Clinical Critical Care

E-ISSN 2774-0048

VOLUME 34 NUMBER 1

JANUARY-DECEMBER 2026



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Clinical Critical Care

Clinical Critical Care
Volume 34, Article ID e260012, 10 pages
https://doi.org/10.54205/ccc.v34.279855

ORIGINAL RESEARCH

eISSN 2774-0048

Nutritional status of mechanically ventilated critically ill patients in a university-based hospital in Northern Thailand

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OPEN ACCESS

Citation:
Sittiwut K, Trongtrakul K, Wongpalee T, Mungmuang A, Anosak N. Nutritional status of mechanically ventilated critically ill patients in a university-based hospital in Northern Thailand. Clin Crit Care 2026; 34: e260012.

Received: January 13, 2026
Revised: March 12, 2026
Accepted: March 13, 2026

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Data Availability Statement:
The data and code were available upon reasonable request (Kanlayanee Sittiwut, email address: kanlasitt@gmail.com)

Funding:
This research received no external funding.

Competing interests:
No potential conflict of interest relevant to this article was reported.

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ABSTRACT:

Background: Malnutrition is common in mechanically ventilated critically ill patients and contributes to poor outcomes. This study evaluated its prevalence and associated factors in a medical critical care unit (MCCU).

Method: A retrospective study of adult mechanically ventilated patients admitted between May 2021 and July 2024. Nutritional status was assessed using NT 2013, with day-7 status used for outcome analysis. Logistic regression identified factors associated with malnutrition.

Result: Among 334 patients, malnutrition prevalence was 36.8% at admission and increased to 44.3% during hospitalization. Malnourished patients had lower BMI and higher severity scores (APACHE II, SAPS II, SOFA). They also experienced worse outcomes, including higher MCCU mortality (26.0% vs. 14.8%), higher in-hospital mortality (41.5% vs. 25.4%), longer mechanical ventilation, and longer hospital stays. These associations persisted in patients hospitalized ≥7 days. Independent factors associated with malnutrition were younger age (aOR 0.97) and higher APACHE II score (aOR 1.07).

Conclusion: Malnutrition is frequent and worsens during MCCU stay, and is linked to poorer clinical outcomes. Early assessment, close monitoring, and timely individualized nutritional support are essential.

Keywords: Critically ill medical patients; Malnutrition; Mechanical ventilation; NT 2013; Prevalence; Risk factors

INTRODUCTION

Critically ill patients are individuals with life-threatening conditions characterized by rapid physiological deterioration and an inability to perform self-care. These patients often require advanced medical interventions and life-support technologies, including mechanical ventilation, central venous catheters, arterial lines, and high-risk medications, together with continuous monitoring to maintain organ function and prevent complications [1].

Respiratory failure is frequently encountered in intensive care units (ICUs) and often requires invasive mechanical ventilation (IMV) to maintain adequate gas exchange and oxygenation [2].Although mechanical ventilation is essential for life-saving treatment, it can limit oral nutritional intake and contribute to metabolic alterations characterized by increased energy expenditure. In addition, gut microbiota dysbiosis has been associated with systemic inflammation and organ dysfunction in critically ill patients [3].

Malnutrition remains a major global health concern, with reported prevalence rates of up to 78.1% in developing countries and 50.8% in developed countries [4]. Among critically ill patients receiving mechanical ventilation, the prevalence of malnutrition ranges from 31% to 35%, and 40–60% of patients experience significant unintentional weight loss during hospitalization [5,6]. The risk of malnutrition is particularly high in ICUs compared with other clinical settings, highlighting the vulnerability of critically ill patients and the importance of early nutritional screening and management [7].

Previous studies have shown that gastrointestinal dysfunction and stress-induced metabolic responses can impair nutrient absorption and utilization, leading to inadequate nutritional intake in critically ill patients [5]. Mechanically ventilated critically ill patients are particularly at high nutritional risk, especially those with elevated NUTRIC scores [8,9]. Malnutrition has been associated with impaired immune function, increased susceptibility to infection, delayed wound healing, prolonged mechanical ventilation, longer hospital stays, and increased mortality [5,10-12].

In patients with severe trauma, those with an Injury Severity Score (ISS) ≥ 25 are at increased risk of malnutrition due to hypermetabolism and inflammatory responses that accelerate the depletion of energy stores and skeletal muscle mass [13]. Critically ill patients frequently receive only 10–50% of estimated energy requirements during the first week of ICU treatment, and malnutrition identified by the Subjective Global Assessment (SGA) or elevated modified Nutrition Risk in the Critically Ill (mNUTRIC) scores has been shown to independently predict mortality [14]. Several clinical factors, including gastrointestinal symptoms, abnormalities in white blood cell counts, and the route of nutritional intake, have also been associated with the development of malnutrition [15].

