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Original article

# Nutritional practices in medical intensive care units: Multicenter, one-day point prevalence study☆

## *Pratiques nutritionnelles dans les unités de soins intensifs médicaux : étude de prévalence ponctuelle multicentrique sur une journée*

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ABSTRACT

*Background/Aim.* – Nutritional planning is an important aspect of Intensive Care Unit (ICU) care. The present study aimed to evaluate the nutritional practices adopted in medical ICUs in Turkiye and to investigate their compliance with current international guidelines.
*Methods.* – This multicenter, cross-sectional study was performed on a predetermined study date. Centers were required to fill three groups of questionnaires: One on ICU characteristics and facilities, one on patients included, and one on outcomes of patients. Forms on patients had questions on demographics and their nutritional status.
*Results.* – A total of 12 sites participated and 132 patients were recorded in the study and 109 patients were included in analyses. The median age was 72 [57–83] years and 55 (50%) of them was female. The median APACHE II score was 23 [18–29], median SOFA score was 6 [4–9] and median BMI was 25.32 [21.22–29.38]. More than 50% of patients were fed enterally; for most, it was started within the first 24 hours of admission. On the study day, the median energy intake of the patients during the last 24 hours was 21.62 [15.9–27.3] kcal/kg and the median amount of protein intake was 1.02 [0.7–1.3] g/kg, representing 83.1% and 78.9% of the targets, respectively. A total of 64 (58.7%) patients were alive on the 28$^{th}$ day of the study, of them 23 (21.1% of all patients) were still in the ICU.

☆ This study has previously been presented at ESICM LIVES Digital 2021 as a poster presentation.

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*Conclusion.* – Nutrition therapy in medical ICUs was initiated early after ICU admission, the enteral route was preferred and target calories were calculated using weight-based formulas. These results suggest that multi-dimensional planning of critical care management of patients by intensivists may provide better nutritional care for the critically ill.



## RÉSUMÉ

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*Objectif.* – La planification nutritionnelle est un aspect important de la prise en charge des malades en unité de soins intensifs (USI). Cette étude visait à évaluer les pratiques nutritionnelles adoptées dans les USI médicales et à enquêter sur leur conformité aux guidelines internationales actuelles.
*Méthodes.* – Les centres devaient remplir trois groupes de questionnaires pour cette étude transversale, multicentrique : un sur les caractéristiques et les installations des soins intensifs, un sur les patients inclus et un sur leurs résultats.
*Résultats.* – Au total, 109 patients de 12 sites ont participé à l'étude. L'âge médian était de 72 [57–83] ans et 55 (50 %) d'entre eux étaient des femmes. l'IMC médian était de 25,32 [21,22–29,38]. Plus de 50 % des patients étaient alimentés par voie entérale ; pour la plupart, il a commencé dans les 24 premières heures suivant l'admission. Le jour de l'étude, l'apport énergétique médian des patients au cours des dernières 24 heures était de 1455 [1132–1750] kcal et la quantité médiane d'apport protéique était de 71 [49–81] g, représentant 83,1 % et 78,9 % des cibles, respectivement. Au total, 64 (58,7 %) patients étaient en vie au 28e jour de l'étude, dont 23 (21,1 % de tous les patients) étaient toujours en USI.
*Conclusion.* – La thérapie nutritionnelle dans les USI médicales a été planifiée tôt après l'admission en USI ; la voie entérale a été préférée ; les apports énergétiques cibles ont été calculées à l'aide de formules basées sur le poids. Ces résultats suggèrent que la planification multidimensionnelle de la prise en charge des patients en soins intensifs par les intensivistes peut fournir de meilleurs soins nutritionnels aux patients gravement malades.



