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MALNUTRITION AT HOSPITAL ADMISSION AND ITS ASSOCIATED FACTORS IN INTERNAL MEDICINE INPATIENTS

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ABSTRACT
Background: *Malnutrition at hospital admission may adversely affect patients' clinical outcomes. The Global Leadership Initiative on Malnutrition (GLIM) recently set a standard of measurable criteria to diagnose malnutrition.*
Objectives: *This study aimed to determine the proportion and risk factors of malnutrition at hospital admission.*
Materials and Methods: *A cross-sectional observational study was conducted in the internal medicine ward of the National General Central Hospital, Dr. Cipto Mangunkusmo (RSCM), Jakarta, from January to May 2022. Subjects aged 18 and above were recruited for this study. Malnutrition at hospital admission was defined according to the GLIM criteria. Then, the data were analyzed using multiple logistic regression to determine malnutrition risk factors, presented by odds ratios (OR) and 95% confidence intervals (CI).*
Results: *A total of 231 subjects were enrolled in the study. Among them, 85.3% were malnourished according to the GLIM criteria. In addition, subjects with a severe to total dependency on functional status (OR 9.406, 95%CI: 3.147–28.109), inadequate energy intake (OR 2.718, 95%CI: 1.197–6.172), and multimorbidity (OR 2.337, 95%CI: 1.045–5.228), were significantly associated with malnutrition at hospital admission cases.*
Conclusion: *According to the GLIM criteria, the proportion of malnutrition at hospital admission is high. The risk factors of malnutrition at hospital admission include low functional status, inadequate energy intake, and multimorbidity.*

Keywords *: Malnutrition; Nutritional status; Nutrition assessment; Hospital admission; Internal medicine, Inpatients*

BACKGROUND
The prevalence of malnutrition is around 15 to 60% globally[1]. Among patient admission to the hospital, the prevalence of malnutrition ranges from 31 to 73%,[2-6] with internal medicine inpatients mostly having the highest rate [5,7]. The number increased by 5% at discharge [2]. Several studies have proven that malnutrition may have a detrimental effect on clinical outcomes, namely in-hospital falls, longer hospital stay, higher admision cost, morbidity or complication or a critical care area neccessity, and mortality [4,8-14].

Malnutrition status at hospital admission was associated with physical function, hospitalization [15], polypharmacy [16,17], and comorbidities [5,18]. Other studies in hospital settings had also mentioned the associated factors of malnutrition or malnutrition at risk, involving age [17,19], gender [10], infections [20], cancer [6], multimorbidities [21], dementia, cognitive decline [19], depression [22,23], inadequate intake [24], gastrointestinal(GI) disorder [25], and medical procedure [26].

Various instruments to determine malnutrition status have emerged, such as the Subjective Global Assessment (SGA) score, which has become the gold standard [27]. However, the SGA malnutrition score is currently facing judgment issues regarding subjectivity which may affect its accuracy. The Academy of Nutrition and Dietetics–American Society for Parenteral and Enteral Nutrition (AND-ASPEN) and the European Society for Clinical Nutrition and Metabolism (ESPEN) have made a consensus that requires at least two clinical criteria to establish malnutrition status, in which AND-ASPEN criteria were proved to have higher accuracy [28]. However, the inter-population comparison is impossible due to the absence of global agreement regarding malnutrition criteria.

Responding to the challenge, Global Leadership Initiative on Malnutrition (GLIM) established a consensus that malnutrition diagnosis requires at least two criteria, including phenotypic (decrease in body weight [BW] or low body mass Index [BMI] or reduced muscle mass) and etiological (low food

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intake/assimilation, or presence of inflammation) [29]. Unlike pre-existing methods, GLIM criteria are well-proven for substantial validity(30) and accuracy in predicting adverse clinical outcomes [30,31]. GLIM can detect 41.6% of malnutrition cases among inpatients in Brazil [30], supported by satisfactory accuracy as a result of a comparative study within several methods [28]. In Asia, a meta-analysis study has reported a significantly higher malnutrition rate based on GLIM criteria due to high diagnostic value [32].