Systematic nutritional assessment is therefore essential for early identification and management of malnutrition. Several validated screening and assessment tools are available, including the NT 2013, SGA, Mini Nutritional Assessment (MNA), Nutritional Risk Screening 2002 (NRS-2002), and the Malnutrition Universal Screening Tool (MUST). At Maharaj Nakorn Chiang Mai Hospital, NT 2013 is used as the primary nutritional assessment tool [16].

In this study, the NT 2013 was selected because it is the standardized nutritional assessment tool routinely implemented in our institution and systematically documented in electronic medical records. NT 2013 integrates objective nutritional parameters—including weight change, BMI, muscle mass, fat stores, dietary intake, and functional status—together with the impact of acute and chronic disease. Previous studies have demonstrated good validity and reliability of NT 2013 in hospitalized and critically ill populations in Thailand [17,18].

Given the high prevalence of malnutrition and its impact on clinical outcomes, this study aimed to determine the prevalence of malnutrition among mechanically ventilated critically ill medical patients admitted to the MCCU and to identify factors associated with malnutrition.

KEY MESSAGES:

- Malnutrition is common among mechanically ventilated patients admitted to the MCCU, with prevalence increasing from admission to during the MCCU stay.
- Malnourished patients have higher disease severity scores and worse clinical outcomes, including higher MCCU and hospital mortality, longer duration of mechanical ventilation, and prolonged hospital stay.
- Age and APACHE II score are independently associated with malnutrition, highlighting the importance of early nutritional assessment and continuous monitoring to guide timely and appropriate nutritional interventions.

OBJECTIVES

1. To determine the prevalence of malnutrition among mechanically ventilated, critically ill medical patients.
2. To identify risk factors associated with malnutrition among mechanically ventilated, critically ill medical patients.

MATERIALS AND METHODS

Study design and setting

This retrospective observational study investigated the prevalence of malnutrition and associated factors among mechanically ventilated patients admitted to the MCCU. The study population included patients who were admitted and received IMV between May 1, 2021, and July 31, 2024.

The study protocol was reviewed and approved by the Human Research Ethics Committee, Faculty of Medicine, Chiang Mai University (Study Code: FAC-MED-2567-0247; Approval No. 316/2567), with the approval valid from August 15, 2024, to August 14, 2025.

Study population

The study population consisted of adult critically ill patients requiring IMV who were admitted to designated MCCU between May 1, 2021, and July 31, 2024. These units included the Medical Intensive Care Unit (MICU), MCCU 1, and MCCU 2, which are administratively and clinically managed under the internal medicine service.

Eligible patients were identified through a retrospective review of the MCCU admission registry and electronic medical records. The admitting service, unit of admission, and primary diagnosis at MCCU admission were reviewed to ensure that only critically ill medical patients were included. Patients admitted under surgical services, including those with primary postoperative respiratory failure, as well as patients transferred from surgical or mixed ICUs or from other hospitals, were excluded according to predefined exclusion criteria.

All patients who met the inclusion criteria during the study period and had complete medical records were included in the final analysis.

Inclusion criteria

Patients were eligible for inclusion if they met the following criteria:

1. Medical critically ill patients who were intubated and received IMV for more than 24 hours and were admitted to the MCCU, including the MICU, MCCU 1, and MCCU 2.
2. Age ≥ 20 years at the time of admission.
3. Received enteral nutrition via a feeding tube during ICU hospitalization.

Exclusion criteria

Patients were excluded from the study if they met any of the following criteria:

1. Length of stay in the MCCU of less than 24 hours.
2. Transfer from surgical or mixed ICUs or from other hospitals prior to admission to the MCCU.
3. Admission under surgical services, including patients whose primary reason for ICU admission was post-operative respiratory failure following surgical procedures.

Sample size calculation

The sample size was calculated based on an expected prevalence of malnutrition of 29%, a margin of error of 5%, and a 95% confidence level. Based on these assumptions, the minimum required sample size was 317 patients.

To account for a potential 5% loss of data or incomplete medical records, the total sample size was increased to 334 patients.

Research instruments and instrument validation

The research instruments used in this study consisted of a structured data collection form for personal and clinical information. The instrument was developed based on a review of relevant literature and medical records and comprised four sections, as follows:

Section 1: Personal and demographic characteristics

General characteristics

General characteristics consisted of a questionnaire collecting personal and demographic characteristics, including age, sex, body weight, height, BMI, comorbidities, referral source before MCCU admission, length of hospital stay before MCCU admission, use of vasopressor agents before MCCU admission, history of cardiopulmonary resuscitation (CPR), and duration of mechanical ventilation before MCCU admission.

