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Nutritional status as a predictor of 30-day mortality among intensive care unit patients in sub-Saharan Africa: a prospective cohort study

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Abstract

Background Malnutrition is a major public health issue, causing significant mortality and morbidity, especially in developing nations. However, the magnitude and its impact on clinical outcomes in Intensive Care Unit (ICU) patients need to be investigated better in Sub-Saharan Africa, and this study was intended to address these issues.

Objective The objective of this study was to assess the effect of malnutrition on clinical outcomes among ICU patients.

Method A prospective cohort study was conducted among 436 ICU patients, 218 of whom were malnourished. After obtaining ethical approval, malnourished and well-nourished patients were followed for thirty days to examine the effects of nutritional status on clinical outcomes and its determinants. At admission, nutritional screening and evaluation were performed with Subjective Global Assessment (SGA) and Malnutrition Universal Screening Tool (MUST), and during the next thirty days, it was evaluated every seven days with SGA, MUST, and modified Nutrition Risk in Critically Ill (NUTRIC).

Result This study demonstrated that the incidence of 30-day mortality was 47.9%(95% CI: 43.2 to 52.6). The hazards of death in patients with malnutrition increased by 40% as compared to well-nourished patients (aHR = 1.4, 95% CI: 1.33 to 2.56), and patients with diabetes mellitus had 4 times the hazards of death (aHR = 4.2, 95% CI: 2.12 to 8.28).

Conclusion Malnutrition is prevalent in adult ICU patients and has been linked to a higher 30-day mortality and a more extended ICU stay. MUST, SGA, and NUTRIC, well-validated, practical, cost-effective, and non-invasive techniques for routinely evaluating nutritional status in critically ill patients, were good predictors of mortality.

Keywords Malnutrition, Incidence, Mortality, Morbidity, Critical care unit

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Background

Malnutrition is defined as the imbalance between the supply of nutrients and energy and the body's demand for them, which can lead to a deficiency or excess of essential nutrients such as energy, protein, vitamins, and minerals [1].

The mechanism of malnutrition in the intensive care unit (ICU) is multifactorial, which results from starvation and the critical illness itself. Malnutrition from starvation is due to the depletion of essential nutrients and inadequate delivery of calories and protein because of delayed feeding. In contrast, malnutrition associated with critical illness results from inflammatory-induced stress catabolism [2].

Nutritional screening and assessment in ICU patients are crucial components of nutritional care. ASPEN defined nutritional screening as "a process to identifying an individual who is malnourished or who is at risk for malnutrition to determine if a detailed nutrition assessment is indicated, which is recommended to start screening within 24 hours of admission to ICU" while nutrition assessment has been defined as "a comprehensive approach to diagnosing nutrition problems that use a combination of medical, nutrition, and medication histories, physical examination, anthropometric measurements, and laboratory data [2–4]."

There are currently over 30 different types of malnutrition Screening and Assessment tools available that have been validated in various healthcare settings and age groups, the most common of which are SGA, NUTRIC, MUST, MST, MNA, NRI, SNAQ, and NRS2002 in ICU, where MUST and NRI are screening. SGA and MNA are considered assessment tools since they include history, physical examination, and/or laboratory indicators [5].

A number of nutritional, enteral, and parenteral societies recommend a combination of more than two screening and assessment tools at a time [3, 6, 7], and nutritional support must be provided timely and appropriately for patients admitted in ICU [5]. ASPEN and European Society of Parenteral and Enteral Nutrition (ESPEN) guidelines recommended initiation of adequate nutrition (25-35 kcal/k/d and 1.5–2 g/kg/d of protein) within 24–48 h of ICU admission [4, 6].

Malnutrition was responsible for half a million deaths in 2015, according to a new Global Burden of Disease analysis from 195 countries, with protein-energy malnutrition accounting for about one-third of all deaths [8], which is associated with weight loss, loss of fat and muscle mass, variations in body composition, and poor muscle performance, and leads to decreased respiratory drive, respiratory muscle weakness, and ventilator dependent. Furthermore, the dietary deficit in the ICU impairs the immunological response and is linked to a higher incidence of nosocomial pneumonia, urinary tract infection, and delayed wound healing [2, 9–11].

Despite administering nutrition as total parenteral or enteral nutrition as a daily practice in the intensive care unit, most patients remain malnourished, and the prevalence of malnutrition in the ICU is as high as 50% [2].

Recent evidence revealed that the burden of malnutrition among critically ill patients is substantially high. However, there are conflicting findings on the effects of malnutrition on mortality, ICU length of stay, mechanical ventilation duration, nutritional assistance doses, and disease severity [9–14].

Studies showed that various nutritional screening and assessment tools have been validated for critically ill patients despite discrepancies in their predictability of patient mortality and length of stay [15–17].

Although the prevalence of malnutrition and malnutrition-related mortality and morbidity is relatively high globally, evidence in Sub-Saharan African countries, particularly in Ethiopia, on the prevalence of malnutrition, mortality, and length of stay linked with malnutrition in ICU is uncertain. Besides, this study is the first-ever prospective cohort study among ICU patients in Ethiopia with these kinds of screening and assessment tools among ICU patients. This prospective cohort study was conducted to examine the effect of nutritional status on patient clinical outcomes and the prognostic relevance of malnutrition screening and assessment tools.

Methods

Study design and setting

This prospective cohort study recruited a total of 436 malnourished ICU and well-nourished ICU patients allocated into equal groups based on their nutritional status at admission, and every patient was followed for 30 days to compare nutritional status on clinical outcomes in the ICU setting from October 2019 to April 2021.