Specifically in Indonesia, undernourishment was observed in 26.7–65.5% of adult internal medicine inpatients.(6,24,33) This number has recently tended to be higher when assessed using the GLIM criteria (75.0%) than the SGA (70.4%) [34]. However, the risk factors for malnutrition based on GLIM criteria have not been examined, particularly among inpatients in Indonesia, which has a large population with the highest mortality caused by comorbidity, namely stroke, ischaemic heart disease, diabetes mellitus, lung disease and liver disease [35].

It is critically important to evaluate risk factors for malnutrition at hospital admission in Indonesia due to the high malnutrition rate among internal medicine inpatients. Therefore, using the GLIM criteria, this study aimed to determine the prevalence and identify the risk factors among inpatients at admission to the internal medicine ward.

MATERIALS AND METHODS

An observational study with a cross-sectional design was conducted in the internal medicine ward of Dr. Cipto Mangunkusmo Hospital (RSCM), Jakarta, from January to May 2022. Dr. Cipto Mangunkusmo Hospital, a national general central hospital, is a well-known national referral center hospital with complete facilities and a high reputation as an educational hospital. This hospital supports the development of health professional human resources, including dietitians. The ethical review was obtained from the Faculty of Medicine Ethics Committee, University of Indonesia (1202/UN2.F1/ETIK/PPM.00.002/2021). In addition, each subject has signed an informed consent form before participating in this study.

The minimum sample size was calculated using the Roscoe formula (1982) for multivariate hypothesis test research; the minimum sample size was ten times the number of variables used in the study [36]. This study has fifteen variables, surpassing the minimum sample size to be analyzed. The minimum sample size in this study was 150 subjects. The inclusion criteria were patients with a minimum age of 18 years, patients who enter the internal medicine ward for a maximum of 48 hours, patients or caregiver who knows the patient's condition either before or during hospital admission, fluent in the Indonesian language, have the ability to understand instructions, and consent to be a subject. Patients were excluded if they were pregnant, could not be weighed (due to severe edema and/or unstable clinical condition), had incomplete data regarding nutritional status or medical history, and had incomplete limbs due to significant amputation or had significant skeletal growth abnormalities.

Three hundred three subjects were recruited using consecutive sampling at the beginning of treatment in the internal medicine ward from January until April 2022. Sixty eight subjects were excluded due to pregnancy (n = 1), could not be weighed (without any recall of weight loss and had normal muscle mass [n = 4], had moderate or severe edema/ascites and/or unstable clinical condition [n = 36]), had incomplete data regarding nutritional status or medical history (n = 30), had skeletal growth abnormalities due to history of juvenile idiopathic arthritis (n = 1). Finally, a total of 231 subjects were enrolled in this study.

A dietitian-nutritionist conducted the daily nutrition assessment for every new patient admitted to this hospital with at-risk malnutrition. The assessment includes malnutrition criteria based on the 2018 GLIM consensus, which requires at least one phenotypic and one etiologic criterion. Specifically, the phenotypic criteria in this study were collected by direct anthropometry measurement and interview, including non-volitional weight loss (> 5% within the last six months, or > 10% for > 6 months), low BMI (< 18.5 kg/m^2 in patients aged < 70 years, or < 20 kg/m^2 in patients aged $\geq$ 70 years),[9,14] and low muscle mass (ref. Asian Working Group of Sarcopenia [AWGS]) with cut-off points for low calf circumference (CC): male < 34 cm and female < 33 cm or low mid-upper arm muscle circumference (MAMC) (male < 21.1 cm, female < 19.2 cm) [38].

The etiologic criteria must consist of either reduced food intake (intake < 50% of energy requirement [ER] for > 1 week, or any reduction for > 2 weeks) or any presence of reduced food/nutrient assimilation (as identified if any occurrence of GI problem which might persistently adversely affect food intake or absorption, including dysphagia, nausea, vomiting, bloating, heartburn, gastrointestinal reflux disease [GERD], gastric cancer, diarrhea, constipation, pancreatic insufficiency, short bowel syndrome, hematochezia or any GI bleeding or any chronic intestinal insufficiency), or the occurrence of disease burden/inflammatory conditions (if there is a diagnosis of the disease with chronic or acute inflammation, or supported by C-reactive protein [CRP] data > 5 mg/L as an inflammatory biomarker) [29,39,40].