Clinical data at MCCU admission

Clinical data at MCCU admission included clinical data at MCCU admission. Baseline vital signs recorded were systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), heart rate (HR), peripheral oxygen saturation (SpO_2), and respiratory rate (RR).

Laboratory investigations

Laboratory investigations included complete blood count (CBC) with platelet count, blood urea nitrogen (BUN), serum creatinine (Cr), serum electrolytes, liver function tests (LFTs), serum albumin, and lymphocyte count.

Laboratory parameters were recorded on day 1 (MCCU admission), day 8 (±3 days), day 15 (±3 days), and day 21 (±3 days) for patients who remained hospitalized in the MCCU.

Assessment of disease severity

Disease severity was assessed on the first day of admission to the MCCU using three validated scoring systems:

- APACHE II, developed by [19]. This scoring system consists of three components: the Acute Physiology Score (APS), age points, and chronic health points (CHP), with a total score ranging from 0 to 71.
- SAPS II, developed by [20]. SAPS II incorporates 12 physiological variables, along with information on age, comorbidities, and type of admission, to generate a total score ranging from 0 to 163, which is used to predict mortality within the first 24 hours of MCCU admission.
- SOFA score, developed by [21]. The SOFA score is used to evaluate the function of six organ systems, including the respiratory, coagulation, hepatic, cardiovascular, neurological, and renal systems. Each organ system is scored from 0 to 4, yielding a maximum total score of 24, which reflects the severity of organ dysfunction and is associated with increased mortality.

Diagnosis and organ dysfunction during MCCU admission

Diagnoses and organ dysfunctions at MCCU admission were recorded from clinical documentation in the medical records. These included sepsis or septic shock, acute respiratory failure, acute kidney injury, acute liver failure, acute heart failure, and pressure injuries during MCCU hospitalization.

Section 2: Nutritional status assessment

Nutritional screening

Nutritional screening was conducted using a four-item screening questionnaire designed to identify the risk of malnutrition. The screening items included:

1. Reduced food or nutrient intake for 7 days or longer prior to assessment.
2. Unintentional weight loss during the preceding 6 months.
3. Abnormal BMI (< 18.5 or > 25 kg/m^2).
4. Presence of critical or semi-critical illness.

Patients who answered "yes" to two or more items underwent further nutritional assessment and/or were referred to a dietitian or the nutrition support team. Patients who answered "yes" to one or fewer items were rescreened once weekly during hospitalization.

Nutrition Triage 2013 (NT 2013)

Nutritional status was further assessed using the NT 2013, a validated nutritional screening and assessment tool developed for use in critically ill patients. The NT 2013 is a validated nutritional screening and assessment tool developed for hospitalized and critically ill patients in Thailand and aligned with ASPEN–ESPEN consensus recommendations [22]. The tool has been widely implemented as part of routine clinical practice in Thai hospitals and is endorsed by national clinical nutrition organizations [22]. NT 2013 integrates both nutritional screening and comprehensive assessment, incorporating dietary intake, weight change, body composition, functional status, and the metabolic impact of acute and chronic illness.

Internationally, several nutritional tools have been used in critically ill patients, including the Nutrition Risk in the Critically Ill (NUTRIC) score and the SGA. The NUTRIC score was primarily developed to identify patients at high nutritional risk based on disease severity and inflammatory burden rather than to diagnose malnutrition itself. In contrast, SGA has long been considered a reference method for nutritional assessment but is limited by its subjective nature and time-consuming clinical evaluation. NT-based assessment has been applied in multicenter ICU research and has demonstrated significant associations with ICU mortality, 28-day mortality, and sepsis outcomes [17]. In addition, NT 2013 allows serial reassessment during hospitalization, which is particularly relevant in mechanically ventilated critically ill patients whose nutritional status may change rapidly during an ICU stay. These characteristics support the validity and suitability of NT 2013 for retrospective real-world research in critically ill populations.

The NT 2013 consists of two components:

1. Non-scored section, which includes general patient information and assessment of physical function.
2. Scored section, which comprises nine domains: dietary intake history, weight change, presence of edema, loss of fat mass, loss of muscle mass, muscle function, and the impact of acute and chronic illness on nutritional status and metabolism.

