCHITECTc8000 clinical chemistry analyzer Abbott. Data collection activities were carried out at the sametime, in malnourished hospitalized patient in the 5th, 7th, and 8th-floor of building A Cipto Mangunkusumo Hospital. The results were analyzed using IBM SPSS Windows version 25.

RESULTS

The initial study was conducted on 13 malnourished patients who were being treated on the 5th, 7th, and 8th floors of building A who met the inclusion criteria from December 2018–December 2020. Then among the 13 subjects, 7 subjects dropped out. One subject had been intervened for 6 days then the patient died, one subject got an intervention for 9 days but suddenly went home before post-supplementation assessment. Three subjects went home at their request because they were bored for too long or repeatedly hospitalized. Two

subjects experienced clinical improvements before receiving intervention at least 7 days in the era of pandemic COVID-19 so it was decided to be discharged immediately to prevent virus transmission that could worsened the patient's condition.

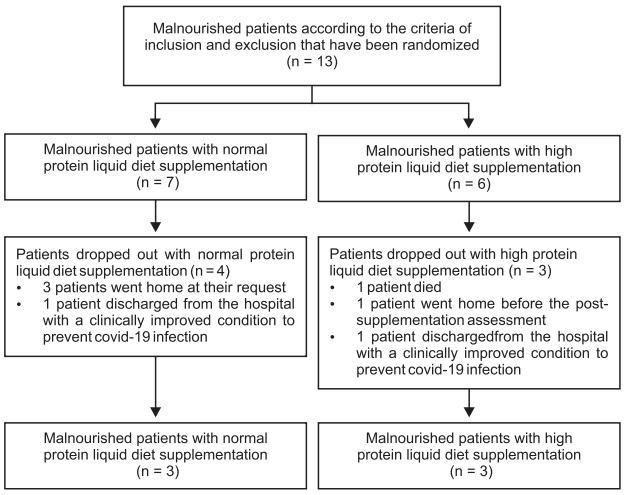

Figure 1. Research flow

Table 7 shows that gender was comparable between men and women by 3 subjects (50%). There was one elderly subject (16.7%). There were 4 subjects who were Javanese (66.7%). There were 3 subjects who were unemployed (50%). There were 3 subjects whose education level was up to senior high school (50%). There were 3 unmarried subjects (50%). All subjects were Muslim (100%). There were 3 subjects who were malnourished and had malignancy (50%).

Table 8 shows the albumin levels before supplementation were abnormal in 4 subjects (66.7%).

Table 9 shows blood sugar levels from all patients before and after supplementation were within normal limits (100%). Hemoglobin levels increased in 3 subjects with normal-protein supplementation (50%). Before the supplementation, 5 subjects from both groups had abnormal BUN levels (83.3%), but after the supplementation, there were 3 subjects who had

Table 7. General characteristics of research subjects

Characteristics	Normal protein liquid diet supplementation (n = 3)	High protein liquid diet supplementation (n = 3)	Total (n = 6)
	n (%)	n (%)	n (%)
Gender			
Men	2 (33.3)	1 (16.7)	3 (50)
Women	1 (16.7)	2 (33.3)	3 (50)
Age			
Elderly	1 (16.7)	0 (0)	1 (16.7)
Adult	2 (33.3)	3 (50)	5 (83.3)
Tribes			
Javanese	2 (33.3)	2 (33.3)	4 (66.7)
Malukunese	0 (0)	1 (16.7)	1 (16.7)
Bugisnese	1 (16.7)	0 (0)	1 (16.7)
Job			
Unemployed	1 (16.7)	2 (33.3)	3 (50)
Civil servants	0 (0)	1 (16.7)	1 (16.7)
Non-civil servants	2 (33.3)	0 (0)	2 (33.3)
Education			
Elementary school	1 (16.7)	0 (0)	1 (16.7)
Senior high school	1 (16.7)	2 (33.3)	3 (50)
3-year diploma	1 (16.7)	0 (0)	1 (16.7)
Bachelor	0 (0)	1 (16.7)	1 (16.7)
Status			
Married	1 (16.7)	1 (16.7)	2 (33.3)
Unmarried	1 (16.7)	2 (33.3)	3 (50)
Widower/widow	1 (16.7)	0 (0)	1 (16.7)
Religion			
Islam	3 (50)	3 (50)	6 (100)
Diagnosis			
Malignancy	2 (33.3)	1 (16.7)	3 (50)
Chronic diseases	1 (16.7)	0 (0)	1 (16.7)
Autoimmune disease	0 (0)	2 (33.3)	2 (33.3)