The clinical parameters consist of medical history (previous surgery during the past five years, previous hospital admission within the past year, and history of the number of drugs consumed daily) [30], dietary history (energy intake) [41,42], and patient's medical status during hospital admission consist of comorbidity index [43], presence of cancer [30], presence of infection [20], GI problem [30], functional status (Barthel Index for Activities of Daily Living [B-ADL]) [44], and the presence of depression and/or dementi [19,22,23]. The primary data, including socioeconomic, dietary intake, and malnutrition status, were collected through direct interviews and measurements. The ward medical doctor assessed Charlson *Comorbidity Index*(CCI) to provide the comorbidity index at admission [43]. Functional status were assessed by ward nurse at admission, non-geriatric patients were collected directly, while geriatric patients were obtained from the medical record [44]. Other secondary data were collected by accessing the Health Information System (HIS) as an electronic version of the medical record, which contains complete data of patients treated at RSCM, including personal data (gender, date of birth and actual age), medical history, and current medical conditions (medical diagnosis, clinical conditions, and CRP).

Anthropometric data were obtained by direct measurements performed by trained personnel. In measuring body height and weight (BW), patients were asked to stand in a digital body stadiometer (SECA, China) while wearing very minimal clothes (precision: 0.1 cm for height and 0.1 kg for BW). Estimated BW was conducted if either edema or ascites were present by correcting the weight percentage based on the severity (mild 5%; moderate 10%; severe 15%), with an additional 5% reduction required when pedal edema bilaterally occurred [45]. BMI were determined by dividing the BW (kg) by height (m) squared. Weight loss was obtained by calculation (weight loss = [previous - actual BW]: previous BW x 100%), with the previous BW relying on subjects or caregiver's recall within the past six months or beyond. Other measurements included knee height (knee height caliper, Indonesia) with a precision of 0.1 cm, which was applied if the patient could not stand up. Then, we calculate the knee height with Shahar and Pooy's formula to obtain height prediction [46]. In addition, this study also included calf circumference (CC) with a precision of 0.1 cm (SECA, China), skin folds (SF) thickness measurement with an accuracy of 1 mm (Baseline, USA), and mid-upper arm circumference (MUAC) with an accuracy of 0.1 cm (SECA, China). Mid-upper arm muscle circumference (MAMC) data was obtained from the SF and MUAC data by calculation using the Nunes et al. formula [47].

At hospital admission, RSCM's trained dietitian-nutritionist assessed dietary history using the semi-quantitative-Food Frequency Questionnaire (FFQ) method to obtain each subject's food pattern, as validated by a previous study [48]. We then analyzed the nutrient intake using a web-based tool — Panganku (https://www.panganku.org, Indonesia) — to obtain daily dietary intake estimation before hospitalization.

All data were grouped into two categories based on references or median for statistical analysis. The factors including age were categorized as an older adult (≥ 60 years) or adult (18–59 years), gender as male or female, level of education as high school and below or higher education, income level as low or sufficient [49], history of surgery/invasive procedure as yes or no, previous hospitalized as yes or no, inadequate energy intake as yes (≤ 75% from daily ER) or no (intake of > 75% of daily ER) [42], drugs consumption before admission as ≥ 5 (polypharmacy) or < 5 (non-polypharmacy) kinds of drugs per day [16], comorbidity index as CCI score ≥ 5 (multimorbidity) or < 5 (not multimorbidity),(6) cancer as yes or no, presence of infectious diseases as yes or no, presence of gastrointestinal problem as yes or no, functional status as B-ADL score ≤ 8 (severe to total dependency) or > 8 which is according to median, and the presence of depression and/or dementia as yes or no.

