High-Protein Dietary Supplementation and Nutritional Status Improvement of Malnourished Patients in Hospital Care

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ABSTRACT

Hospital malnutrition is common in Indonesia and other developing countries. In Asia, the prevalence of hospital malnutrition ranges between 27-39%. The causes of malnutrition in hospital care include insufficient food intake and increased catabolic processes due to underlying causes such as metabolic disease, infection, and malignancy. Several studies have demonstrated that malnutrition increases the morbidity and mortality of hospitalized patients, prolongs hospital stay, and delays recovery. Therefore, healthcare providers must recognize malnutrition early by conducting nutritional screening and assessment to prevent worsening of malnutrition and administer the optimal nutritional therapy to patients. Apart from giving a standard diet, high-protein food supplementation in liquid form remains a suitable alternative for patients, especially since it is easily digestible. A high protein diet is associated with a better mortality rate, better weight gain, and improved SGA score in patients.

Keywords: *Hospital malnutrition, high-protein dietary supplementation*

ABSTRAK

Malnutrisi di rumah sakit adalah masalah yang umum ditemukan di Indonesia dan negara-negara berkembang lainnya. Di Asia, prevalensi malnutrisi di rumah sakit berkisar antara 27-39%. Malnutrisi di rumah sakit dapat terjadi akibat asupan nutrisi yang tidak mencukupi dan peningkatan proses katabolik yang disebabkan oleh beberapa penyebab yang mendasari seperti penyakit metabolik, infeksi, dan keganasan. Beberapa studi menunjukkan bahwa malnutrisi meningkatkan morbiditas dan mortalitas pada pasien yang dirawat di rumah sakit, memperpanjang durasi rawat di rumah sakit, dan menunda pemulihan. Oleh karena itu, tenaga kesehatan harus mengidentifikasi malnutrisi sesegera mungkin dengan melakukan skrining nutrisi dan penilaian untuk mencegah perburukan malnutrisi dan memberikan terapi nutrisi yang optimal kepada pasien. Selain memberikan diet standard, suplementasi makanan cair tinggi protein masih termasuk alternatif yang

tepat bagi pasien, terlebih karena konsistensinya yang cair sehingga mudah ditelan. Diet tinggi protein berkaitan dengan tingkat mortalitas yang lebih baik, peningkatan berat badan, dan peningkatan skor SGA pada pasien.

Kata kunci : Malnutrisi di rumah sakit, suplementasi makanan tinggi protein

INTRODUCTION

Malnutrition is defined as a condition that results from a deficiency, excess, or imbalance of energy, protein, and other nutrients. Generally, malnutrition can be classified as undernutrition or overnutrition, commonly known as obesity.[1] The diagnosis of malnutrition is made through comprehensive history taking regarding nutritional intake, anthropometric measurements, and nutrition-related laboratory examinations.

Malnutrition is a common problem in hospitalized patients. It is often found in developing countries around the world. The numbers of hospital malnutrition vary between 15-70%.[2,3] A study in Canada reported the prevalence of malnutrition to be 45%.[2] In Europe, the prevalence of hospital malnutrition was 20-30%, profoundly found in the elderly and patients with malignancy[4,5] Meanwhile, in Asia, the prevalence of malnutrition in the hospital was 27-39%.[6] These discrepancies in the prevalence of malnutrition between regions are primarily driven by the differences in the study population and the screening method used for detecting malnutrition.

Hospital malnutrition can occur due to insufficient nutritional intake, impaired absorption, loss of nutrition due to underlying diseases, or increased metabolic requirements during a disease.[3] Several studies have highlighted that malnutrition in the hospital increases morbidity and mortality, prolongs hospital stay, and delays recovery.[2,7,8] This would subsequently increase the cost of care in hospitals.[9] Thus, nutritional support is needed to lower morbidity and mortality, increase treatment efficacy, shorten the length of hospital stay, and improve the quality of life. This nutritional status improvement can be achieved by giving food supplementation. Currently, various liquid food supplementation formulas are made both commercially and in the hospital. Since liquid helps food be swallowed more easily, liquified foods have become suitable alternative forms of nutrition used in hospitals.