## 1. Introduction

Inadequate nutrition is a common problem that negatively affects the clinical outcome of critically ill patients [1]. During the early phase of severe acute critical illness, unlike starvation, profound inflammation results in metabolic instability and severe catabolism. This is mediated by cytokines, and hormonal and metabolic alterations [2]. The resulting increased metabolic demand underscores the importance of nutrition therapy in critically-ill patients [1–3]. The inability to meet nutritional targets for various reasons results in severe malnutrition. Macro- and micro-nutrient deficiencies result in impaired metabolism and immune dysfunction [4]. Loss of muscle mass results in decreased muscle strength leading to restricted mobilization and weakness in respiratory muscles [5,6]. Malnutrition is associated with an increased risk of sepsis, organ dysfunctions, prolonged need for mechanical ventilation, secondary infections, delayed wound healing, increased costs, extended intensive care unit (ICU) stay, and excess mortality [1,7,8].

The awareness of the importance of medical nutrition therapy on patient outcomes is of utmost importance to prevent inadequate nutrition and its consequences in the ICUs [9–11]. Various associations and societies regularly publish recommendations and guidelines to emphasize the importance of nutrition and to assist in implementing adequate nutrition therapy [9–11].

As well, the ICU training curriculum includes topics on clinical nutrition. However, it is commonly observed that practice guideline recommendations and actual practices show variations worldwide [12–14].

The present study aimed to evaluate the nutritional practices adopted in medical ICUs of university, training, and research hospitals in Turkiye and to discuss their compliance with the current international guidelines [9,15].

## 2. Material and methods

The study was performed in Turkiye, in third level medical ICUs of university and training research hospitals led by certified intensivists who accepted to participate. Medical ICU is defined as an ICU admitting mainly patients with medical conditions, like sepsis, respiratory failure, acute organ failures. Patients needing surgical interventions and trauma patients are admitted only if no beds are available in the related ICU's. The study was planned as a cross-sectional, point prevalence study similar to ICU Nutrition Day [11], yet we have included only medical ICU's directed by intensivists. The study was conducted according to the Declaration of Helsinki guidelines. Ethical approval was obtained on September 12, 2019, with the decision number İ3-111-19. Centers were asked to record data for all patients treated at their ICUs during the 24-hour period commencing at 08:00 (local time) on November 5, 2019.

## 3. Questionnaires

Participants were required to fill out two questionnaires on the study day and were later questioned about the 28th-day outcome of patients. Questionnaire 1 consisted of questions on ICU characteristics and facilities: the number of active beds in the ICU, intensivists, other physicians, nurses, nurse/bed ratio, dietician visits to the ICU, and the presence of a clinical nutrition committee in the hospital.

Questionnaire 2 included questions on patients' demographics and their body mass index (BMI), Sequential Organ Failure Assessment Score (SOFA), Acute Physiologic and Chronic Health Evaluation Score II (APACHE II), Nutritional Risk Screening Score (NRS-2002), modified Nutrition Risk In Critically Ill Score (mNUTRIC), admission diagnosis and comorbidities, need for sedation, mechanical ventilation requirement, need for vasopressor treatment, whether renal replacement therapy was applied, nutrition

**Fig. 1.** Participant distribution across Turkey.

plan including the feeding route and nutritional prescription, the method used for calculation of target calories and protein targets, calories and protein received during the last 24 hours (actual nutritional delivery), albumin (g/dL), phosphorus (mg/dL), lactate (mEq/L), minimum glucose (mg/dL) and maximum glucose (mg/dL) levels and complications related to nutritional therapy. Laboratory values included in the study were the values obtained within the last 24 hours of the study day.

Body weight and height were determined by measuring, when not possible, the last recorded measurements were taken into account. Body weight index was calculated as body weight (in kg) divided by square of height (m). For patients receiving oral intake, dietary intake was calculated by counting calories of consumed food. The patients on exclusively dextrose infusion have been recorded as not receiving nutrition therapy and excluded from the analyses.

On December 3, 2019, the 28$^{th}$-day outcome (date of ICU and hospital discharge, if no longer hospitalized; date of ICU/hospital death if lost) of patients included in the study were questioned with Questionnaire 3.