The study was conducted in Dilla University Teaching and Referral Hospital found in Dilla Town, Gedeo Zone, on the main road from Addis Ababa to Kenya 360 km South of Addis Ababa, 90 km South of Hawassa. It is one of the public university hospitals providing health services to more than 4 million population of Gedeo Zone and neighboring catchment areas of Sidama and Oromia Region with 500 hospital beds. The hospital has four main departments (Medical et al. / Obstetric wards), three special care units (Medical Intensive Care Unit, Neonatal Intensive Care Unit, operation theatre, and Recovery Room) and five clinics (Eye, Anti-retro viral Treatment, Dental, TB and MDR-TB clinics).

Eligibility criteria

All adult patients who were older than 16 years admitted to ICU and stayed for over 24 h were included, while patients who transferred or left against medical treatment before 2 h, patients readmitted for the same diagnosis within a week, patients who did not have an attendant/guardian, patients having discordant nutritional assessment with Subjective Global Assessment (SGA) of malnutrition and Malnutrition Universal Screening Tool (MUST) at admission, and patients who refused to participate were excluded.

Sample size determination

The optimum sample size was calculated using the survival analysis command in STATA version 15 [18] with the assumption of a 95% confidence level and a study power of 80%, an equal number of cases, and malnutrition mortality rate and Hazard Rate from the previous study [12] as, z_1- α/2=1.96, Zβ=0.84, and HR=1.3. So, the optimum sample size was 464, which was 232 for each well-nourished and malnourished group.

A random number generator software (excel, 2013) was used to randomly select Four Hundred and thirty-six (464) Adult ICU patients by considering the Annual Adult ICU patient report of 800 patients admitted in the last two years. All patients admitted to ICU during the study period were assessed for eligibility criteria, and a sequential number was given. Nutritional status was determined with SGA and MUST, and patients would be eligible if the scores were concordant. Otherwise, the patients were skipped from the group after the second evaluation. Then, patients having similar nutritional status with SGA and MUST at admission were randomized into two equal groups based on their nutritional status as malnourished (undernourished) and well-nourished (Fig. 1).

Study variables

The independent variables were Sociodemographic variables (age, sex, height, weight, BMI), diagnosis, type of admission, malnutrition, comorbidity, severity scores (APACHE II, SOFA), nutritional screening and assessment tools (modified NUTRIC, MUST, SGA) and biochemical tests (serum albumin), whereas, the dependent variables were 30 -day mortality, overall nutritional status, length of stay in ICU, and complications.

Data collection procedure

After ethical approval was obtained from the institutional review board (RERP) of Dilla University College of Medicine and Health Science and informed consent from each participant, data were collected by using a pretested structured questionnaire and nutrition assessment tools which were adapted from societies of Parenteral and Enteral nutrition Guidelines validated in ICU settings. Training was provided for data collectors and supervisors by the principal investigator. After evaluating the eligibility criteria, the nutritional assessment was conducted with SGA and MUST.

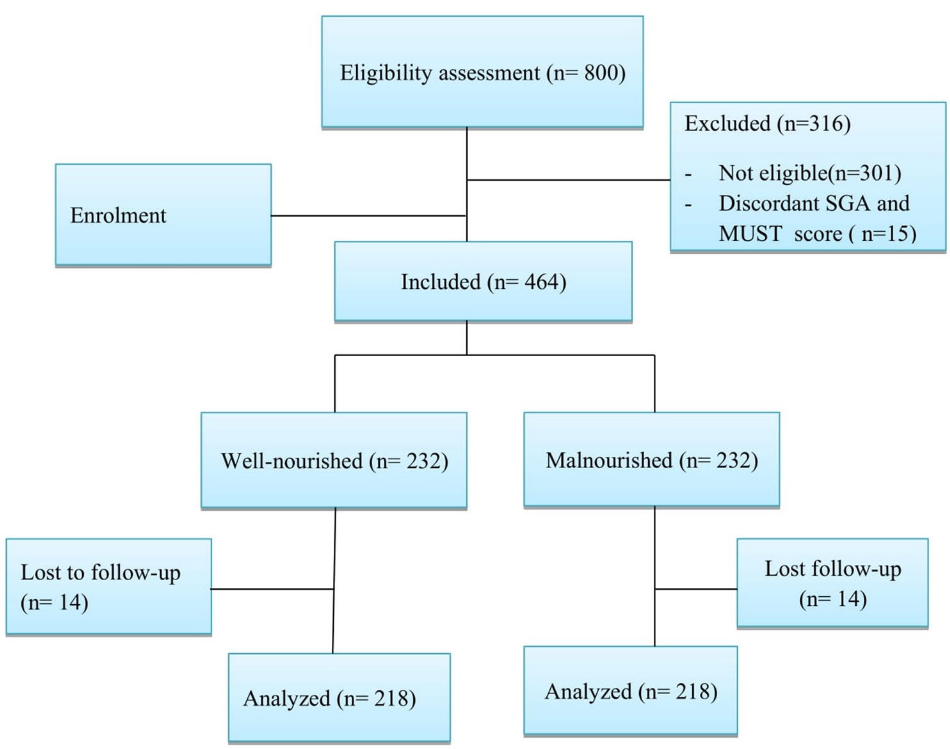

Fig. 1 STROBE Flow Diagram

were 19 to 29 and >40 years. The majority of participants were male, 249(56.4%). This study showed a significant difference between admission heart rate, arterial oxygen saturation, and Glasgow coma scale with survival status. Nearly, Fifty-percent 292(45.4%) of the patients had a Glasgow coma scale of less than eight, where more than forty per cent of them died during the follow-up 85(40.6%) (Supplemental Table 1).

