ORIGINAL ARTICLE

Nutrition Characteristics and Delivery in Relation to 28-day Mortality in Critically Ill Patients

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ABSTRACT

Introduction: The limited data regarding nutrition characteristics and the delivery of critically ill patients in South Asia is intriguing. This study was conducted to investigate the nutrition characteristics and delivery in relation to 28-day mortality in mechanically ventilated patients. **Methods:** This prospective observational study was conducted in the intensive care unit (ICU) of the Maldives government referral hospital. Data about nutrition characteristics and delivery were collected from the ICU charts, and each patient was followed for a maximum of 28 days. **Results:** We recruited a total of 115 patients (mean age: 61.57±17.26 years, 52% females, mean BMI: 25.5±6.19kg/m2), of which 61 (53%) of them died within 28 days of ICU admission. Mean energy intake was 681.15±395.37 kcal per day, and mean protein intake was 30.32±18.97g per day. In the univariate logistic regression analysis, length of stay in ICU (OR = 0.950, 95% CI: 0.908 – 0.994, p = 0.027), and received intervention by a dietitian (OR = 0.250, 95% CI: 0.066 – 0.940, p = 0.040) were associated with 28-day mortality. None of the factors in the multivariate regression analysis remains significant when adjusted for sex, SOFA total score, daily energy and protein dosage. **Conclusion:** 28-day mortality was much higher in this study than in similar studies in South Asia, Asia and around the globe. None of the variables was significantly associated with 28-day mortality in the multivariate logistic model. However, there was a trend towards higher mortality for patients with shorter length of stay in the ICU, larger mean gastric residual volume, and no intervention by a dietitian.
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Keywords: Critically ill, Mortality, Nutrition Characteristics, Nutrition Delivery, ICU

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INTRODUCTION

The Intensive Care Unit (ICU) is a specialized discipline to treat the most seriously ill patients in a hospital. Due to the critical condition of patients in ICU, they are given comparably special attention through a multidisciplinary team of intensivists, specialized doctors, nurses and allied health specialists, including dietitians and physiotherapists (1). ICU mortality around the globe is approximately between 10 and 20% (2–6). In some Asian countries such as Malaysia, Singapore, and Nepal, the mortality of critically ill patients was reported as ranging 15.2% to 51.5% (7–9). Mortality in South Asian countries was reported between 18.7 and 34.0% (10,11).

Different studies use different mortality endpoints to report the mortality of critically ill patients. Standard mortality endpoints are set at 60-day mortality, 28 or 30-day mortality, in-hospital mortality, and in-ICU mortality. The 28-day mortality was taken in this study based on a similar study done in Canada and India (10,12), which was considered sufficient to obtain the information required for this study.

Nutrition plays a critical role in critically ill patient. Achieving optimal nutritional status is equally important to ensure good clinical outcomes during critical conditions, thus reducing the rates of mortality. Critical illness increases the risk of Protein Energy Malnutrition (PEM) (13). It was demonstrated that targeted nutrition and the early introduction of protein as part of a key 'bundle' are important for creating ICU survivors (14). A well-planned nutrition delivery is essential to overcome the increased catabolism created with ICU admission (15). Nonetheless, there are not many studies look into nutritional characteristics and how they influences the survivorship among critically ill patients.

There are many clinical other factors that have been studied including age, sex, source of admission, admission category, number of days admissted in the hospital before being transferred to ICU, number of days admitted in the ICU, number of days on invasive mechanical ventilation (IMV), number of inotropes given, daily highest mean random blood glucose (RBG), daily mean lowest RBG, daily mean Insulin dosage, number of comorbidities, disease severity measured using Acute Physiological and Chronic Health Evaluation (APACHE) II score and Sequential Organ Failure Assessment (SOFA) score, and administration of motility agenst.

Studies show that increasing age is associated with in-ICU and in-hospital mortality (2), 28-day mortality (16) and 60-day mortality (8,17). Few studies show that men are at a higher risk of 60-day mortality compared with women (17). In addition, admission category and whether patient is transferred from hospital or is directly admitted to ICU also have shown association with mortality. Researchers reported that patients admitted in hospital before being transferred to ICU had 3-fold increased risk of 60-day mortality (8). In another study it was found that surgical patients have a higher risk of 60-day mortality (17).

Disease severity as measured using APACHE score has shown to be statistically higher in non-survivors compared to survivors. In addition, APACHE II has shown to predict in-hospital mortality with good diagnostic accuracy (3). In the retrospective cohort in Australia, it was demonstrated that those critically ill patients who did not survive in hospital had higher APACHE score compared to those who survived (2). Some studies show an association between disease severity as measured using SOFA score and 28-day mortality (16). In addition, in their study they found out that those who did not survive in hospital had higher blood urea concentration (2). In the retrospective cohort done in Australia, they found out that most of the patients who did not survive in hospital required IMV (66.7%) compared to those who required non-invasive ventilation (32.1%) (2).

Feeding products that provide a targeted nutrition is important in delivering targeted nutrition in critically ill patients (15). Based on available nutrition guidelines for critically ill patients in South Asian countries, it is questionable whether patients are fed with commercial products to achieve nutrition goals or whether patients are fed with blended tube feeds (11,18,19). Some studies show that providing higher energy and protein is beneficial with regards with mortality in critically ill patients (12,20,21) while others show higher energy and protein can be harmful (22–24). Some studies produced inconclusive results (25–27).