The main outcome of this study was malnutrition status, defined by at least one phenotypic and one etiologic criterion. These criteria must meet the GLIM consensus, specifically for the Asia population requirement, as mentioned [29]. In the end, the nutritional status was categorized into two categories; malnutrition or normal.

Descriptive analysis was performed to determine the characteristic data. Bivariate analysis was performed using the chi-square test to assess the association between categorical independent variables and malnutrition status. Variables with $p < 0.25$ that have been considered clinically associated were applied to multivariate analysis using backward stepwise multiple logistic regression to identify malnutrition risk factors at hospital admission. The *p*-value < 0.05 indicated a statistically significant result. Odds ratios (ORs) and a 95% confidence interval (CI) were obtained. The IBM SPSS 23.0 statistical software was used for statistical analysis.

RESULTS

Malnutrition at hospital admission

Table 1 shows the subject's characteristics. Among all subjects, 85.3% were malnourished. The phenotypes of malnourished subjects were as follow: weight-loss (59.4%), low BMI (18%), and reduced muscle mass (90.9%). Etiological criteria in malnutrition group were established from reduced food intake/assimilation (77.2%), and the presence of disease burden/inflammatory conditions accounted for a larger percentage (98.0%).

Tabel 1. Characteristics of The Subjects According to Malnutrition Status

Parameter	Total	Malnutrition n=197	Normal n=34
Age (years), mean (SD)	54 (16)	55 (16)	45 (16)
Comorbidity Index (CCI), median (min-max)	4 (0–14)	5 (0–14)	2 (0–9)
Functional Status (B-ADL), median (min-max)	8 (0–20)	8 (0–20)	13 (4–20)
Nutritional Status, n (%)		197 (85.3)	34 (14.7)
Phenotypic Criteria, n (%)			
Weight Loss			
Yes		117 (59.4)	5 (14.7)
No		18 (9.1)	22 (64.7)
N/A		62 (31.5)	7 (20.6)
Low BMI			
Yes		35 (18)	0 (0)
No		53 (27)	34 (100)
N/A		109 (55)	0 (0)
Reduced muscle mass			
Yes		179 (90.9)	2(5.9)
No		18 (9.1)	32 (94.1)
Etiologic Criteria, n(%)			
Reduced food intake/assimilation			
Yes		152 (77.2)	18(52.9)
No		45 (22.8)	16 (47.1)
Disease burden/inflammatory condition			
Yes		193 (98.0)	25 (73.5)
No		4 (2.0)	9 (26.5)

B-ADL= Barthel Index for Activities of Daily Living; CCI=Charlson Comorbidity Index; N/A = Not Applicable; SD=Standard Deviation

Associated factors of malnutrition at hospital admission

Tabel 2 shows that the most affected factors was in the older adult group (93.3%) while other characteristics including male (87.6%), secondary school and lower educational level (86.2%), low-income level (84.8%), having surgery/invasive treatment before being admitted to the hospital (86%), having a history of being hospitalized (85.3%), having inadequate intake (89.7%), non-polypharmacy (86.9%), severe comorbidity index or multimorbidity (90.8%, the overall major chronic disease were tumour 26%, diabetes mellitus 14.3%, liver disease 10.8%), as well as the presence of certain clinical conditions including cancer (87.9%), infection (89.6%), having GI tract disorders (86.7% with dyspepsia 31.2% as the major symptom among all subjects), and severe to total dependency of functional status (96.6%), and depression and/or dementia (93.3%).