Admission characteristics

Out of 436 participants, more than fifty per cent of patients, 254(58.3%), were emergency cases, followed by perioperative, 48(11.1%). In this study, the main indication for ICU admission was respiratory disorders, with a significant proportion of mortality 84(40.2%). Furthermore, nearly one-third of patients had hypertension with significant mortality. Overall, most admission characteristics were strongly associated with a 30-day cumulative incidence of mortality (Table 1).

Table 1 Admission characteristics of participants admitted at Dilla University Referral Hospital Intensive Care Unit (*N*=436)

Variables	Survivors(*N*=227)	Non-survivors (*N*=209)	*P* value
Patterns of admission			
Emergency	94(41.4)	160(76.6)	
Medical	23(10.1)	12(5.7)	< 0.001
Perioperative	26(11.5)	23(11.1)	
Gyn/obstetrics	15(6.6)	7(3.3)	
Others	69(30.4)	7(3.3)	
Indication for admission			
Respiratory	73(32.2)	84(40.2)	< 0.001
Cardiac	40(17.6)	30(14.5)	
Shock	32(14.1)	53(25.4)	
Trauma	13(5.7)	23(11)	
Other	69(30.4)	19(4.4)	
Comorbidity			
Hypertension	48(21.2)	78(37.3)	< 0.001
DM	18(7.9)	32(15.3)	
CVD	46(20.3)	31(14.7)	
COPD/Asthma	23(10.1)	48(23)	
Others	92(40.5)	20(9.7)	
Nutritional status			
Well Nourished	158(69.6)	60(28.7)	< 0.001
Malnourished	69(30.4)	149(71.3)	
Disease Severity index			
Mild	95(41.8)	12(5.8)	< 0.001
Moderate	66(29.1)	77(36.8)	
Severe	66(29.1)	120(57.4)	
Mode of Ventilation			
Invasive	60(26.4)	116(55.5)	< 0.001
Non-invasive	176(73.6)	93(44.5)	
APACHE II Score			
< 15	132(58.1)	31(14.8)	< 0.001
15–20	39(17.2)	48(23)	
20–25	26(11.5)	37(17.7)	
> 25	30(13.2)	93(44.5)	

*Significant; **very significant; ***extremely significant, COPD: Chronic obstructive Pulmonary Disease; DM: Diabetes Mellitus; CVD: Cardiovascular Disease; APACHE II: Acute Physiologic and Chronic Health Evaluation

Nutritional status in ICU

This study revealed that the magnitude of malnutrition at admission was 29%, and the cumulative incidence of malnutrition during follow-up with SGA scores of mild to moderate (27%, 95% CI: 22 to 31) and severe (22%, 95% CI: 19 to 27), while it was 65% (95% CI: 61 to 70) with modified NUTRIC and 32% (95% CI: 27 to 35) to MUST respectively. The study showed that patients with higher nutritional screening scores had a high risk of 30-day mortality(Supplemental Table 2).

We estimated linear prediction of nutritional status and length of stay in ICU to investigate the interaction between nutritional status during ICU stay. It has been shown that there is a risk of malnutrition over the follow-up time, but there is no interaction between the two as the lines are parallel. Besides, there is no significant difference because the confidence interval of the two estimations is overlapping (Supplemental Fig. 1).

Predictability of nutritional status screening tools

We computed the area under the curve to investigate the predicting ability of nutritional screening tools such as MUST, modified NUTRIC, and SGA. In this regard, it MUST be found to be highly predictive of malnutrition risk, AUC=0.81(95% CI: 0.77 to 0.85) compared to NUTRIC, AUC=0.59(95% CI: 0.55 to 0.65), and SGA, UC=0.51(95% CI: 0.45 to 0.56) (Fig. 2).

Clinical outcomes

This prospective cohort study identified different clinical outcomes in patients with malnutrition admitted to the intensive care unit, which include 30-day mortality, overall malnutrition status with different screening tools, length of ICU stay, and complications.

Mortality

This study showed that the cumulative incidence of mortality among patients admitted to ICU was 47.9%(95% CI: 43.2 to 52.6), whereas the mortality was very high in the malnourished compared to the well-nourished group, 54.9%(95% CI: 49.6 to 60.1) and 21.1%(95% CI: 13.9 to 30.8) respectively. The median survival time for the well-nourished and malnourished was ten days (95% CI: 8 to 11) and 5 days (95% CI: 4 to 6), respectively. The median survival time of patients was determined for variables predicted to be affecting the outcomes of patients, which might include nutritional status, disease severity index, APACHE II score at admission, Malnutrition risk with