Each domain is scored from 0 to 3, according to the severity of impact. The maximum total score is 24, and nutritional status is classified into four levels as follows:

- NT-1 (0–4 points): Normal nutritional status or mild nutritional risk
- NT-2 (5–7 points): Mild malnutrition
- NT-3 (8–10 points): Moderate malnutrition
- NT-4 (>10 points): Severe malnutrition

Nutritional assessment using NT 2013 was repeated every 7 days, and the date of malnutrition onset was clearly documented (Critically Ill Nutrition Triage/NT 2013, as cited in [17]).

Several validated tools are used for nutritional screening and assessment in critically ill patients, including the NUTRIC score [23], the SGA [24], and the NT 2013 [17]. The NUTRIC score identifies patients at high nutritional risk based on disease severity and inflammatory status, whereas the SGA provides a clinical evaluation of nutritional status but partly relies on subjective assessment [23,24].

In contrast, NT 2013 integrates both nutritional screening and comprehensive assessment within a structured instrument aligned with international malnutrition diagnostic criteria. The tool evaluates key domains relevant to critically ill patients, including weight change, BMI, muscle and fat loss, edema, dietary intake, and the impact of acute and chronic illness, and allows repeated assessment during hospitalization. Previous multicenter studies in Thai ICU populations have shown that higher Bhumibol Nutrition Triage/Nutrition Triage scores are significantly associated with mortality and sepsis, supporting its clinical and prognostic relevance [17]. Therefore, NT 2013 was considered appropriate for evaluating malnutrition prevalence and associated factors in mechanically ventilated critically ill patients in the present study.

Section 3: Nutritional therapy during MCCU admission

Data on nutritional therapy during MCCU admission were collected for patients who remained hospitalized in the MCCU. Variables included the route of nutrition delivery (enteral nutrition, parenteral nutrition, or nil per os [NPO]), time from NPO status to initiation of the first feeding, daily energy and protein requirements, and actual energy and protein intake, calculated as the average intake during the first week of MCCU admission.

Section 4: Treatment and clinical outcomes

Clinical outcomes included 28-day mortality, MCCU mortality, and in-hospital mortality. Additional outcomes were MCCU length of stay, hospital length of stay, and duration of mechanical ventilation.

Section 5: Nutritional status

To preserve an appropriate temporal relationship between exposure and outcomes, nutritional status assessed on day 7 after MCCU admission was used as the primary exposure variable for outcome analyses. Nutritional status at MCCU admission was used solely to describe the base-

line prevalence of malnutrition. The day-7 assessment was selected to better represent the established nutritional status during the course of critical illness and to minimize potential misclassification associated with acute physiological changes occurring shortly after MCCU admission.

Instrument validation and reliability

Validity

In this study, no additional validity testing was performed, as the assessment instruments employed have been routinely used in the critical care unit, which represents the real-world clinical context of the study. These instruments are widely accepted and standardized, with established and appropriate assessment criteria, and are considered capable of providing reliable and clinically relevant data.

According to previous validation studies, the instruments demonstrated a content validity index (CVI) of 0.94, indicating excellent content validity [25].

Reliability

To assess instrument reliability, a pilot test was conducted in 10 mechanically ventilated critically ill patients with characteristics similar to the study population. Internal consistency was evaluated using Cronbach's alpha coefficient.

The analysis revealed a Cronbach's alpha value of ≥ 0.80, which indicates acceptable to good reliability for academic and clinical research purposes [26,27].

Data collection

After the research protocol was reviewed and approved by the Human Research Ethics Committee, Faculty of Medicine, Chiang Mai University (Study Code: FAC-MED-2567-0247; Approval No. 316/2567; valid from August 15, 2024, to August 14, 2025), permission to conduct the study was obtained from the MCCU, including the Medical Intensive Care Unit, MCCU 1, and MCCU 2 at Maharaj Nakorn Chiang Mai Hospital. The objectives and procedures of the study were explained to the relevant personnel, and authorization was granted to access patient data for patients admitted between May 1, 2021, and July 31, 2024. All data were collected retrospectively from medical records using a standardized data collection form.

Protection of human subjects

All patient data collected in this study were fully anonymized, with no identifying information such as names, hospital numbers, or other personal identifiers recorded. The data was stored in a password-protected computer accessible only to the researcher.

All analyses were performed using aggregate data to ensure confidentiality and protect patient privacy. Access to the data was strictly restricted in accordance with ethical guidelines. The collected data will be securely destroyed one year after publication of the research findings.

Statistical analysis

All collected data were reviewed and verified for accuracy prior to statistical analysis. Statistical analyses were performed using STATA software, version 16. The analyses were divided into two main components:

1. Descriptive analysis was conducted to summarize the general characteristics of the study population. Continuous variables were presented as mean ± standard deviation (SD) or median with interquartile range (IQR), depending on data distribution. Categorical variables were reported as frequencies and percentages. Comparisons between groups were performed using the Chi-square test or Fisher's exact test for categorical variables and the Student's t-test or Mann–Whitney U test for continuous variables, as appropriate.