Tabel 2. Simple Logistic Regression of The Factors Associated with Malnutrition At Admission

Parameter	Malnutrition n (%)	Normal n (%)	OR(95%CI)	p-*value*
Demographic				
Age			3.469 (1.374–8.756)	0.010
Older adult (≥ 60 years)	84 (93.3)	6 (6.7)		
Adult (18–59 years)	113 (80.1)	28 (19.9)		
Gender			1.475 (0.709–3.070)	0.390
Male	106 (87.6)	15 (12.4)		
Female	91 (82.7)	19 (17.3)		
Socioeconomic				
Education Level			1.370 (0.594–3.160)	0.500
Secondary School or lower	156 (86.2)	25 (13.8)		
College	41 (82)	9 (18)		

Parameter	Malnutrition n (%)	Normal n (%)	OR(95%CI)	p-*value*
Income level			0.884 (0.389–2.011)	0.930
Low	140 (84.8)	25 (15.2)		
Sufficient	57 (86.4)	13 (13.6)		
Clinical paramater				
Previous surgery/invasive treatment			1.155 (0.554–2.406)	0.845
Yes	117 (86)	19 (14)		
No	79 (84.2)	15 (15.8)		
Previous hospitalized			1.004 (0.440–2.291)	1.000
Yes	145 (85.3)	25 (14.7)		
No	50 (85.2)	9 (14.8)		
Inadequate energy intake			4.071 (1.874–8.841)	0.0001
Yes (≤75% ER)	165 (89.7)	19 (10.3)		
No	31 (68.1)	15 (31.9)		
Drugs consumption before admission			0.601 (0.272–1.329)	0.294
≥ 5 (polypharmacy)	44 (80.0)	11 (20.0)		
< 5 (non-polypharmacy)	153 (86.9)	23 (13.1)		
Comorbidity index (CCI)			2.590 (1.197–5.602)	0.022
Severe (≥5)	109 (90.8)	11 (9.2)		
Not Severe (< 5)	88 (79.3)	23 (20.7)		
Cancer			1.356 (0.580–3.172)	0.618
Yes	58 (87.9)	8 (12.1)		
No	139 (84.2)	26 (15.8)		
Infection			3.280 (1.542–6.978)	0.003
Yes	155 (89.6)	18 (10.4)		
No	42 (72.4)	16 (27.6)		
Gastrointestinal problem			1.937 (0.795–4.719)	0.224
Yes	170 (86.7)	26 (13.3)		
No	27 (77.1)	8 (22.9)		
Functional status (B-ADL)			10.301 (3.495–30.362)	0.0001
≤8	114 (96.6)	4 (3.4)		
>8	83 (73.5)	30 (26.5)		
Depression and/or dementia			2.525(0.321–19.854)	0.704
Yes	14 (93.3)	1 (6.7)		
No	183 (84.7)	33 (15.3)		

B-ADL= Barthel Index for Activities of Daily Living; CCI=Charlson Comorbidity Index; CI=confidence interval; ER = Energy Requirements; OR=odds ratio.

Based on bivariate analysis, several factors were independently significantly associated with malnutrition at hospital admission, namely elderly (OR 3.469, 95%CI: 1.374–8.756, p = 0.010) with 70-years-old on average, followed by inadequate energy intake (OR 4.071, 95%CI: 1.874–8.841, p = 0.0001), multimorbidity (OR 2.590, 95%CI: 1.197–5.602, p = 0.022), presence of infection (OR 3.280, 95%CI: 1.542–6.978, p = 0.003), and severe–total dependency of functional status (OR 10.301, 95%CI: 3.495–30.362, p = 0.0001).

Multivariate logistic regression model of malnutrition at hospital admission

Potential risk factors for malnutrition are shown in Table 3. Based on the multivariate analysis, several factors were proved to increase the odds of malnutrition during hospital admission; the subject's functional status, inadequate energy intake, and comorbidity index.

Severe to total dependency on the subject's functional status (B-ADL ≤ 8) was the most significant risk factor for malnutrition cases (OR 9.406, 95%CI: 3.147–28.109), which was greater than the subject with mild to moderately dependent or independent functional status. Subjects with inadequate energy intake was significantly increasing the odds of malnutrition (OR 2.718, 95%CI: 1.197–6.172), meaning that subjects with insufficient energy intake pose a greater risk of having malnutrition at hospital admission than those with adequate intake. Lastly, patients with severe CCI during hospital admission might had greater odds of malnutrition in this study (OR 2.337, 95%CI: 1.045–5.228).