MALNUTRITION

The European Society for Clinical Nutrition and Metabolism (ESPEN) consensus defined malnutrition as a condition caused by insufficient nutritional intake that causes changes in body composition (decreased fat-free mass (FFM) and, more specifically, decreased cell mass) and body function.[10] Malnourished patients in the hospital are often closely related to disease-related malnutrition, where malnutrition occurs due to an underlying disease process found in patients or occurs during extended hospital stays. Malnutrition is not regularly diagnosed in hospitals; approximately one-third of patients without malnutrition become malnourished during hospitalization.[11] The cause for this hospital malnutrition is decreased food intake caused by decreased appetite, uncomfortable gastrointestinal symptoms, decreased ability to masticate and swallow, or even the nil per os (NPO) to the underlying diseases experienced by the patients.[11]

Malnutrition in Hospital Care

The prevalence of malnutrition in hospitals ranges between 20-50% depending on the population and diagnostic criteria.[12] According to the 2013 Indonesian Basic Health Research report, the prevalence of the adult population experiencing nutritional deficiencies was 8.7%. In Jakarta, a study reported that 20-60% of patients suffered from malnutrition, 69% experienced a decrease in nutritional status during their hospital stay.[13]

Classification and Diagnosis of Malnutrition

Currently, there are several types of malnutrition classifications. One of the most frequently used classifications for malnutrition in adults is based on the body mass index (BMI) recommended by the World Health Organization (WHO) in 2004, which divides patients into mild, moderate, and severe malnutrition (Table 1).[14]

Aside from the WHO's BMI criteria, malnutrition in adults can be confirmed by various methods, such as the ESPEN 2015 recommendations, the American Society for Parenteral and Enteral Nutrition (ASPEN) recommendations, which primarily utilize clinical

Table 1. Adult malnutrition classification according to the WHO[14]

Body mass index (kg/m^2)	Classification
17.00–18.49	Mild malnutrition
16.00–16.99	Moderate malnutrition
< 16.00	Severe malnutrition

features, or according to objective laboratory values. The ESPEN recommendation (2015) diagnosed and classified malnutrition in two different ways (Table 2).

Table 2. Malnutrition diagnosis criteria according to the ESPEN consensus (2015)[14]

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: (1) BMI < 20 kg/m^2 for aged < 70 years or BMI <22 kg/m^2 for aged ≥70 years, or; (2) Fat free mass index (FFMI) <15 kg/m^2 for females or FFMI < 17 kg/m^2 for male

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

Furthermore, the ASPEN recommendations can clinically determine malnutrition if two of the following six criteria are present: (1) Inadequate intake. Malnutrition can be a result of inadequate intake or assimilation of food and nutrients. The main criterion for diagnosing malnutrition requires an analysis of dietary intake at the onset of illness and comparing it with the estimated daily needs. Clinicians need to gather information about the dietary intake, estimate the optimal energy requirements, and compare them with the estimated consumed energy. Inadequate intake is assessed as a percentage of the estimated energy needed over a certain period; (2) Weight loss. Clinicians need to evaluate any weight loss, including the presence or absence of low or high body fluids. Assessment of body weight changes over a certain period is necessary, and the percentage of weight loss compared to the initial weight must be calculated; (3) Decreased muscle mass. Loss of muscle mass can be seen in the muscles located in the temporal region, clavicle (pectoral and deltoid muscle), interosseous scapula, latissimus dorsi, trapezius, thigh, and calf muscles; (4) Decreased subcutaneous fat mass. Subcutaneous fat loss can be seen in the orbital area, triceps, and fat between the ribs; (5) Any local or generalized fluid accumulation. Clinicians need to evaluate the presence of generalized or localized (specifically to the extremities, vulvar/scrotal edema, and ascites) fluid build-up. Weight loss often goes undetected due to fluid retention (edema) and is often observed as weight gain; (6) Decrease in functional status as measured by grip strength.

HIGH-PROTEIN DIET

Current recommendations for malnourished patients with refeeding syndrome are conservative. The recommended diet of 1200 kcal/day with daily increments of about 200 kcal/day is intended to avoid refeeding syndrome. This syndrome can present as a potentially fatal electrolyte shift when insulin is released in response to nutritional intake (especially carbohydrates). Although the evidence suggests that refeeding syndrome risk is highest in severely malnourished patients, the low-calorie diet is still widely and safely adopted.[15] However, this approach may be too conservative for maximizing nutritional recovery in most hospitalized patients. In the United States, administering a high-calorie diet to moderately malnourished adolescents (those with a BMI of about 75-85% than required) caused by anorexia nervosa showed better weight gain than a low-calorie diet.[15]

A meta-analysis and systematic review are done by Gomes F et al to study the association between nutritional support and clinical outcomes in inpatients who are malnourished or at nutritional risk.[16] The study collected 27 clinical trials with a total of 6803 patients included in the study. The patients who are included are all medical inpatients who are not critically ill with malnutrition or at risk of malnutrition and are assigned to nutritional intervention and control groups with various clinical conditions. The primary outcome was the mortality and secondary outcome, including non-elective hospital readmission, length of stay, infection rate, functional outcome, daily caloric, protein intake, and weight change.