## 4. Statistical analyses

The statistical analyses were done with the SPSS (Statistical Package for Social Sciences) 25.0 program (SPSS Inc, Chicago, IL). Descriptive statistics were presented as median [25$^{th}$–75$^{th}$ percentile] or frequency distribution and percentage, where appropriate.

## 5. Results

### 5.1. Participant center characteristics

A total of 12 medical ICUs, with a median of 11 [9–17] ICU beds, participated in the study (Fig. 1). The median of the total number of nurses working in these units was 21 [14–28] and patient to nurse ratio during the day shift was 3 [2–3]. The median number of physicians was 6 [2–8], and the median number of intensive care specialists was 2 [1–3]. Nutrition committees were present in 10 (90.9%) of the centers. However, only 8 (72.7%) of the units had regular visits by a dietician.

### 5.2. Patient characteristics

A total of 132 patients were recorded in the study. At the study day 12 patients' length of ICU stay was < 3 days, 10 patients were receiving dextrose infusion for calories (due to severe shock state or plan for invasive procedures) and one patient had missing data. After excluding above patients, totally 109 patients were included in the analyses.

The median age was 72 [57–83] years. The number of female patients was 55 (50%). The median APACHE II score was 23 [18–29] and study day median SOFA score was 6 [4–9]. The median BMI of patients was 25.32 [21.22–29.38]. Thirteen patients' BMI was lower than 18.5; and 18 patients' BMI was over 30. None were above 45. On the study day, 63 patients (58%) required invasive mechanical ventilation and 20 (18%) patients required non-invasive mechanical ventilation. Twenty-five (23%) of the patients were sedated and 22 (20%) of all study patients needed vasopressor treatment. Renal replacement therapy was required in 22 (20%) patients.

The most common causes for ICU admission were respiratory disorders (81 patients, 74%), sepsis and shock (68 patients, 62%) and neurological disorders (39 patients, 36%). Of these patients, 5 were surgical and 4 were trauma patients with concomitant medical problems, requiring ICU admission. Hypertension was the most common comorbidity and was present in 53 (49%) patients.

The median hospital stay before ICU admission was 2 days [1.0–7.0], 54 of the patients had a hospital stay more than 3 days before ICU admission. The median length of ICU stay before the study day for all patients was 9 days [6–28]. Patients' characteristics, admission diagnosis and comorbidities, laboratory parameters, treatment modalities and outcomes are presented in Table 1.

### 5.3. Nutrition practices

Nutritional evaluation and management plan of patients and the complications associated with nutrition are presented in Table 2. The nutritional risk was evaluated by NRS-2002 in all centers. The median NRS-2002 score was 4 [4,5]. As well, mNUTRIC was evaluated in 8 centers. The median mNUTRIC score was 5 [4–7].

On admission, 27 (24.8%) of patients were already on nutrition therapy. Nutrition therapy was started/continued on the first day of admission to the ICU in 63 (57.7%) patients. Oral support was in 19 (17.4%) patients and EN was preferred in 74 (67.8%) patients. PN was utilized in 11 (10%) patients. In 5 (4.5%) patients, EN was combined with PN.

All ICUs participating in this study were providing traditional rate-based feeding. Target calories were commonly calculated based on the patients' ideal body weight in eight centers. Three centers calculated target calories using the Harris-Benedict equation and one center used the Schofield equation. Indirect calorimetry was used in one patient. Not all centers were actively evaluating proteic targets. Centers supplementing proteins to attain proteic targets calculated the daily amount of protein using 1.2gr/kg/day equation as recommended in the guidelines (ASPEN and ESPEN). Of the patients, 85 (78%) had received at least 70% of the target calories.