Thus, severe to total dependency on functional status (96.6%), inadequate energy intake (89.7%), and multimorbidity (90.8%) were the significant risk factors for malnutrition at hospital admission.

Tabel 3. Multivariate Logistic Regression Analysis of The Factors Associated with Malnutrition at Admission

Variable	B	OR	95% CI	p-Value
Functional Status (B-ADL ≤8)	2.241	9.406	3.147–28.109	0.0001
Inadequate Energy Intake (≤ 75% ER)	1.000	2.718	1.197–6.172	0.017
Comorbidity Index (≥ 5)	0.849	2.337	1.045–5.228	0.039

B-ADL= Barthel Index for Activities of Daily Living; CCI=Charlson Comorbidity Index; CI=confidence interval; ER = Energy Requirements; OR=odds ratio.

Description: involving independent variable of bivariate test results with a p-value < 0.25. Age, gastrointestinal tract disorder and infection were excluded during the backward stepwise multivariate regression analysis due to p >0.05.

DISCUSSION

This study found a very high malnutrition rate among inpatients of the internal medicine ward (85.3%), higher than most previous studies in Indonesia (26.7–65.5%) [6, 24,33]. However, their studies did not use GLIM criteria. Meta-analysis studies regarding hospital settings have showed that malnutrition prevalences range from 4% to 100% in Asia (>40% were reported by over 60% of studies), with SGA as the common tools being used.(50) Other studies reporting 44.2% were malnourished using the GLIM (6 of 20 studies held at hospitalized patients have reported malnutrition at a range of 30–90%) [32].

Apparently, previous studies have not distinguished between malnutrition at hospital admission or discharge. Moreover, the wide prevalence range might be due to different research methodologies and mixed populations. A greater malnutrition proportion at admission in present study has been confirmed by previous findings (GLIM 75% vs. SGA 70.4 %) [34], and supported by Syam et al. with malnutrition rate according to SGA have reached 65,5% among non-surgical inpatients [33]. This could be explained by the use of the GLIM which has 2 measurable criteria as the latest validated diagnosis tools which proved has better performance than previous methods in validity, and accuracy in predicting negative clinical outcomes [28, 30-32]. We also found that malnutrition have affected more on male group were similar to morbidity rate at national level [51], and low BMI (10.8%) were at most among male population in this country.(52) Furthermore, internal medicine inpatients were prevalent of malnutrition [5,7]. It might be due to the inflammatory conditions as proved by this study. These high-risk populations need early nutritional intervention for medical care management [42,53].

Subjects with severe to total dependency (B-ADL ≤ 8) on functional status have the highest potential risk factor for malnutrition at hospital admission, supported by a systematic review by Fávaro-Moreira et al. who sentenced that a general health decline including physical function were contributed [15]. It may be reasoned by an association between muscle mass and physical status among unhealthy adult [54], specifically malnourished patients were profiled as low of muscle mass, quality, strength and physical function [55].

Low functional status might be due to the reduction in muscle mass as it was mostly occure among malnourished group, and it was also affected by burden of disease as we found that multimorbidity was independently associated to malnutrition in this study, supported by Gn et al. (at risk of malnutrition had CCI median of 6) [56]. Moreover, muscle mass reduction have indicated a higher malnutrition rate among cancer patients when compared to using BMI, according to Sánchez-Torralvo et al [57].

Muscle mass were essential in determining sarcopenia which was defined by AWGS as "age-related loss of muscle mass, plus low muscle strength, and/or low physical performance" [38]. Even though this study using GLIM criteria which only consider muscle mass examination, decrease muscle strength could be another relevant parameters in nutritional assessment as investigated by Allard et al., low hand grip strength was related to malnutrition [18]. Other studies have found that poor hand grip strength worsens functional status [58].

A systematic review had concluded malnutrition factors including eating dependency among unhealthy individuals since they could have difficulty in daily activity including grabbing eating utensils and sitting autonomously [15]. Age factor might also explain this, the elderly group in present study were independently significantly associated to malnutrition, similar to previous research [59, 61]. This might be due to the fact that elderly with a significant low activity might experience reduction of muscle mass [25, 62, 63]. Furthermore, elderly patients with malnutrition at risk or malnutrition status were vulnerable to fall due to decreased muscle mass [14, 64]. Therefore, it has been recommended to evaluate muscle strength as a thorough assessment in sarcopenic risk patients [39].