2. Analytical and associative analysis was performed using univariable and multivariable logistic regression to identify independent predictors of malnutrition, both at MCCU admission and during MCCU hospitalization. Variable selection was guided by clinical relevance, prior literature, and the rule-of-thumb regarding the number of events per variable in logistic regression. Additionally, the potential factors from univariable analysis with p-value <0.25 that are shown in Table 1 were analyzed by using multivariable logistic analysis [28]. Moreover, the multicollinearity was checked, and the variables with VIF > 10 were removed from the multivariable logistic analysis [29]. Results were displayed as an odds ratio (OR) together with a 95% confidence interval (CI) for OR. In addition, time-to-event analysis was conducted to compare 28-day survival between patients with and without malnutrition. All statistical analyses were performed using STATA version 16. A two-sided p-value < 0.05 was considered statistically significant.

RESULTS

Prevalence of malnutrition and patient characteristics

Among 334 mechanically ventilated critically ill patients admitted to the MCCU, the prevalence of malnutrition at MCCU admission was 36.8% (95% CI: 31.7–42.0). The prevalence increased to 44.3% (95% CI: 35.5–53.1) during MCCU hospitalization (Table 1).

Patients with malnutrition had a significantly lower BMI than those without malnutrition (20.9 vs. 22.5 kg/m^2, p = 0.004). In addition, APACHE II, SAPS II, and SOFA scores were significantly higher in malnourished patients than in those without malnutrition (all p < 0.001).

Clinical outcomes

Malnourished patients had significantly higher MCCU mortality (26.0% vs. 14.8%, p = 0.014) and in-hospital mortality (41.5% vs. 25.4%, p = 0.003) than those without malnutrition. They also had longer durations of mechanical ventilation and hospital length of stay (median 5 vs. 4 days, p = 0.048; and 28 vs. 16 days, p < 0.001, respectively) (Table 2).

Outcomes in patients with hospital length of stay ≥ 7 days

Subgroup and multivariable analyses

In the subgroup analysis of patients with a hospital length of stay ≥ 7 days (n = 122), malnourished patients had significantly higher in-hospital mortality than those without malnutrition (46.3% vs. 25.4%, p = 0.021). In addition, malnourished patients had a significantly longer duration of mechanical ventilation and longer MCCU length of stay than patients without malnutrition (median 13.5 vs. 10 days, p = 0.001; and 16.5 vs. 11 days, p = 0.001, respectively) (Table 3).

In the multivariable analysis, younger age (aOR 0.97; 95% CI: 0.94–0.99; p = 0.016) and a higher APACHE II score (aOR 1.07; 95% CI: 1.01–1.14; p = 0.018) were independently associated with malnutrition among patients with a hospital length of stay ≥ 7 days (Table 3).

Factors associated with malnutrition

Multivariable logistic regression analysis demonstrated that younger age (aOR = 0.97, 95% CI: 0.94–0.99, p = 0.016) and a higher APACHE II score (aOR = 1.07, 95% CI: 1.01–1.14, p = 0.018) were independent predictors associated with the presence of malnutrition among patients with a hospital length of stay ≥ 7 days (Table 4).

Table 1. Characteristics of all subjects.

Characteristics	Malnutrition (n=123)	Non-malnutrition (n=211)	p-value
Age (years)	67.6 ± 16.1	66.5 ± 15.9	0.536
Male	65 (52.9)	123 (58.3)	0.361
BMI (kg/m^2)	20.9 ± 3.9	22.5 ± 4.8	0.004*
During admission			
Respiratory failure	119 (96.8)	198 (93.8)	0.308
Sepsis	23 (18.7)	47 (22.3)	0.487
AKI-ESRD	13 (10.6)	23 (10.9)	1.000
DKA	2 (1.6)	5 (2.4)	1.000
Liver failure	2 (1.6)	3 (1.4)	1.000
Metabolic-Lactic acidosis	11 (8.9)	15 (7.2)	0.673
Co-morbidities			
Diabetes Mellitus	41 (33.3)	80 (37.9)	0.412
Hypertension	53 (43.1)	110 (52.1)	0.114
Chroinic kidney diseases	28 (22.8)	37 (17.5)	0.254
AF/Other cardiac diseases	19 (15.5)	20 (10.9)	0.235
Cirrhosis	8 (6.5)	15 (7.1)	1.000
COPD/Asthma	8 (6.5)	23 (10.9)	0.241
Stroke	16 (13.0)	17 (8.1)	0.183
Cancer-malignancy	18 (14.6)	17 (8.1)	0.066
APACHE II score	25.8 ± 7.5	22.2 ± 7.1	<0.001*
SAPS II score	55.4 ± 15.2	47.9 ± 15.3	<0.001*
SOFA score (median, IQR)	7.0 (5.0, 10.0)	5.0 (4.0, 8.0)	<0.001*