Table 8.Albumin levels before supplementation

Characteristics	Normal protein liquid diet supplementation (n = 3)	High protein liquid diet supplementation (n = 3)	Total (n = 6)
	n (%)	n (%)	n (%)
Albumin levels (g/dL) Before supplementation			
Abnormal	3 (50)	1 (16.7)	4 (66.7)
Normal	0 (0)	2 (33.3)	2 (33.3)

improvement in BUN levels in both groups. However, it did not showedn that the effectiveness of high-protein supplementation (intervention group) was better compared to normal protein supplementation (control group). The right-hand grip strength tended to be increased in 5 subjects (83.3%) in both supplementation groups (intervention and control groups), and there was a tendency to be increase in right handgrip in 3 subjects (50%) with supplementation of high protein liquid supplementation (intervention group).

While in the left handgrip examination, there was no difference in strength between before and after supplementation, and there was no difference between normal-protein (control group) and high-protein supplementation (intervention group).

Increased BMI was found in 3 subjects (50%) who received high protein liquid dietary supplementation (intervention group). Based on the SGA score, 3

Table 9. Descriptive data of subject's characteristics before and after supplementation

Characteristics	Normal protein liquid diet supplementation (n = 3)	High protein liquid diet supplementation (n = 3)	Total (n = 6)
	n (%)	n (%)	n (%)
Blood sugar levels (mg/dL) before supplementation			
Normal	3 (50)	3 (50)	6 (100)
Blood sugar levels (mg/dL) after supplementation			
Normal	3 (50)	3 (50)	6 (100)
Hemoglobin levels (g/dL) before supplementation			
Abnormal	3 (50)	3 (50	6 (100)
Hemoglobin levels (g/dL) after supplementation			
Normal fixed/ increase	0 (0)	0 (0)	0 (0)
Normal decrease	0 (0)	0 (0)	0 (0)
Abnormal fixed/ increase	3 (50)	1 (16.7)	4 (66.7)
Abnormal decrease	0 (0)	2 (33.3)	2 (33.3)
BUN levels (mg/dL) before supplementation			
Normal	0 (0)	1 (16.7)	1 (16.7)
Abnormal	3 (50)	2 (33.3)	5 (83.3)
BUN levels (mg/dL) after supplementation			
Abnormal	1 (16.7)	2 (33.3)	3 (50)
Normal	2 (33.3)	1 (16.7)	3 (50)
Right handgrip before supplementation			
Abnormal	3 (50)	3 (50)	6 (100)
Normal	0 (0)	0 (0)	0 (0)
Right handgrip after supplementation			
Normal fixed/increase	0 (0)	0 (0)	0 (0)
Normal decrease	0 (0)	0 (0)	0 (0)
Abnormal fixed/ increase	2 (33.3)	3 (50)	5 (83.3)
Abnormal decrease	1 (16.7)	0 (0)	1 (16.7)
Left Handgrip before supplementation			
Normal	0 (0)	0 (0)	0 (0)
Abnormal	3 (50)	3 (50)	6 (100)
Left handgrip after supplementation			
Normal fixed/ increase	0 (0)	0 (0)	0 (0)
Normal decrease	0 (0)	0 (0)	0 (0)
Abnormal fixed/ increase	1 (16.7)	1 (16.7)	2 (33.3)
Abnormal decrease	2 (33.3)	2 (33.3)	4 (66.7)
BMI before supplementation			
Mild malnutrition	1 (16.7)	1 (16.7)	2 (33.3)
Moderate malnutrition	1 (16.7)	1 (16.7)	2 (33.3)
Severe malnutrition	1 (16.7)	1 (16.7)	2 (33.3)
BMI after supplementation			
Normal	0 (0)	1 (16.7)	1 (16.7)
Mild malnutrition	1 (16.7)	0 (0)	1 (16.7)
Moderate malnutrition	0 (0)	2 (33.3)	2 (33.3)
Severe malnutrition	2 (33.3)	0 (0)	2 (33.3)
SGA before supplementation			
Mild-moderate malnutrition	1 (16.7)	0 (0)	1 (16.7)
Severe malnutrition	2 (33.3)	3 (50)	5 (83.3)
SGA after supplementation			
Normal/ well-nourished	0 (0)	1 (16.7)	1 (16.7)
Mild-moderate malnutrition	1 (16.7)	2 (33.3)	3 (50)
Severe malnutrition	2 (33.3)	0 (0)	2 (33.3)
Fat-free mass index before supplementation			
Normal	3 (50)	3 (50)	6 (100)
The fat-free mass index after supplementation			
Normal fixed/increase	1 (16.7)	3 (50)	4 (66.7)
Normal decrease	2 (33.3)	0 (0)	2 (33.3)
Abnormal fixed/increase	0 (0)	0 (0)	0 (0)
Normal decrease	0 (0)	0 (0)	0 (0)

subjects were suffering from malnutrition (50%) before the administration of high protein supplementation and after the administration of high protein liquid supplementation (intervention group), nutritional status tended to be improved in 2 mild-moderate malnutrition subjects (33.3%) and 1 subject with normal/well nourished (16.7%).