Mortality rate in with nutritional intervention group and control group was 8.3% (230 of 2,758) and 11.0% (307/2787) respectively and show significant reduction of mortality rate in intervention group (OR = 0.73; 95% CI: 0.56-0.97; p = 0.03). Non elective hospital admission rate also show significant difference between intervention group 14.7% (280/1903) and control group 18% (339/1880) with intervention group have fewer non elective admissions (RR = 0.76; 95% CI: 0.60-0.96; p = 0.02). The intervention group also is associated with higher energy intake (1618 kcal in the intervention group vs. 1331 kcal in the control group; mean difference, 365 kcal; 95% CI: 272-458 kcal) and protein intake (59 g in the intervention group vs. 48 g in the control group; mean difference, 17.7g; 95% CI: 12.1-23.3 g). Consequently, there is a significant increase in body weight associated with better muscle mass (0.63 kg in the intervention group vs -0.19 kg in the control group; mean difference, 0.73 kg; 95% CI: 0.32-1.13 kg).However there is no significant difference between control and intervention group in a infection rate (4.8%[88 of 1817] vs. 5.6%[102 of 1825]; OR = 0.86; 95% CI: 0.64-1.16, functional outcome at follow up 17.3 vs. 16.9 points; mean difference in Barthel index score, 0.32 points; 95% CI: -0.51 to 1.15), and length of

stay 11.5 days vs 12.0 days; mean difference, -0.24 days; 95% CI: -0.58 to 0.09). Funnel plots test were done and showed no evidence of any publication bias.

This study suggests an association between increased protein intake and energy intake in the intervention group; consequently, there is an increased weight which is beneficial for undernutrition patients. There is also added benefit of reduced mortality and hospital readmission in the intervention group.

A placebo-controlled double-blinded randomized controlled trial done by Deutz NE et al study malnourished geriatric patients with various clinical conditions (congestive heart failure, acute myocardial infarction, or chronic obstructive pulmonary disease).[17] The intervention group was given HP-HMB (high protein enriched with β-hydroxy-β-methyl butyrate) with standard care (n = 328). The Control group was given a placebo with standard care (n = 324). The primary end point was 90-day post-discharge incidence of death or non-elective readmission. Secondary endpoints included 30- and 60-day post-discharge incidence of death or readmission, length of stay, SGA class, body weight, and activities of daily living score.

Patient selection criteria were aged ≥ 65 years old with recent hospital admission with a primary diagnosis of CHF, AMI, or COPD with SGA class of B. These patients were screened due to higher risk of malnutrition in the geriatrics population with comorbidities. Exclusion criteria including patients with diabetes mellitus (type 1 or 2) due to product composition not intended for patients with diabetes, current active cancer or under treatment, impairment of renal and liver function as these patients might have impairment in protein metabolism. Selected patients were randomly allocated to consume two servings of HP-HMB or placebo for 90 days post-discharge for the hospital.

Both groups are similar in baseline demographic and clinical characteristics. Both groups have similar treatment adherence. Primary endpoint show significant difference in 90 days mortality with 4.8% and 9.7% (p = 0.018) relative risk 0.49 (95% CI: 0.27-0.90) in intervention group and control group respectively. However, both rates of the first readmission and/or death and readmission in these groups did not differ statistically. Secondary endpoints show a significant difference in 30 and 60 day mortality rate (2.9% vs. 6.2%; p = 0.049) and (4.2% vs.8.7%; p = 0.020) respectively. On day 90 intervention group had a higher proportion of patients with SGA-A (well-nourished) in comparison to the control group and this resulted in significantly higher odds (OR ¼ 2.04; 95% CI: 1.28 - 3.25; p = 0.009) (Figure 1).