Data are mean ± SD or n (%), otherwise stated. . Nutritional status assessed on day 7 after MCCU admission was used for malnutrition classification.
Abbreviation: BMI: Body mass index; AKI: Acute Kidney Injury; ESRD: End-Stage Renal Disease; DKA: Diabetic Ketoacidosis; AF: Atrial Fibrillation; COPD: Chronic Obstructive Pulmonary Disease; IQR: Interquartile Range

Table 2. Outcome of all subjects.

Outcomes	Malnutrition (n=123)	Non-malnutrition (n=211)	p-value
28 day mortality, n(%)	36 (29.2)	44 (21.1)	0.229
ICU mortality, n(%)	32 (26.0)	31 (14.8)	0.014*
Hospital mortality, n(%)	51 (41.5)	53 (25.4)	0.003*
ICU length of stay (days), (median, IQR)	7.0 (4.0, 13.0)	6.0 (4.0, 10.0)	0.320
MV day (days), (median, IQR)	5.0 (3.0, 11.0)	4.0 (2.00, 9.0)	0.048*
Hospital length of stay (days), (median, IQR)	28.0 (13.0, 55.0)	16.0 (8.0, 31.0)	<0.001*

Abbreviation: IQR: Interquartile Range; ICU: Intensive Care Unit; MV day: Mechanical Ventilation Day

Table 3. Characteristics of 122 subjects who stay in ICU ≥ 7 days.

Characteristics	Malnutrition (n=54)	Non-malnutrition (n=68)	p-value
Age (years)	68.7 ± 16.9	72.4 ± 14.5	0.198
Male	24 (44.4)	38 (55.9)	0.274
BMI (kg/m^2)	20.9 ± 3.9	23.0 ± 6.6	0.034
During admission			
Respiratory failure	50 (92.9)	66 (97.1)	0.404
Sepsis	13 (24.1)	17 (25.0)	1.000
AKI-ESRD	6 (11.1)	9 (13.2)	0.787
DKA	0 (0.0)	2 (2.9)	0.503
Liver failure	1 (1.9)	0 (0.0)	0.443
Metabolic-Lactic acidosis	6 (11.3)	4 (6.1)	0.337
Co-morbidities			
Diabetes Mellitus	20 (37.0)	23 (33.8)	0.849
Hypertension	23 (42.6)	34 (50.0)	0.467
Chroinic kidney diseases	12 (22.2)	13 (19.1)	0.822
AF/Other cardiac diseases	8 (14.8)	11 (16.2)	1.000
Cirrhosis	2 (3.7)	3 (4.4)	1.000
COPD/Asthma	2 (3.7)	12 (17.6)	0.021*
Stroke	4 (7.4)	9 (13.2)	0.383
Cancer-malignancy	6 (11.1)	6 (8.8)	0.764
APACHE II score	26.7 ± 7.7	23.5 ± 6.9	0.019*
SAPS II score	56.1 ± 15.7	50.6 ± 1.6	0.039*
SOFA score (median, IQR)	7.0 (5.0, 9.0)	6.0 (4.5, 8.0)	0.003*

All subjects (LOS ≥ 7 days) were included in the analysis. Data are mean ± SD or n (%), otherwise stated. Nutritional status assessed on day 7 after MCCU admission was used for malnutrition classification. Abbreviation: BMI: Body mass index; AKI: Acute Kidney Injury; ESRD: End-Stage Renal Disease; DKA: Diabetic Ketoacidosis; AF: Atrial Fibrillation; COPD: Chronic Obstructive Pulmonary Disease; IQR: Interquartile Range

Table 4. Multivariable analysis of factors associated with malnutrition in mechanically ventilated critically ill patients of 122 subjects who stay in ICU ≥ 7 days.