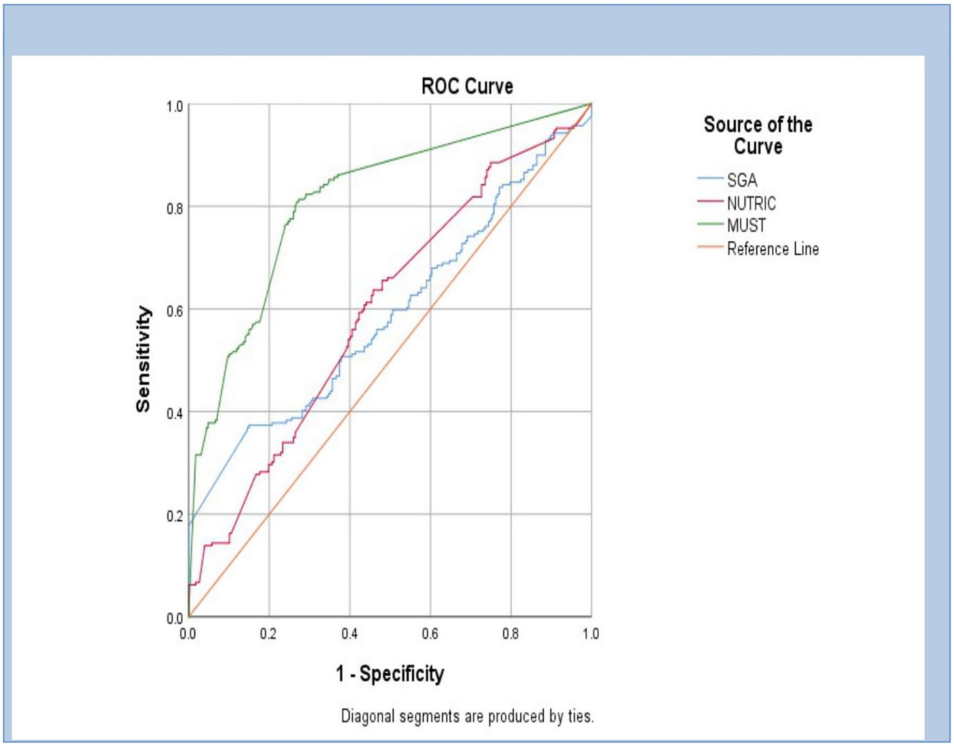

Fig. 2 A receiver Operating Characteristic (ROC) Curve showing the predictability of nutritional screening tools in the intensive care unit. SGA: Subjective Global Assessment of Nutritional Status; NUTIRC: Nutrition Risk in Critically Ill; MUST: Malnutrition Universal Screening Tool

Subjective Global Assessment (SGA), Nutritional Risk in the critically Ill (NUTRIC), Malnutrition Universal Screening Tool (MUST), and Level of Serum albumin.

The median time of survival among patients admitted to ICU was seven days with an incidence rate of 90/1000 person-years and time at risk of 2 305 days. The equality of the survival function was determined with a log-rank test. It was found that the null hypothesis was rejected as there was a significant difference in survival time between survivor and no survivor($X^2=234.4$, $p<0.001$) (Fig. 3A). Furthermore, the cumulative survival probabilities were very short in patients with malnourished (Fig. 3B), low subjective global assessment score (Fig. 3C), high-risk NUTRIC score (Fig. 3D), APACHE II score>25(Fig. 3E), and high disease severity index (Fig. 3F).

Complication

This study demonstrated many complications, including but not limited to ventilator-associated pneumonia (VAP), sepsis, cardiac arrest, aspiration, and others. The most prevalent complication in ICU was VAP 60(13.8%), followed by aspiration 53(12.2%), and aspiration 48(11%). The mortality in patients experiencing VAP, cardiac arrest, and sepsis was 81.7%, 81.1%, and 72.7%, respectively (Supplemental Fig. 2).

Predictive probability of mortality

A predictive probability model was built to estimate the predictive probability of mortality with respect to independent predictor variables, including length of ICU stay, age, APACHE II, and SGA. The graph revealed an increase in the probability of death with a unit change in parameters (Fig. 4).

Predictors of time to death

This prospective cohort identified independent predictors of time to death among patients admitted to ICU, including but not limited to patterns of admission, indication for admission, disease severity index, nutritional assessment tools, nutritional screening tools, body mass index, overall nutritional status, length of ICU stay, and complications, and variables that showed a significant association with a p-value of <0.25 in the bivariate cox proportional hazard model were taken in the multivariate cox proportional hazard model. The multivariate Cox proportional hazard model demonstrated that nutritional status, at admission, comorbidity, SGA nutritional assessment tool, Modified NUTRIC MUST, APACHE II score, and disease severity score was associated with 30-day ICU mortality.

This study demonstrated that patients with malnutrition at admission had a 60% higher risk of death than those well-nourished at admission (aHR=1.4(95% CI:

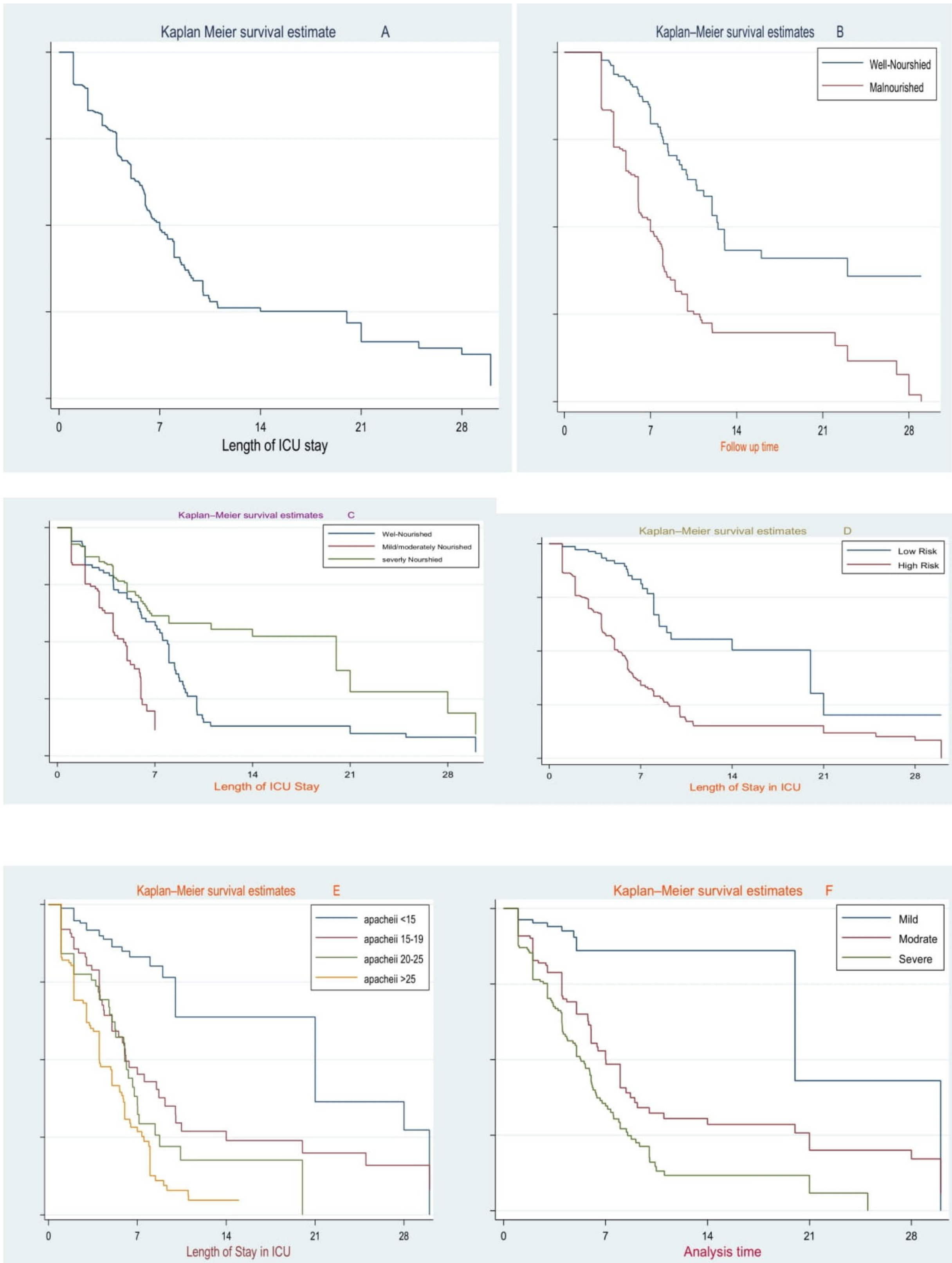

Fig. 3 Cumulative survival probability across nutritional screening tools and severity indexes. A: Overall survival curve; B: comparison of survival curves among well-nourished and malnourished individuals; C: comparison of survival curves with SGA score; D: comparison of survival curves with NUTRIC score; E: comparison of survival curves with APACHE II severity score; F: comparison of survival curves with disease Severity index