**Table 1**
Patients characteristics, treatment modalities, admission diagnosis and comorbidities, laboratory parameters, and outcomes.

| **All patients** | **(*n* = 109)** |
|---|---|
| Age, years[a] | 71 [57–83] |
| Female[b] | 55 (50) |
| Height, cm[a] | 165 [160–173] |
| Weight, kg[a] | 70 [60–80] |
| BMI[a] | 25.3 [21.2–29.4] |
| SOFA[a] | 6 [4–9] |
| APACHE II[a] | 23 [18–29] |
| Need for sedation[b] | 25 (23) |
| Need for mechanical ventilation[b] | |
| IMV | 63 (58) |
| NIMV | 20 (18) |
| Need for vasopressors[b] | 22 (20) |
| Renal replacement therapy[b] | 22 (20) |
| Admission diagnosis[b] | |
| Respiratory failure | 81 (74) |
| Sepsis | 43 (39) |
| Neurologic disorders | 39 (36) |
| Renal disorders | 37 (34) |
| Cardiac disorders | 32 (29) |
| Shock | 25 (23) |
| Postoperative admission | 5 (4.5) |
| **Comorbidities**[b] | |
| Hypertension | 53 (49) |
| Diabetes mellitus | 35 (32) |
| Heart failure | 28 (26) |
| Coronary artery disease | 27 (25) |
| Malignancy | 26 (24) |
| End stage renal failure | 19 (17) |
| Cerebrovascular disease | 18 (16) |
| Dementia | 16 (15) |
| Chronic hepatic failure | 4 (3.6) |
| Chronic obstructive pulmonary disease | 4 (3.6) |
| **Laboratory parameters**[a] | |
| Albumin (g/dL) | 2.4 [2.2–2.9] |
| Phosphorus (mg/dL) | 3.4 [2.8–4.7] |
| Lactate (mEq/L) | 1.35 [1.0–2.1] |
| Glucose minimum (mg/dL) | 110 [95–129] |
| Glucose maximum (mg/dL) | 158 [140–194] |
| Mortality 28$^{th}$ day[b] | 64 (58.7) |

APACHE, acute physiology and chronic health evaluation; BMI, body mass index; IMV, invasive mechanical ventilation; NIMV, non-invasive mechanical ventilation; SOFA, sequential organ failure assessment.
[a] Continuous variables are presented as median [25$^{th}$–75$^{th}$ percentile].
[b] Categorical variables as n (%).

**Table 2**
Comparison of nutritional parameters depending on percent of target calories received.

| Nutrition therapy | All patients (*n* = 109) |
|---|---|
| Nutritional Risk Screening 2002[a] | 4 [4,5] |
| mNUTRIC Score[a] | 5 [4–7] |
| Feeding started on the first day[b] | 63 (57.7) |
| **Nutrition Route**[b] | |
| Enteral | 74 (67.8) |
| Nasogastric route | 69 (63.3) |
| Orogastric route | 5 (4.5) |
| Oral | 19 (17.4) |
| Parenteral | 11 (10) |
| Parenteral (central venous line) | 8 (7.3) |
| Parenteral (peripheral venous line) | 3 (2.7) |
| Enteral + Parenteral | 5 (4.6) |
| Additional protein supplementation[b] | 35 (32) |
| **Complications**[b] | |
| Vomiting | 11 (10) |
| Diarrhea | 10 (9) |
| Electrolyte imbalance | 7 (6.4) |
| Distension | 4 (3.6) |
| Hypoglycemia | 4 (3.6) |
| Hyperglycemia | 3 (2.7) |
| Aspiration | 1 (0.9) |

mNUTRIC, modified nutrition risk in critically ill.
[a] Continuous variables are presented as median [25$^{th}$–75$^{th}$ percentile].
[b] Categorical variables as *n* (%).

The median of target calories was 1750 [1500–1881] kilocalories and the median of target protein was calculated as 90 [75–105] g. The median calorie intake of the patients in the last 24 hours was 1455 [1132–1750] kilocalories (21.62 [15.9–27.3] kcal/kg), which was 83.1% of the caloric target. The median amount of protein intake was 71 [49–81] g (1.02 [0.7–1.3] g/kg), which was 78.9% of the protein target (Fig. 2).