In addition, there is also a significant weight gain in the intervention group compared to the control group on day 30. No significant effects were seen in the length of

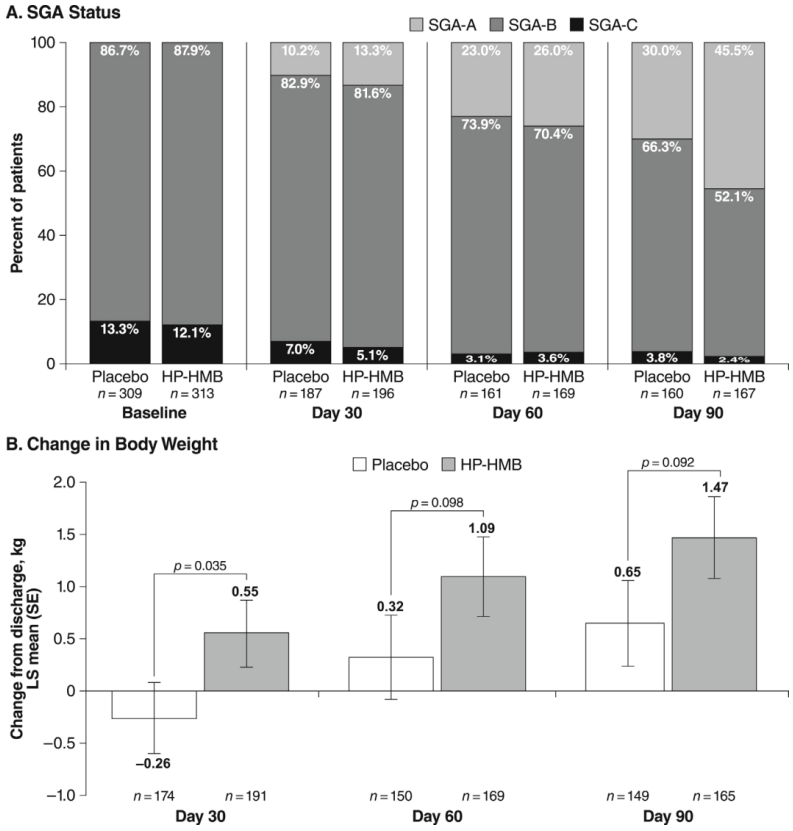

Figure 2. Nutritional status and weight change[17]

stay and average daily living score. Post hoc analysis on COPD subgroups shows an improvement of handgrip strength in intervention groups compared to the control group. (1.56 ± 0.67 vs. 0.34 ± 0.63, p = 0.0413)

Similar to the previous meta-analysis, this study has shown a significant reduction of the mortality rate in the group with high protein intake compared to the control group. An increased nutritional status, as shown by SGA score, is an improvement. Followed by increase weight which is shown to improved malnutrition status in geriatric patients. Increase handgrip strength is also an indicator of nutrition status and is strongly associated with favourable clinical outcomes. Overall this study also supports giving a high protein diet to improve the patient's condition.

High-protein Liquid Supplementations currently available on the market include commercial and hospital liquid foods. Examples of commercial high-protein liquid food include Peptisol (Kalbe Farma), which contains 14 g of protein/200 mL. New Ensure Enlive (Abbott) contains 20 g of protein and 350 kcal per bottle. Protein (Otsuka), which contains 10 g of protein and 212 kcal per 200 ml of serving).[18,19,20] Liquid food formula produced in Cipto Mangunkusumo Hospital includes the CLLM milk with 60 g of protein per 1000 kcal (Table 3).[21]

Table 3. Composition of liquid food formula CLLM (Cipto Mangunkusumo Hospital, Jakarta)[21]

CLLM 60-gram Formula Content	Per 1000 kcal
Carbohydrate	126 grams
Protein	60.3 grams
Total Fat	32.7 grams
Cholesterol	330 milligrams
Vitamin	
Vitamin A	2209 RE
Vitamin E	5.89 grams
Vitamin B1 (Thiamine)	680 milligrams
Vitamin B2 (Riboflavin)	847 milligrams
Vitamin B3 (Niacin)	4.27 milligrams
Vitamin B5 (Pantothenic acid)	2.66 milligrams
Vitamin B6 (Pyridoxine)	508 milligrams
Vitamin B9 (Folic acid)	47.5 micrograms
Vitamin B12 (Cobalamin)	1.22 micrograms
Vitamin C	57.5 milligrams

The Rationale for Giving High-protein Liquid Food Supplementation

Malnutrition is positively associated with poor patient outcomes. However, this condition remains treatable, mainly when there is adequate nutritional management. Identifying patients with malnutrition or at risk of malnutrition is the first step in the multidiscipline treatment process. It is crucial to identify such patients as early as possible so that nutrition therapy can be started in a timely and effective manner. A quick and accurate assessment method is helpful, especially in an interdisciplinary approach (Figure 1).