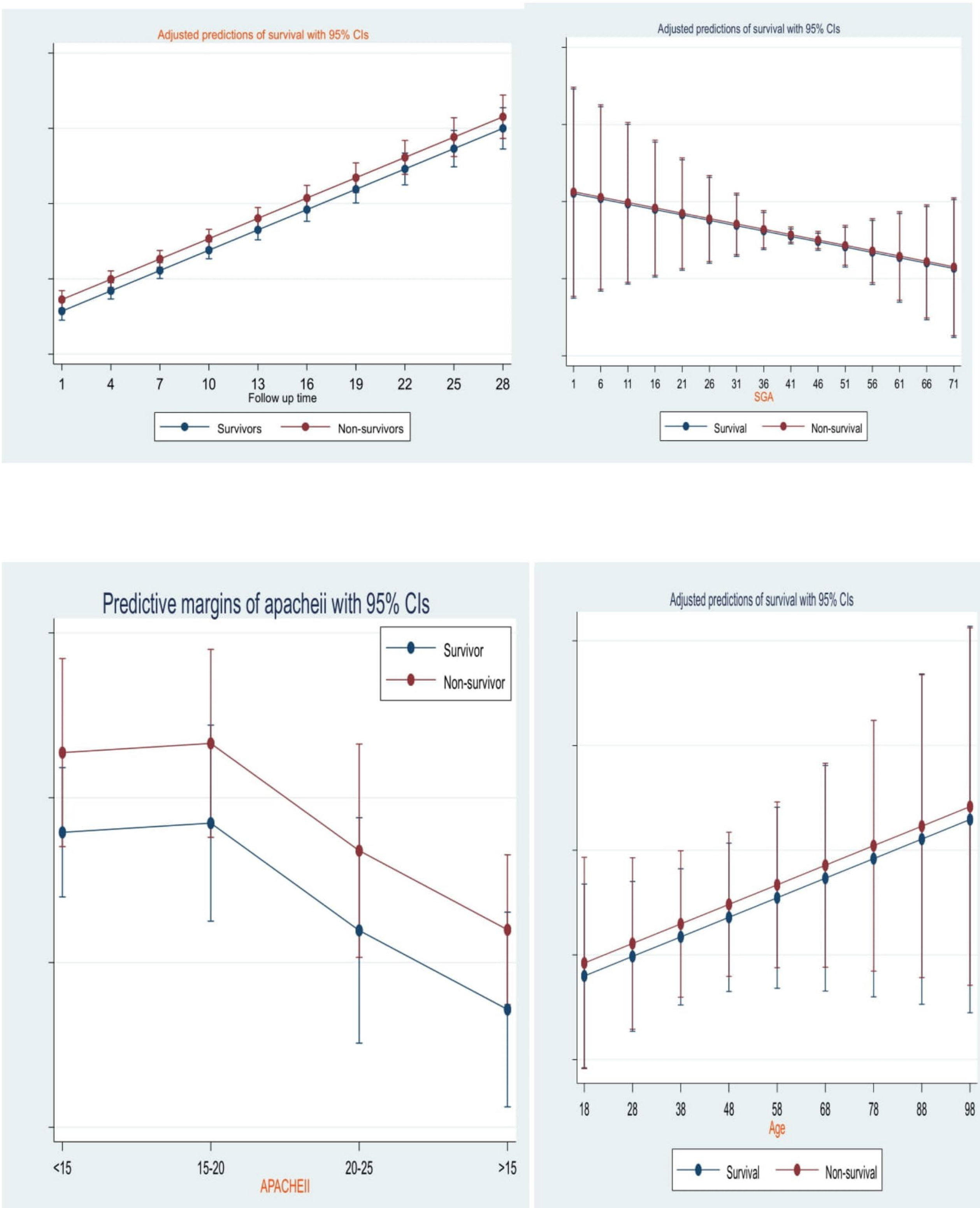

Fig. 4 Predictive probability of mortality with predictor variables among patients admitted to ICU

1.33, 2.56, $P<0.001$). Similarly, patients with a high risk of malnutrition MUST be more than two times the risk of death within 30-day follow-up in ICU (aHR=2.2(95% CI: 1.34, 3.46, $p<0.001$) compared to patients with low and moderate MUST scores. At the same time, patients with a high risk of malnutrition with modified NUTRIC score had a three-fold increased risk of death (aHR=2.7(95% CI: 1.67, 4.49, $p<0.001$). The multivariate analysis also showed that comorbidity, disease severity index, and APACHE II score were significantly associated with 30-day mortality in ICU. Patients with hypertension had three times the increased risk of mortality in ICU (aHR=). Similarly, patients with DM and CVD increased the risk of mortality by 4 times (HR=4.2(95% CI: 2.12, 8.28, $P<0.001$) and three times (aHR=3.2(95% CI: 1.69, 6.09, $p<0.001$) respectively. However, the admission patterns did not show a significant difference in multivariate analysis despite a significant difference in bivariate analysis. On the other hand, the APACHE II score at admission demonstrated an enormously significant difference with mortality (Table 2).

Table 2 Multivariate Cox proportional hazard analysis of the association between risk factors and 30-day mortality among ICU patients in Ethiopia (*N*=436)

Variables	Survival status		AHR(95% CI)	*P* value
	Yes	No		
Nutritional status				
Well -Nourished	158(69.6)	60(28.7)	Reff	Reff
Malnourished	69(30.4)	149(71.3)	1.4(1.33, 2.56)	< 0.001***
Pattern of admission				
Emergency	94(41.4)	160(76.6)	2.1(0.6, 4.9)	0.09
Medical	23(10.1)	12(5.7)	1.3(0.44, 3.66)	0.66
Perioperative	26(11.5)	23(11.1)	0.9(0.35, 2.31)	0.82
Gyn/obstetrics	15(6.6)	7(3.3)	0.9(0.28,2.95)	0.88
Others	69(30.4)	7(3.3)	Reff	Reff
Comorbidities				
Hypertension	48(21.2)	78(37.3)	3.1(1.69, 5.73)	0.001**
DM	18(7.9)	32(15.3)	4.2(2.12, 8.28)	< 0.001***
CVD	46(20.3)	31(14.7)	3.2(1.69, 6.09)	0.001**
COPD/Asthma	23(10.1)	48(23)	4.2(2.25, 7.90)	0.001***
Others	92(40.5)	20(9.7)	Reff	Reff
Disease severity index				
Mild	95(41.8)	12(5.8)	Reff	Reff
Moderate	66(29.1)	77(36.8)	1.4(0.74, 2.83)	0.23
Severe	66(29.1)	120(57.4)	2.5(1.28, 4.82)	0.007*
APACHE II				
< 15	132(58.1)	31(14.8)	Reff	Reff
15–20	39(17.2)	48(23)	3.2(1.93, 5.25)	< 0.001***
20–25	26(11.5)	37(17.7)	3.5(2.10, 6.18)	< 0.001***
> 25	30(13.2)	93(44.5)	4.1(2.51,6.76)	< 0.001***
MUST				
Low risk	114(50.2)	27(12.9)	Reff	Reff
Medium risk	73(32.2)	83(39.7)	1.2(0.75, 2.06)	0.38
High risk	40(17.6)	99(47.4)	2.2(1.34,3.46)	0.001**
Modified NUTRIC				
Low risk	121(53.3)	30(14.5)	**Reff**	Reff
High risk	106(46.7)	179(85.5)	**2.7(1.67,4.49)**	< 0.001***
SGA				
Severe	29(12.8)	70(34.5)	1.8(1.19,2.76)	0.005**
Mild/Moderate	48(21.2)	69(33)	1.5(1.02,2.17)	0.038*
Normal	150(66)	70(34.5)		

*Significant; **very significant; ***extremely significant, COPD: Chronic obstructive Pulmonary Disease; DM: Diabetes Mellitus; CVD: Cardiovascular Disease; APACHE II: Acute Physiologic and Chronic Health Evaluation; MUST: Malnutrition Universal Screening tool; NUTRIC: Nutrition Risk in Critically Ill; SGA: Subjective Global assessment of nutritional status

Discussion

This study revealed that malnutrition in an ICU setting was significant. The study also found a strong association between malnutrition and clinical outcomes, highlighting the importance of addressing this issue. In particular, the prognostic relevance of NUTRIC, MUST, and SGA was deemed to be of paramount importance.