When patients were grouped depending on their ICU day on the study date: caloric intake, and protein intake did not significantly differ between the patients with less than five days of stay, patients on 5$^{th}$–15$^{th}$ days of their stay, and patients whose stay was more than 15 days (p = 0.218 and p = 0.132, respectively).

Protein supplements (the only product in our country is Protifar®) were used as protein salts included in patients' nutrition orders. Protein salts were additionally supplemented in 35 (32%) patients.

Gastric residual volume measurement was not routinely performed for enterally fed patients, and the cut-off ranged between 300 mL and 500 mL.

When complications associated with nutrition until the study day were questioned the most commonly reported complication was vomiting (11 patients, 10%). Other complications were diarrhea

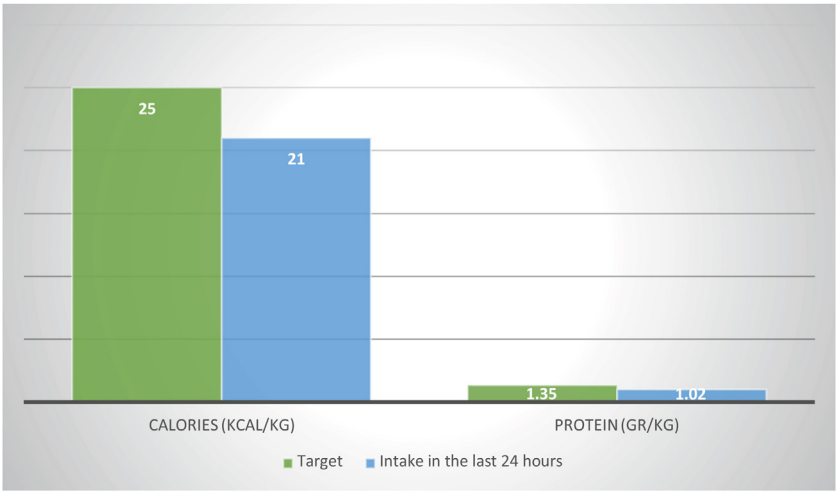


**Fig. 2.** Target and attaining calories in the last 24 hours.

in 10 (9%), electrolyte imbalance in 7 (6.4%), distension in 4 (3.6%), hypoglycemia in 4 (3.6%) and hyperglycemia in 3 (2.7%) patients. Aspiration was observed in one patient (0.9%).

The median albumin level measured on the study day was 2.4 g/dL [2.2–2.9], the median phosphorus level was 3.4 mg/dL [2.8–4.7], the median lactate level was 1.35 mEq/L [0.99–1.81], the median minimum glucose level was 110 mg/dL [95–129] and the median maximum glucose level was 158 mg/dL [140–194].

### 5.4. Outcome

A total of 64 (58.7%) patients were alive on the 28$^{th}$ day of the study, of them 23 (21.1% of all patients) were still in the ICU.

## 6. Discussion

Critically-ill patients are usually in a catabolic state with an elevated level of metabolic stress secondary to a systemic inflammatory response. Awareness of the importance of nutrition therapy and its effect on survival is essential. This study was conducted to examine nutrition practices in medical ICUs across our country. Results of the study revealed that participating medical ICUs with intensivists as directors have adopted early enteral feeding as recommended by the international guidelines. Likewise, PN was reserved for patients who cannot be fed by the enteral route. However, target calories were still calculated by formulas instead of indirect calorimetry due to unavailability of the equipment. As well, nutrition therapy should be monitored to evaluate ongoing or changing needs of the patients, to evaluate whether the targets are attained and to recognize presence of any complications. Monitorization of nutrition seemed to be inadequate in some centers, yet this is a poorly addressed topic in the guidelines, as well. About a quarter of these centers lacked regular visits by nutrition teams. Therefore, active nutrition planning by intensivists was of utmost importance.