Therefore, screening for the risk of malnutrition with a rapid and straightforward tool should be carried out systematically in hospitalized patients. A detailed and comprehensive malnutrition assessment should be performed in all patients with malnutrition or at risk of developing the condition. Trained workers should perform this screening using subjective and objective parameters such as clinical history, physical examination, BMI measurement, assessing the body's function, and laboratory values. This systematic and standardized screening will ultimately reduce treatment costs.[15,22,23,24]

Nutrition is an effective treatment option to prevent and/or treat malnutrition, thus reducing morbidity and mortality. The results of a study in Asia suggested that providing nutritional support to patients at risk of malnutrition and patients who are already experiencing malnutrition can reduce morbidity and mortality, improve quality of life and/or function; and reduce the length of stay in the hospital, use of resources, and cost of care.[23] Oral nutritional therapy was also reported to increase the body weight and BMI of postoperative gastrointestinal cancer patients despite no significant improvement in the patient's quality of life. Several preliminary studies in Indonesia showed

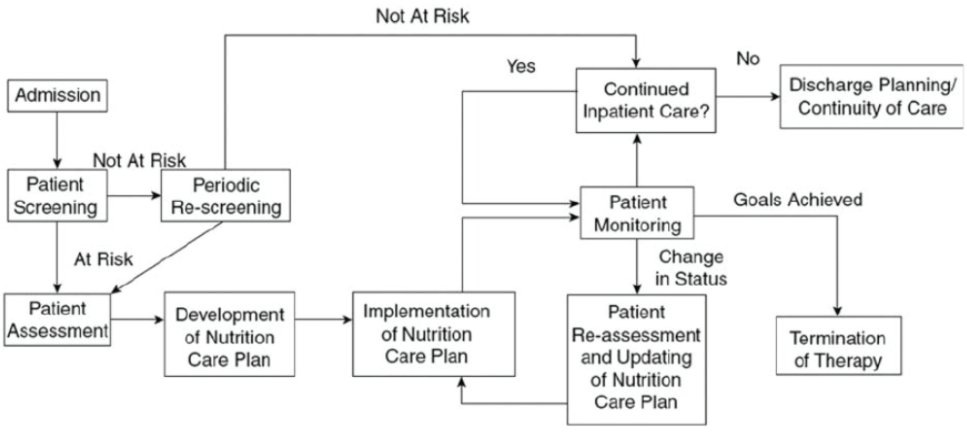

Figure 1. Nutrition care algorithm[10]

that providing adequate high-protein nutrition could improve nutritional status and immunity, thereby accelerating the healing process and shortening the length of stay.[25]

To date, not much is known regarding the cost-effectiveness of administering nutritional therapy to such patients. Thus, this warrants further research in the area before clinical implementation. Additionally, it may also be essential to study the metabolic system and the gut microbiome diversity in patients given nutritional therapy.[26]

Contraindication of High Protein Diet in Malnourished Patients

One study by Hanna RM et al highlights a high protein diet contraindication in malnourished patients.[27] The study explores patients with chronic kidney disease or end-stage renal disease with protein-energy wasting. Protein-energy wasting (PEW) is a state of nutritional and metabolic derangements in patients with chronic kidney disease and end-stage renal disease characterized by simultaneous loss of systemic body protein and energy stores. A Hypercatabolic state induced by uremia, anorexia due to poor appetite, and inflammation from systemic condition or dialysis process might explain the negative balance of protein and energy stores from the body. The processes above will lead to cachexia, fat loss, and lean muscle mass loss; therefore, nutritional therapy is required for patients with protein-energy wasting.

Dietary intervention in these patients is required to preserve lean muscle mass and provide adequate energy supply, which is vital to the health of dialysis patients. Recommended protein intake for these patients is 0.6-0.8 g/kg/day and dietary calorie intake of 30-35 kcal/kg/day for patient stage IIIB-V CKD. However, the risk of negative protein balance low protein diet (LPD) is recommended due to the higher risk of CKD progression with a higher protein diet. However, kidney disease progression through LPD is more beneficial in younger patients. As such, protein restriction in older populations should be balanced against PEW, which would result in worse renal and mortality outcomes.

CONCLUSION

Rapid and accurate assessment methods will be beneficial for detecting malnutrition, especially when using an interdisciplinary approach. Furthermore, treatment costs can be reduced through systematic and standardized screening of patients at risk of malnutrition. Furthermore, nutritional therapy with high-protein liquid food supplementation can be an effective alternative therapy for malnourished patients in the hospital. However, it must be highlighted that not all patients benefited from a high protein diet; for example, in patients with chronic kidney disease with end-stage renal disease, protein intake must be restricted because it can damage the kidney further.

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