Therefore, this data showed that there was an improvement in nutritional status after being given high protein liquid dietary supplementation (intervention group) compared to normal protein supplementation (control group). Fat-free mass index tended to be increased in 3 subjects (50%) on high protein liquid dietary supplementation (intervention groups). Therefore, there was an increase in the fat-free mass in the intervention group who received high protein liquid dietary supplementation compared to the control group who received normal protein supplementation.

Adverse effects were not found in patients who received high-protein liquid dietary supplementation (intervention groups) and normal protein liquid dietary supplementation (control group).

DISCUSSION

The results of this study showed that gender was comparable between men and women in each supplementation by 3 subjects (50%). This is in line with the study conducted by Lim SL et al, where there were 59% men (n = 818) and 41% women (n = 818).[12] Other studies that showed the same results were the research conducted by Huynh DTTet al, with 59% men (n = 104) and 45% women (n = 104).[8]

This study included one elderly subject (16.7%). This is in line with research by Sakinah & Tan in Malaysia which obtained 21 out of 100 patients (21%) with malnutrition who were > 65 years old.[5] However, this was contradictive with a study conducted by Lei et al in China that obtained 134 out of 184 patients (72.8%) with malnutrition who were > 60 years old. Malnutrition was more common in older subjects (58 years old than 49 years old, p < 0.001, 95% CI: 7-11) and more often in male subjects (32% vs. 26%, p 1/4 0,016).[7]

This study included 3 subjects who were malnourished and had malignancy (50%). This is in line with a study conducted by Lim SL et al, based on SGA scores, 71% of subjects were classified as normal, 25% with mild-moderate malnutrition, and 4% with severe malnutrition. The highest prevalence of malnutrition was found in patients with cancer (71%), endocrine problems (48%), and respiratory diseases (47%).[5] But this result was in contrast with the results of the research conducted by Huynh DTT et al, in which diagnosis of malnutrition in patients with infectious diseases had the highest prevalence by 39.5%.[8] Malnutrition in hospitalized cases of malignancy is often found. Approximately 20% death of cancer patients were not caused by the malignancy of cancer but due to the effects of malnutrition. Several factors that affect malnutrition in cancer patients such as type, location, tumor stage, cancer therapy, patient characteristics, and changes in taste and loss of appetite that if prolonged can cause cachexia. Malnutrition occurs as a result of an imbalance between the patient's nutritional needs and the needs of tumors and the availability of nutrients in the body.[13]

Before the supplementation, 5 subjects from both groups had abnormal BUN levels (83.3%), but after the supplementation, there were 3 subjects (50%) who had improvement in BUN levels in both groups. Albumin levels before supplementation were abnormal in 4 subjects (66.7%).

Research conducted by Huynh DTT et al stated that there was no significant improvement in the total protein, albumin, and pre-albumin levels in patients who received high protein supplementation compared to normal protein supplementation.[12] This is in line with several other studies that stated the validity of serum markers as a determinant of the nutritional status of patients cannot yet be trusted. Some studies also stated that laboratory examinations only cannot be reliable. Serum studies provide objective and quantitative results, but can only be used as a complement to the findings of an in-depth examination. Protein serums such as albumin are better at detecting inflammatory states than detecting malnutrition. Therefore, a physical examination is a better method of diagnosing malnutrition. Newer techniques such as body composition using BIA are being investigated for their usefulness in determining nutritional status. Body composition examination also has the advantage of being non-invasive and relatively cost-effective, which allows the determination of the patient's muscle mass. However, it is still uncertain that this technique is superior to physical examinations.[14]

Right handgrip strength tended to be increase in 5 subjects (83.3%) in both supplementation groups and there was increased in right handgrip in 3 subjects (50%) with supplementation of high-protein liquid dietary supplementation. This is in line with the research conducted by Cawood AL et al, that stated high

protein liquid supplementation significantly increases handgrip strength.[15] In contrast, the research conducted by Huynh DTT et al stated that no differences were found in the change in handgrip strength between the two groups in their study.[12]