Our study has revealed that EN (67.8%) was the first choice in the participating sites, in the absence of contraindications. The rate of PN administration was only 10%. This finding was compatible with the recent guidelines recommending that the enteral route should be the first choice [9,16]. In the participating ICUs, nutrition therapy was administered within the first 24 hours of admission in the absence of contraindications. The rate of EN commencement within the first 24 hours of ICU admission was between 10% to 84% in similar studies from other countries around the world [11,13,17,18]. Yet, an important confounding factor was that these patients had several comorbidities and many were already hospitalized for at least a few days before ICU admission. As well, almost a quarter had already been started nutrition. So, it was not possible to discuss the feeding practices in the early acute phase of the critical illness.

Patients who are fed enterally may experience difficulties in attaining the targeted calories. In the study by Altintas et al., comparing EN and PN, it was reported that frequent interruptions, due to interventional procedures such as transport, routine care, and certain practices such as measurement of gastric residual volumes, prevented administration of target calories during EN [19]. To attain target calories despite interruptions, it is recommended that volume-based feedings should be preferred over traditional rate-based feeding [20]. Almost all ICUs participating in this study were providing traditional rate-based feeding. Perhaps the next step to our study could be to investigate the feasibility and efficacy of volume-based feeding as described by Heyland et al. to ameliorate delivery of energy and protein to patients [21].

A recent study by Matejovic et al., including 11 European countries have demonstrated that 83% of ESPEN caloric target and 65% of ESPEN protein target could be provided to patients [14]. Their results have shown that 10–20 kcal/kg/day was associated with earlier weaning and longer survival compared to lower and higher intakes. They suggested moderate caloric and protein intake throughout the ICU stay, after a gradual increase of nutrition over days. However, their study population was younger, APACHEII scores lower BMI higher, and almost half of the patients were surgical patients rendering a direct comparison between groups impossible.

When the calories and protein received by the patients during the last 24 hours were examined, it was observed that only 83.1% of the targeted calories and 78.9% of the targeted protein could be administered. ICUs in our study, similar to the centers in other studies, reported that they primarily used commercially available standard enteral formulas. However, it is commonly recognized that standard formulas are not adequate for critically ill, who need formulas with lower non-protein energy: nitrogen ratios [21]. Therefore, to meet these targets, protein should be supplemented separately if standard formulas are going to be used. However, protein supplementation was provided only in certain centers and it was not a common practice across different ICUs in our study. In the study performed by Heyland et al. [22], 79 ICUs in Canada, which included dieticians in their teams, it was observed that patients reached 56% of the target calories and 62% of the target proteins. In the NutritionDay ICU study, it was observed that the target calorie and protein levels could not be attained and results were similar to Heyland's study [11]. In the Latin American study, it was shown that only 59.7% of the patients could attain more than 90% of the targeted calories within the first 24 hours [18]. In the study conducted in China, the rate of patients reaching 80% of the targeted calories in the first 7 days remained at a very low rate of 17.8% [13]. Two studies from ICUs in Turkey revealed that the percent calories attained may vary between 46% and 80% [19,23]. ICUs participating in this study were mainly medical ICUs and gastrointestinal integrity was preserved in most patients, which may have resulted in higher tolerance of enteral nutrition. This and high adherence to guidelines may have resulted consequently in the attainment of higher nutritional targets, which were, yet, similar to the recommended moderate levels by Matejovic et al. [14].

Still, some patients were underfed. Many factors may have contributed to underfeeding including hemodynamic instability, metabolic imbalances, diagnostic/therapeutic interventions, or problems related to the route of nutrition [19]. As well, our study group consisted of older patients with several admission diagnoses. Therefore, they were probably more vulnerable to the adverse effects of underfeeding. Still, it can be stated that being unable to attain caloric and protein targets should alert the physician that the patient may have a poor outcome and elaborate care is needed.