Factors	Univariable analysis		Multivariable analysis	
	Odds ratio (95%CI)	p-value	Adjusted Odds ratio (95%CI)	p-value
Age	0.98 (0.96, 1.01)	0.199	0.97 (0.94, 0.99)	0.016*
Male	0.63 (0.31, 1.29)	0.210	0.51 (0.23, 1.15)	0.104
APACHE score	1.06 (1.01, 1.12)	0.022	1.07 (1.01, 1.14)	0.018*
Diabetes Mellitus	1.15 (0.55, 2.43)	0.712	1.00 (0.45, 2.26)	0.992
Chroinic kidney diseases	1.21 (0.50, 2.92)	0.673	1.24 (0.46, 3.32)	0.670
Metabolic-Lactic acidosis	1.98 (0.53, 7.41)	0.311	1.31 (0.33, 5.22)	0.699

All subjects (LOS ≥ 7 days) were included in the analysis. Due to the exploratory research all of factors in univariable logistic regression analysis were entre to the multivariable logistic regression analysis . Nutritional status assessed on day 7 after MCCU admission was used as the primary outcome. Abbreviation: IQR: Interquartile Range; ICU: Intensive Care Unit

DISCUSSION

This study investigated the prevalence of malnutrition and factors associated with malnutrition among mechanically ventilated critically ill patients admitted to the MCCU. The results demonstrated a high prevalence of malnutrition in this population, highlighting that nutritional impairment remains a significant challenge in critical care practice. These findings are consistent with previous reports indicating that critically ill patients are particularly vulnerable to malnutrition due to hypermetabolism, systemic inflammation, and limitations in nutritional delivery during the acute phase of illness, which may lead to inadequate energy and protein intake [30].

In the present study, patients with malnutrition had significantly lower BMI and higher APACHE II, SAPS II, and SOFA scores compared with those without malnutrition. These findings suggest a close relationship between malnutrition and greater disease severity. Similar associations have been reported in mechanically ventilated patients with pulmonary diseases, where malnutrition was linked to prolonged mechanical ventilation, longer hospital length of stay, and increased mortality [31]. Previous studies have also shown that critically ill patients at high nutritional risk experience more severe illness, longer MCCU stays, and higher mortality rates [32]. Likewise, low BMI (BMI < 18.5 kg/m^2) has been associated with increased hospital mortality in both Western and Asian populations, with an even greater risk observed among Asian patients [33].

Multivariable analysis in this study identified younger age and higher APACHE II scores as independent factors associated with malnutrition. However, the finding that increasing age was associated with a lower likelihood of malnutrition should be interpreted cautiously. Nutritional status used for outcome analyses was assessed on day 7 after MCCU admission, and only patients who survived long enough to undergo this assessment were included. Older critically ill patients with severe malnutrition may have died before the day-7 evaluation, potentially introducing survivor or selection bias. Therefore, the observed association between younger age and a higher likelihood of malnutrition may reflect the characteristics of the analyzed population rather than a true protective effect of older age.

Previous studies have also suggested that nutritional deficits and feeding intolerance in critically ill patients are influenced by multiple factors related to patient characteristics, disease severity, and treatment conditions, including age, BMI, APACHE II score, sepsis, renal insufficiency, gastrointestinal dysfunction, and treatment-related factors such as sedative use, vasoactive agents, antibiotics, and prolonged mechanical ventilation [34]. These factors may impair nutritional tolerance and contribute to cumulative energy and protein deficits, thereby increasing the risk of malnutrition.

Malnutrition remains common among hospitalized patients and is particularly prevalent in critically ill populations, where increased metabolic demands and physiological stress responses accelerate depletion of fat and protein reserves [35]. Consequently, malnourished, critically ill patients often experience poorer clinical outcomes and longer MCCU stays. These findings are consistent with the present study, in which patients with lower BMI and malnutrition demonstrated greater disease severity and prolonged hospitalization.

Interestingly, this observation challenges the conventional assumption that older age inherently confers a higher risk of malnutrition. Evidence suggests that resting energy expenditure declines with advancing age, resulting in relatively lower energy requirements among older individuals. In contrast, younger critically ill patients may have higher metabolic demands and accumulate greater energy and protein deficits when nutritional intake is insufficient, particularly during the early phase of critical illness [36]. This concept is consistent with the ESPEN guidelines on clinical nutrition in intensive care, which emphasize monitoring early energy deficits in critically ill patients regardless of baseline nutritional status [30]. Furthermore, malnutrition remains highly prevalent among mechanically ventilated critically ill patients and is strongly associated with greater disease severity, adverse clinical outcomes, and increased mortality [3].

Overall, these findings underscore the importance of early identification of malnutrition, continuous nutritional monitoring, and individualized nutritional interventions in critically ill patients admitted to the MCCU. Early nutritional assessment at MCCU admission, combined with appropriate nutrition therapy and ongoing reassessment during critical illness, may help improve clinical outcomes and reduce complications.