This study revealed that the magnitude of malnutrition at admission was 29%. The cumulative incidence of malnutrition during follow-up was mild to moderate (27%, 95% CI: 22 to 31) and severe (22%, 95% CI: 19 to 27) with SGA score, compared to 65% (95% CI: 61 to 70) with modified NUTRIC and 32% (95% CI: 27 to 35) with MUST which is consistent with a study done in Singapore among 439 ICU patients, where the prevalence of malnutrition with SGA screening tool was 28% mildly malnourished, moderately malnourished 25%, and severely malnourished 3% [20].A similar finding was observed in a study by Kang MC et al. among 300 hospitalized patients, where malnutrition was 22% with SGA screening tool, strongly associated with older age, admission for medical treatment, and underlying pulmonary and oncologic problems [21].

In contrast to this study, studies conducted in Egypt among 68 ICU patients by Zaki et al. (50%) [22], Albania among 963 elderly ICU patients by Shpata et al. (71.24), and Pakistan among 139 ICU patients by Arbab et al.(71.9) [23] revealed a higher prevalence of malnutrition. The variations could be explained by the differences in socioeconomic status, diversity among the people participating in the study, disparities in the methods used to assess nutrition, differences in admission practices, and variations in types of intensive care units, discrepancies in the size of the sample, and discrepancies in the way ICU care is provided.

A systematic review conducted by Lew et al. with 20 studies demonstrated that the prevalence of malnutrition varied from 38 to 78%, which was more prevalent in the elderly (29%), acute kidney injury (78%), liver transplantation (53%) and cardiac patients (12.5%) [11]. Similarly, another systematic review conducted by Correia et al., including 66 studies with 29,474 patients from 12 Latin

American countries, reported a higher rate of malnutrition, 40–60% in ICU patients [2]. These variations may be related to the underlying clinical illness. For example, most patients with gastrointestinal diseases typically experience nausea, vomiting, malabsorption, and diarrhoea, which could exacerbate malnutrition. Similarly, socioeconomic status, frailty in the elderly, dietary restriction for some patients, pattern of patient admission, variability of nutritional screening/assessment tools, and sample size might contribute to the inconsistent figure across regions over the years.

There are different types of malnutrition Screening and Assessment tools available that have been validated in various healthcare settings and age groups, including SGA, NUTRIC, MUST, MST, MNA, NRI, SNAQ, and NRS2002 in ICU, where MUST and NRI are screening [2, 11, 16]. This study demonstrated that MUST were found to be highly predictive of malnutrition risk, AUC=0.81(95% CI: 0.77 to 0.85) compared to NUTRIC, AUC=0.59(95% CI: 0.55 to 0.65), and SGA, AUC=0.51(95% CI: 0.45 to 0.56 which consistent with a study done in Jordan by Al-Kalaldeh et al. among 321 ICU patients to investigate the predictability of MUST and Phase Angle screening tools, where MUST was a reasonably reliable screening tool along with Phase Angle screening tool [24]. Another study conducted in the USA by Canales et al. among 312 Adult patients Admitted to ICU to compare the effectiveness of NUTRIC and NRS2002 nutritional status screening tools showed that NUTRIC was superior compared to NRS2002 on screening of Malnutrition in ICU patients [25].

Furthermore, a study conducted in South Korea by Jeong et al. among 482 septic patients admitted to a medical ICU to compare the predictability of NUTRIC and modified NUTRIC tools on 28 days mortality showed that the two tools were consistent as depicted by Area under the curve (AUC=0.76, 95% CI=0.718–0.806 VS AUC=0.757, 95% CI=0.713–0.801 and $P=0.45$) respectively [26]. Overall, there are inconsistent reports in the literature as to which nutrition screening and assessment tools are effective and reliable so far, and recent evidence recommends combining tools for further nutritional assessment rather than relying on a single tool [2, 7].

This study showed that the cumulative incidence of mortality among patients admitted to ICU was 47.9%(95% CI: 43.2 to 52.6), whereas the mortality was very high in the malnourished compared to the well-nourished group, 54.9%(95% CI: 49.6 to 60.1) and 21.1%(95% CI: 13.9 to 30.8) respectively which is consistent with a systemic review conducted by Lew et al. (30.3-69.6%) [11], and study in Egypt by Zaki et al. (55.9%) [22], which is hypothesized that malnutrition causes a loss in muscle mass, which results in decreased respiratory drive, respiratory muscle weakness, and ventilator reliance, as well as an impairment in immune response, which is linked to a high prevalence of nosocomial infections. However, studies done in Turkey by Atalay et al. among 119 elderly patients and a study from Singapore by Lew et al. among 440 patients failed to show a significant association between malnutrition and mortality [14, 27]. The possible reason for such a discrepancy might be differences in pattern of disease, disease severity, ICU setting, study population, and sample size.