There are some limitations to our study. Firstly, this study was a cross-sectional study, aiming to reveal the current practices in intensivist-led medical ICUs. Therefore, complications and outcomes related to nutrition could not be evaluated in detail. As well, the adaptation of nutrition therapy to changing needs of patients over time could not be evaluated due to the design of this study. Besides, the patients receiving the least calories might as well have been the sickest ones, despite the insignificant difference between groups for APACHE II scores. Secondly, intensivist-led medical ICUs represent a small portion of the ICUs in our country, and most ICUs are mixed, general ICUs. Therefore, the number of participating sites and the number of patients were small, despite being a better defined, more homogenous group. For the same reasons, these findings cannot be generalized to surgical or trauma patients and ICUs led by other specialities. Lastly, calorie targets were calculated with formulas in the centers participating in the study. The use of indirect calorimetry is recommended in the current guide-

lines to determine the target calories; however, the equipment was not readily available on participating sites. It is commonly reported that formula-based targets may result in significant inaccuracy.

## 7. Conclusion

Overall, awareness of the importance of nutrition on patient outcomes was high in participating medical ICUs and adherence to current guidelines was better than previously reported. Nutrition therapy in intensivist-led medical ICUs was planned early after ICU admission, the enteral route was preferred and target calories were calculated using weight-based formulas. These results suggest that multi-dimensional planning of critical care management of patients by intensivists may provide better nutritional care for the critically ill.

## Authors' contributions

Leyla Ferlicolak, N. Defne Altintas, Arzu Topeli equally contributed to the conception and design of the research and as well analysis and interpretation of the data. Leyla Ferlicolak, N. Defne Altintas, Arzu Topeli and Kursat Gundogan critically revised the manuscript. Leyla Ferlicolak, Burcin Halacli, Sahin Temel, Ozlem Cakin, Melda Turkoglu, Bilgin Comert, Gurhan Taskin, Avsar Zerman, Turkay Akbas, Emre Karakoc, Kamil Gonderen and Ismail Hakkı Akbudak contributed to acquisition and analysis of the data. All authors drafted the manuscript, agree to be fully accountable for ensuring the integrity and accuracy of the work, and read and approved the final version of the manuscript.

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## Disclosure of interest

The authors declare that they have no competing interest.