This study also found inadequate intake had increased malnutrition rate by almost three times, as revealed by a previous study, it might be affected by appetite decrease [41]. This might occur since inadequate intake is recognized as an obvious direct factor of undernourishment which may result in nutritional status decline, and is therefore taken into account when deciding malnutrition status. Inadequate intake could be a manifestation of diseases in which was influenced either by inflammatory conditions or any symptoms regarding alteration in GI tract function specifically in regards to nutrient digestion or absorption [29]. High prevalence of GI tract disorders among the malnourished group based on our findings might be the reason.

The inflammation occurrence either in acute on chronic diseases might negatively impact nutrition intake or utilization. This issue could possibly supported as we have found the contribution of multimorbidity in developing malnutrition status, this was inline with previous observation [5]. Even though only limited studies regarding association of low intake and high CCI, the elderly patients which was at risk of multimorbidit [65] was founded to have lower intake among malnutrition group [66]. We may confirmed this due to the association of age and malnutrition were revealed.

Even though infection as a presence of acute inflammatory were not contributed to malnutrition case in this study, it was correlated to malnutrition status on present. Though limited studies regarding infection as a malnutrition risk factor at hospital admission, Fitzpatrick et al. discovered that Healthcare-Associated Infection (HCAI) raises the malnutrition risk among inpatients [67]. Infection and malnutrition are well-known as vicious cycle associations. Infection may cause low nutrient intake or assimilation or increase the catabolic state due to inflammation [68], this might explain our findings. Either inadequate intake and catabolic phase can affect muscle mass reduction[29,39,69], or nutrient intake/assimilation could be affected by pharmacotherapy [16,17], as proven by Graeb et al. that the presence of infection alone were associated with a higher intake insufficiency [70].

Another possible factors of malnutrition might be educational levels as proven by previous research [71,72]. Unfortunately this is contrary to our findings as a slight variation among the malnourished group might be the reason. The current insignificant findings regarding the association of income levels and malnutrition might also related to this, contrary to the previous research [72]. We may hypothesize that education and income levels which were possibly co-linear in influencing the food preferences were not a significant factors among our respondents as health issues were at most affecting the respondents nutritional status as previously mentioned. Nevertheless, several other factors which found insignificant in present study were necessary to be evaluated in future investigation as mentioned by O'Keeffe et al., finding determinant factors of malnutrition among adult patient in particular [73].

To the best of our knowledge, this study is the first to investigate malnutrition, using GLIM criteria, and its associated factors in internal medicine inpatients in Indonesia. A large number of subjects enrolled in this study might represent malnutrition proportion in this population. In addition, nutritional assessment in this study were performed by trained personnel with equivalent understanding, and the population studied were specifically only newly admitted inpatients. Several factors that have been proven to influence the development of malnutrition at admission might be considered during initial assessment in daily practice. Despite the advantages of this study, we had limitations due to difficulty in obtaining weight data because not all patients capable to stand up as well as cut-off points were not established regarding muscle mass for certain conditions (severe edema) in particular. Therefore, we maximized by using validated anthropometric measures, bed scale and chair scale for BW, while calf circumference were used to determine muscle mass reduction as recommended. Assimilation of food was also maximized by using medical diagnosis and clinical data, as the cut-off point of frequency, intensity, duration, and severity of GI tract disorders were still unavailable.

CONCLUSIONS

This study found a higher malnutrition rate among inpatients at hospital admission. Low functional status is the most significant risk factor for malnutrition, followed by inadequate energy intake, and multimorbidity. A large number of malnutrition cases compared to previous studies reveals the importance of using valid malnutrition assessment tools, the needs of effective treatment of malnutrition, and further investigation regarding the clinical impact of malnutrition at hospital admission.

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