This study has several limitations that should be considered when interpreting the findings. First, as a retrospective observational study, the analysis relied on data obtained from medical records, which limited control over data collection. Consequently, the findings depended on the completeness and accuracy of clinical documentation, and missing or incomplete data may have introduced information bias. In addition, the retrospective design precludes causal inference; therefore, the observed associations should be interpreted with caution.

Limitations

This study has several limitations. First, as a retrospective observational study, the analysis relied on data obtained from medical records, which inherently limits control over data collection. Consequently, the findings depended on the completeness, accuracy, and consistency of documentation in the medical records. Missing or incomplete data may have introduced information bias and could have affected the reliability of the results. In addition, the retrospective study design precludes the establishment of causal relationships, and the observed associations should therefore be interpreted with caution. Furthermore, although several clinical factors may influence the development of malnutrition in critically ill patients, not all potential confounders could be included in the multivariable model. Variables such as sepsis, renal replacement therapy, vasopressor use, and nutritional intake adequacy were not simultaneously included because of the limited number of outcome events and the need to avoid model overfitting. Future studies with larger sample sizes are warranted to further investigate the influence of these clinically relevant variables. Another limitation relates to the timing

of nutritional assessment used for outcome analyses. Nutritional status was evaluated on day 7 after MCCU admission to better reflect the established nutritional condition during critical illness. Consequently, only patients who survived long enough to undergo this reassessment were included in the analysis. Older critically ill patients with severe malnutrition may have experienced early mortality before the day-7 evaluation and therefore may not have been captured in the analysis. This may introduce potential survivor or selection bias and could partially explain the observed association between younger age and higher odds of malnutrition. Therefore, this finding should be interpreted with caution.

Implications for practice and quality improvement (QI)

1. Integration of nutritional therapy into holistic nursing care. The findings of this study support the integration of nutritional therapy into holistic nursing care plans for critically ill patients. The results may be used to guide the determination of appropriate nutritional requirements and routes of nutrition delivery, tailored to disease severity and individual patient needs. Close collaboration with the multidisciplinary team, including physicians, dietitians, and pharmacists, is essential to optimize nutritional management and improve patient outcomes.

2. Use of study findings to support QI initiatives. The results of this study may serve as a data-driven foundation for QI initiatives in critical care units. Key findings can be applied to monitor and evaluate nutrition-related performance indicators, such as the rate of nutritional screening, the prevalence of malnutrition, and associated clinical outcomes. Continuous evaluation of these indicators may facilitate systematic improvements in nutritional care processes and overall quality of critical care services.

CONCLUSION

Malnutrition is highly prevalent among mechanically ventilated critically ill patients admitted to the MCCU, and its prevalence increases during hospitalization. In this study, malnutrition was associated with worse clinical outcomes, including higher MCCU and hospital mortality, prolonged mechanical ventilation, and longer hospital length of stay. Younger age and higher APACHE II scores were associated with malnutrition in the analyzed population. However, the observed association between younger age and malnutrition should be interpreted with caution, as older patients with severe malnutrition may have experienced early mortality before nutritional assessment. These findings highlight the importance of early nutritional assessment and continuous monitoring in critically ill patients to support timely nutritional interventions and improve clinical outcomes.

CONFIDENTIALITY

All data were anonymized, and no personal identifiers were collected. Data were securely stored in a password-protected system accessible only to the researcher and analyzed in aggregate form. Confidentiality and privacy were strictly maintained, and all data will be destroyed one year after publication.

ACKNOWLEDGEMENT

The authors would like to express their sincere gratitude to the MCCU of Maharaj Nakorn Chiang Mai Hospital for granting access to patient data essential to the completion of this study. The authors also extend their heartfelt appreciation to the experts who generously reviewed the manuscript and provided valuable comments and constructive suggestions, particularly Warawut Chaiwong, Ph.D., and Fuengfa Khobkhun, Asst. Prof., Ph.D. Their insightful feedback substantially contributed to enhancing the quality and academic rigor of this work.

AUTHORS' CONTRIBUTIONS

(I) Conceptualization and study design: Kanlayanee Sittiwut; (II) Literature review: Kanlayanee Sittiwut; (III) Data collection: Kanlayanee Sittiwut, Napapat Anosak; (IV) Data analysis: Kanlayanee Sittiwut; (V) Manuscript drafting: Kanlayanee Sittiwut; (VI) Manuscript review and editing: Kanlayanee Sittiwut, Konlawij Trongtrakul, Tula Wongpalee, Aroonsri Mungmuang; (VII) Supervision: Konlawij Trongtrakul, Tula Wongpalee, Aroonsri Mungmuang.

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