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## References

[1] Singer P. Preserving the quality of life: nutrition in the ICU. Crit Care 2019;23(Suppl. 1):139.
[2] Javid Mishamandani Z, Norouzy A, Hashemian SM, Khoundabi B, Rezaeisadrabadi M, Safarian M, et al. Nutritional status of patients hospitalized in the intensive care unit: A comprehensive report from Iranian hospitals, 2018. J Crit Care 2019;54:151–8.
[3] Rubinson L, Diette GB, Song X, Brower RG, Krishnan JA. Low caloric intake is associated with nosocomial bloodstream infections in patients in the medical intensive care unit. Crit Care Med 2004;32(2):350–7.
[4] Sharma K, Mogensen KM, Robinson MK. Pathophysiology of critical illness and role of nutrition. Nutr Clin Pract 2019;34(1):12–22.
[5] Naber TH. Lean body mass depletion is associated with an increased length of hospital stay. Am J Clin Nutr 2004;79(4):527–8.
[6] Wischmeyer PE, Puthucheary Z, San Millán I, Butz D, Grocott MPW. Muscle mass and physical recovery in ICU: innovations for targeting of nutrition and exercise. Curr Opin Crit Care 2017;23(4):269–78.
[7] Correia MI, Waitzberg DL. The impact of malnutrition on morbidity, mortality, length of hospital stay and costs evaluated through a multivariate model analysis. Clin Nutr 2003;22(3):235–9.
[8] Allen K, Hoffman L. Enteral nutrition in the mechanically ventilated patient. Nutr Clin Pract 2019;34(4):540–57.
[9] Singer P, Blaser AR, Berger MM, Alhazzani W, Calder PC, Casaer MP, et al. ESPEN guideline on clinical nutrition in the intensive care unit. Clin Nutr 2019;38(1):48–79.
[10] Elke G, Wang M, Weiler N, Day AG, Heyland DK. Close to recommended caloric and protein intake by enteral nutrition is associated with better clinical outcome of critically ill septic patients: secondary analysis of a large international nutrition database. Crit Care 2014;18(1):R29.
[11] Bendavid I, Singer P, Theilla M, Themessl-Huber M, Sulz I, Mouhieddine M, et al. A 7 year worldwide prevalence study of nutrition practice in intensive care. Clin Nutr 2017;36(4):1122–9.
[12] Adam S, Batson S. A study of problems associated with the delivery of enteral feed in critically ill patients in five ICUs in the UK. Intensive Care Med 1997;23(3):261–6.
[13] Xing J, Zhang Z, Ke L, Zhou J, Qin B, Liang H, et al. Enteral nutrition feeding in Chinese intensive care units: a cross-sectional study involving 116 hospitals. Crit Care 2018;22(1):229.
[14] Matejovic M, Huet O, Dams K, Elke G, Vaquerizo Alonso C, Csomos A, et al. Medical nutrition therapy and clinical outcomes in critically ill adults: a European multinational, prospective observational cohort study (EuroPN). Crit Care 2022;26(1):143.
[15] Taylor BE, McClave SA, Martindale RG, Warren MM, Johnson DR, Braunschweig C, et al. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient: Society of Critical Care Medicine (SCCM) and American Society for Parenteral and Enteral Nutrition (A.S.P.E.N.). Crit Care Med 2016;44(2):390–438.
[16] Compher C, Bingham AL, McCall M, Patel J, Rice TW, Braunschweig C, et al. Guidelines for the provision of nutrition support therapy in the adult critically ill patient: the American Society for Parenteral and Enteral Nutrition. JPEN J Parenter Enteral Nutr 2022;46(1):12–41.
[17] Ridley EJ, Peake SL, Jarvis M, Deane AM, Lange K, Davies AR, et al. Nutrition therapy in Australia and New Zealand intensive care units: an international comparison study. JPEN J Parenter Enteral Nutr 2018;42(8):1349–57.
[18] Vallejo KP, Martínez CM, Matos Adames AA, Fuchs-Tarlovsky V, Nogales GCC, Paz RER, et al. Current clinical nutrition practices in critically ill patients in Latin America: a multinational observational study. Crit Care 2017;21(1):227.
[19] Altintas ND, Aydin K, Türkoğlu MA, Abbasoğlu O, Topeli A. Effect of enteral versus parenteral nutrition on outcome of medical patients requiring mechanical ventilation. Nutr Clin Pract 2011;26(3):322–9.
[20] Taylor S, Dumont N, Clemente R, Allan K, Downer C, Mitchell A. Critical care: meeting protein requirements without overfeeding energy. Clin Nutr ESPEN 2016;11:e55–62.
[21] Heyland DK, Dhaliwal R, Lemieux M, Wang M, Day AG. Implementing the PEP uP Protocol in critical care units in Canada: results of a multicenter, quality improvement study. JPEN J Parenter Enteral Nutr 2015;39(6):698–706.
[22] Heyland DK, Schroter-Noppe D, Drover JW, Jain M, Keefe L, Dhaliwal R, et al. Nutrition support in the critical care setting: current practice in Canadian ICUs–opportunities for improvement? JPEN J Parenter Enteral Nutr 2003;27(1):74–83.
[23] Balaban H, Aygencel Ş, Türkoğlu M, Ülger Z. Nutritional support therapy practices in a medical intensive care unit. Bir dahili yoğun bakım ünitesinde nütrisyon destek tedavi uygulamaları. Yogun Bakim Derg 2014;5(2):30–5.