There was an increase in BMI values in 3 subjects (50%) who received high protein liquid dietary supplementation. The research conducted by Zhu Mw et al stated that oral nutritional supplements can increase the weight and BMI of patients with gastrointestinal malignancy after surgery.[17] Research by Huynh DTT et al also stated that there was a significant increase in BMI values in the high-protein intervention group compared to the control group.[8]

Based on the SGA score, there were 3 subjects (50%) suffering from malnutrition before giving high protein liquid dietary supplementation and after the administration of high-protein liquid dietary supplementation. The nutritional status tended to be improved in 2 subjects with mild-moderate malnutrition (33.3%) and 1 subject with normal nutrition status (16.7%). In the research conducted by Lovesley D et al, there was an increase in nutritional status withthe administration of high-protein oral supplementation according to a significant SGA score ($p = 0.031$).[17] In contrast to research conducted by Huynh DTT et al, that nutritional status based on SGA scores improved in both groups and no patients experienced severe malnutrition at the end of the study, the percentage of well-nourished patients increased from 1% to 84% in high-protein liquid supplementation and 3% to 79% in the control group.[12]

The fat-free mass increased in 3 subjects (50%) on high protein liquid dietary supplementation. Lauque et alstated that by giving high protein oral intake can significantly increase the fat-free massin Alzheimer's patients who are at risk of malnutrition.[18]

This research has not been able to do an analytical test to find a relationship between research variables because the number of samples was insufficient. Research subjects who met the inclusion criteria were very difficult to obtain with an estimated sample size of 69 samples for each group due to the ongoing COVID-19 pandemic until this report is completed. In each group there were only 3 patients due to pandemi COVID-19 situation and high exclusion rates in Dr. Cipto Mmangunkusumo Hospital at that time. Most of the patients with malnutrition in Dr. Cipto Mangunkusumo Hospital were caused by malignancies or cancers, which were excluded in this study. Therefore, researchers do not look for correlations between the independent and dependent variable, but presenting only in descriptive form. Some patients who have been included in the study dropped out because the doctor in charge of the patient must immediately discharge the patients with a fairly stable condition during the ongoing COVID-19 pandemi so that the possibility of COVID-19 transmission can be prevented. Another thing that caused the subject to drop out was that the patient chose to go home at his request, and several prospective study subjects with malnutrition could not stand (bedridden) which was the exclusion criteria for this study.

CONCLUSION

The administration of high protein liquid diet tended to improve the malnutrition in hospitalized patients as seen in the improvement of the SGA score, BMI, fat-free mass, and handgrip strength. Further research is needed to determine the effectiveness of supplementation of highprotein liquid diet in malnourished hospitalized patients and recommended to include inclusion criteria for bedridden patients so that the number of samples is easier to obtain.

Declarations

Ethics approval and consent to participate**.**
The study was approved by the Ethics Committee of the Faculty of Medicine, Universitas Indonesia on June 25th, 2019 with the approval number KET-313/UN2. F1/ETIK/PPM.00.02/2019.

Availability of data and materials

Data sharing does not applicable to this article as no data sets were generated or analyzed during the current study.

This study is a clinicaltrial, however, we registered this study in the WHO International, Clinical Trial Registry Platform.

Competing interest

Marcellus Simadibrata reports grants from The Indonesian Ministry of Research, Technology, and Higher Education during the conduct of the study. Murdani Abdullah has nothing to disclose. Fiastuti Witjaksono has nothing to disclose.

Virly Nanda Muzellina has nothing to disclose. Amanda Pitarini Utari has nothing to disclose. Yohannessa Wulandari has nothing to disclose. Ari

Wijayanti has nothing to disclose.

Raja Mangatur Haloho has nothing to disclose. Aditya Rachman has nothing to disclose. Daniel Martin Simadibrata has nothing to disclose. Rizka Mutiara has nothing to disclose. Kaka Renaldi has nothing to disclose. Dewi Mustikarani has nothing to disclose.

Funding

This research/article's publication is supported by the Indonesian Ministry of Research, Technology, and Higher Education through the Penelitian Dasar Unggulan Perguruan Tinggi (PDUPT) decree No 6/E/KPT/2019. Program Contract 1/E1/KP.PTNBH2019 and 234/PKS/R/UI/2019

Acknowledgements

This research/article's publication is supported by The Indonesian Ministry of Research, Technology, and Higher Education through the Penelitian Dasar Unggulan Perguruan Tinggi (PDUPT) decree No 6/E/KPT/2019. Program Contract 1/E1/KP.PTNBH2019 and 234/PKS/R/UI/2019.