It is mainly reported in the literature that malnutrition is associated with an increased length of hospital stay and decreased median survival time, and this study showed consistent findings. Kaplan-Meier survival curve demonstrated that the median survival time was 7.0 (95% CI, 6 to 8) days. In contrast, the median survival time for well-nourished and malnourished was ten days (95% CI: 8 to 11) and five days (95% CI: 4 to 6) respectively. However, a study from Singapore by Lew et al. among 440 patients failed to demonstrate a significant association between malnutrition and ICU length of stay, β=-0.015(95% CI: -2.25, 1.67, $p=0.771$) [14], where this inconsistency might be attributable to variations in nutritional status assessment tool, ICU type and setting, admission pattern, severity of disease, and socioeconomic status.

This study identified some independent mortality hazards among ICU patients, including nutritional status at admission, comorbidity, APACHE II score, and higher scores of malnutrition screening tools. Death hazards in a patient with malnutrition increased by 40% compared to well-nourished patients (aHR=1.4, 95% CI: 1.33 to 2.56), which is consistent with a study conducted in Singapore by Lew et al. (aHR=1.33, 95% CI:1.05 to 1.69) [13]. Similarly, another study conducted by Fontes et al. in Brazil among 185 ICU patients showed significant odds of mortality in patients with malnutrition (AOR=8.12, 95% CI: 2.94 to 22.42, $P<0.05$) [28].

A meta-analysis including eight studies with 4076 participants examining the pooled effect of malnutrition on mortality using modified NUTRIC demonstrated a high risk of mortality in patients with malnutrition(aHR=2.03, 95% CI: 1.488 to 2.788, $P<0.001$) [29].

However, a study by Coporossi et al. recruiting 248 medical and surgical ICU patients to examine the effect of malnutrition on mortality with the thickness of Adductor Pollicis muscle didn't show a significant difference(AOR=2.00, 95% CI:0.5 to 7.6) [28]. These differences might not be replicable because there might be a huge difference in the nutritional assessment tools, study population, and ICU setting, and most importantly, these studies used different statistical models and effect estimates, where the estimated parameter would be over-inflated in the case of the odds ratio. Furthermore, this study revealed that APACHE II>25 (aHR=4.1, 95% CI: 2.51 to 6.67), higher NUTRIC score (aHR=2.7, 95% CI:

1.67 to 4.49), being diabetic (aHR=4.2, 95% CI: 2.12 to 8.28), and being asthmatic (aHR=4.2, 95% CI: 2.25 to 7.9) were strong risks of 30-day mortality. Similarly, patients with a high risk of malnutrition at admission with MUST and SGA had a high risk of mortality (aHR=2.2, 95% CI: 1.34 to 3.46 and aHR=1.8, 95% CI: 1.19 to 2.70) respectively, which is consistent with a study conducted in an Albanian ICU where APACHE II>15(AOR=2.77, 95% CI=1.69 to 4.57), and malnutrition (AOR=2.68, 95% CI:1.74 to 4.18) were strongly associated with mortality [30]. However, the mortality magnitude might differ as it was determined with different statistical models and effect estimates.

Strengths and limitations of the study

This study is the first-ever prospective cohort study investigation of the effects of malnutrition on clinical outcomes of ICU patients with validated screening and assessment nutrition tools. To our knowledge, these screening and assessment tools were not validated in Sub-Saharan Africa in ICU settings. However, this study has limitations. Firstly, this study included heterogeneous participants concerning Sociodemographic characteristics, diagnosis, and comorbidities. Secondly, this was a single-centre study with limited biochemical tests to integrate with nutritional screening tools.

Implications for policymakers

The burden of malnutrition is very high in low and middle-income countries, particularly in critically ill patients. However, nutritional risk screening and assessment is separate from clinical practice in most of this country, including in this study area; even the knowledge and practice of clinicians of these tools is minimal. Hence, the stakeholders should incorporate a protocol for screening, assessment and timing for nutrition supplementation for all patients admitted to the intensive care units.

Implications for further study

This was a prospective cohort study with a relatively large sample size and follow-up time, but further observational multicenter studies with a homogenous population in age, diagnosis, and comorbidities are recommended as there was significant heterogeneity in Sociodemographic characteristics, admission pattern, and comorbidity in this study.

Conclusion

Malnutrition is prevalent among adult patients in the intensive care unit (ICU) and has been linked to higher 30-day mortality rates, complications, and longer ICU stays. Therefore, it is crucial to implement proper nutritional screening and evaluation upon ICU admission in order to develop an appropriate nutritional plan and minimize the negative effects of malnutrition on both patients and the healthcare system. The significance of reliable and practical tools like NUTRIC, MUST, and SGA in assessing the prognosis of critically ill patients' nutritional status cannot be overstated. These tools have been well-validated, feasible, affordable, and non-invasive, making them suitable for routine use.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s40795-024-00964-5.

Supplementary Material 1

Supplementary Material 2

Supplementary Material 3

Supplementary Material 4: Marginal plots depicting linear prediction of nutritional status over the length of stay

Supplementary Material 5: Complications by survival status among patients admitted in Dilla University referral hospital ICU: VAP: Ventilator-Associated Pneumonia.

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Author contributions

Semagn Abate: Conceptualization, Methodology, Software, Reviewing; Bedru Jemal: writing original draft, supervision; Muhiddin Tadesse: Reviewing, editing the draft; Mahlet Birhane: Reviewing and editing, validation; Solomon Nega: Reviewing, editing the draft; Bahru Mantefardo: Reviewing and Editing; and Abinet Meno: Reviewing and Editing.

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Data availability

Data will be available by Corresponding Author with reseasonale request.

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from Dilla University Research Ethics and Review Board (RERP), and informed consent was obtained from each participant.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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