REFERENCES

1. Meijers JMM, van Bokhorst-de van der Schueren MAE, Schols JMGA, Soeters PB, Halfens RJG. Defining malnutrition: Mission or mission impossible? Nutrition 2010;26:432–40.
2. Allard JP, Keller H, Jeejeebhoy KN, Laporte M, Duerksen DR, Gramlich L, et al. Malnutrition at Hospital Admission - Contributors and Effect on Length of Stay: A Prospective Cohort Study From the Canadian Malnutrition Task Force. J Parenter Enter Nutr 2014;40:487–97.
3. Álvarez-Hernández J, Planas Vila M, León-Sanz M, García de Lorenzo A, Celaya-Pérez S, García-Lorda P, et al. Prevalencia y costes de la malnutrición en pacientes hospitalizados; estudio PREDyCES®. Nutr Hosp 2012;27:1049–59.
4. Schindler K, Pernicka E, Laviano A, Howard P, Schütz T, Bauer P, et al. How nutritional risk is assessed and managed in European hospitals: A survey of 21,007 patients findings from the 2007-2008 cross-sectional nutrition Day survey. Clin Nutr 2010;29:552–9.
5. Lim SL, Ong KCB, Chan YH, Loke WC, Ferguson M, Daniels L. Malnutrition and its impact on the cost of hospitalization, length of stay, readmission, and 3-year mortality. Clin Nutr 2012;31:345–50.
6. Garber AK, Mauldin K, Michihata N, Buckelew SM, Shafer M, Moscicki A, et al. Higher Calorie Diets Increase Rate of Weight Gain and Shorten Hospital Stay in Hospitalized Adolescents With Anorexia Nervosa 2015;53:579–84.
7. Mangunkusumo RDC. Instalasi gizi dan produksi makanan RSCM. Jakarta; 2020.
8. Departemen patologi klinik RSUPN Dr. Cipto Mangunkusumo. Jakarta;2020.
9. Unal M, Kose O, Arik H, Guler F, Acar B, Yuksel H. Hand grip strength: Age and gender stratified normative data in Anatolian population. Hand Microsurg 2018;6:1.
10. Corbel MJ, Tolari F, Yadava VK. Appropriate body-mass index for Asian populations and its implications. Lancet 2004;363:157–63.
11. Cederholm T, Bosaeus I, Barazzoni R, Bauer J, Van Gossum A, Klek S, et al. Diagnostic criteria for malnutrition - An ESPEN Consensus Statement. Clin Nutr 2015;34:335–40.
12. Detsky AS, Mclaughlin J, Baker JP, Johnston N, Whittaker S, Mendelson RA, et al. What is a subjective global assessment of nutritional status? J Parenter Enter Nutr 1987;11:8–13.
13. Chern CJH, Lee SD. Malnutrition in hospitalized Asian seniors: An issue that calls for action. J Clin Gerontol Geriatr 2015;6:73–7.
14. Huynh DTT, Devitt AA, Paule CL, Reddy BR, Marathe P, Hegazi RA, et al. Effects of oral nutritional supplementation in the management of malnutrition in hospital and post-hospital discharged patients in India: a randomized, open-label, controlled trial. J Hum Nutr Diet 2015;28:331–43.
15. Wulandari Y, Tambunan V, Purwoto G. Deteksi malnutrisi pasien kanker ginekologik : patient-generated subjective global assessment dengan subjective global assessment. Universitas Indonesia 2015
16. Bharadwaj S, Ginoya S, Tandon P, Gohel TD, Guirguis J, Vallabh H, et al. Malnutrition: Laboratory markers vs nutritional assessment. Gastroenterol Rep 2016;4:272–80.
17. Cawood AL, Elia M, Stratton RJ. Systematic review and meta-analysis of the effects of high protein oral nutritional supplements. Ageing Res Rev [serial online] [cited 2019 December 08] 2012;11:278–96. Available from: http://dx.doi.org/10.1016/j.arr.2011.12.008
18. Zhu MW, Yang X, Xiu DR, Yang Y, Li GX, Hu WG, et al. Effect of oral nutritional supplementation on the post-discharge nutritional status and quality of life of gastrointestinal cancer patients after surgery: a multi-center study. Asia Pac J Clin Nutr 2019;28:450–6.
19. Lovesley D, Parasuraman R, Ramamurthy A. Combating hospital malnutrition: Dietitian-led quality improvement initiative. Clin Nutr ESPEN 2019;30:19–25.
20. Lauque S, Arnaud-Battandier F, Gillette S, Plaze JM, Andrieu S, Cantet C, et al. Improvement of weight and fat-free mass with oral nutritional supplementation in patients with Alzheimer's disease at risk of malnutrition: a prospective randomized study. J Am Geriatr Soc 2004;52:1702–7.