All these studies were conducted in western countries. Data from some South-East Asian countries, including Singapore and Malaysia, regarding critical care nutrition suggest the importance of tailored nutrition in critically ill patients for their survival (7,8). Studies done in South Asian countries is meagre (19), and those that were done did not mention nutrition provision in ICU (10,11). This is pertinent in the present context as dietitians' involvement in the nutrition management of critically ill patients from South Asian countries are relatively unknown (10,11). Indeed, there is no available data from the Maldives regarding the management of critically ill patients. Hence, this study was conducted to investigate nutrition characteristics and delivery in relation to 28-day mortality in mechanically ventilated patients admitted to the government referral hospital of the Maldives. The findings of this study would provide fundamental data regarding 28-day mortality and nutrition characteristics and delivery among mechanically ventilated patients admitted to government referral hospitals in the Maldives.

MATERIALS AND METHODS

Study design

This prospective observational study was conducted from April 2019 to March 2020 in the main ICU of a government referral hospital in the Maldives. Those patients who cannot be treated in regional hospital ICUs are transferred to the ICU in this hospital by sea or air. This study was approved by Universiti Putra Malaysia (UPM) ethics review committee (UPM/TNCPI/RMC/JKEUPM/1.4.18.2(JKEUPM)), Maldives ethics review committee and IGMH ethics review committee / National Health Care Academy (NHA). Informed consent was waived as no interventions were given to the patients.

Sampling and Subject Selections

All adult critically ill patients on invasive mechanical ventilation in the first 72 hours of ICU admission were included in the study. Patients who were excluded from the study were those who started on oral nutrition within 48 hours of admission, were moribund, pregnant, and were discharged within 48 hours of ICU admission.

Sample size

The sample size was calculated using Open Epi, with the proportion of mortality (34%) taken from the study done in Indian ICU (10). Considering this proportion, an estimated critically ill population of IGMH as 100 in one year, and a confidence level of 99.99%, the sample size was 93. After adding 20% for incomplete data, the minimum sample size for the study was 112.

Measurements and Data Collection

Nutrition Characteristics

Length of stay (LOS) in a hospital before ICU admission counted as the day the patient was admitted to the hospital until transferred to ICU (8). LOS in the ICU was counted as days, with one day taken as 24 hours, starting from the ICU admission date (7).

Information for nutrition characteristics were collected from patients' charts including Highest daily Random Blood Glucose (RBG) and lowest RBG for the first 12 days of admission in ICU , mean daily Insulin dosage for the first 12 days of admission in ICU, number of comorbidities, number of inotropes and ventilator setting. Disease severity was assessed using Acute Physiological And Chronic Health Evaluation (APACHE) II and Sequential Organ Failure Assessment (SOFA). The tool used to assess patients' risk of malnutrition was the Modified NUTrition Risk in Critically Ill (mNUTRIC) score. The sum of scores was categorized as a high nutrition risk (5 – 9 points) and a low nutrition risk (0 – 4 points) (7).

Nutrition Delivery

No attempt was made to modify energy and protein prescription, and it was left at the discretion of the patient management team. Enteral and parenteral nutrition for each patient was recorded for a maximum of 12 evaluable nutrition days. If the patient dies before day 12, the number of nutrition days were recorded as the last 24 hours before death. Similarly is the patient was started on oral feeds or gets discharged, records were made likewise (7).

Energy provision was recorded from enteral commercial feeds (CF), blended tube feeds (BTF), parenteral nutrition (PN) including Dipeptiven®, other amino acid solutions, propofol infusions and dextrose (7). Energy and protein from CF were calculated by multiplying the total number of scoops of feeds given from each type of CF product with the amount of energy and protein contained per scoop according to the nutrition information on the can. Energy and protein from BTF were calculated based on recipes described by the patient relatives or the canteen providing BTF (Table I). Energy and protein from PN packs and amino acid drips were calculated according to the information provided on the packs. Energy from propofol was calculated as 1.1 kcal/ml, and energy from dextrose was calculated based on dextrose infusion strength, with 1 gram of dextrose considered as 3.4 kcal (7). 24-hour accumulated gastric residual volume (GRV) was measured for the first 12 days of admission in ICU. Intervention by dietitian was recorded for those patients whose nutrition was planned and managed by dietitians.

28-day mortality

Each patient was followed for a maximum of 28 days from the day of admission in the ICU. In the ICU, the record of admissions and discharge was maintained daily, including contact numbers of the relatives. Using this registry, patients discharged from the ICU were followed by a phone call. If the patient dies before day 28, it was recorded as died. If a patient survived more than 28 days, it was recorded as survived.

Table I: Estimated nutrition composition of the feeds

Commercial feeds				
Product	*Amount per scoop*		*Amount per 100ml solution*	
	Energy (kcal)	*Protein (g)*	*Energy (kcal)*	*Protein (g)*
Ensure powder	36.1	1.3	108.3	3.9
Ensure Plus	36.8	1.69	110.4	5.07
Ensure Diabetes Care	37	1.7	111	5.1
Nepro HP	44.6	1.9	178.4	7.6
Resource whey protein	43	10.2	Used in combination with others	
Blended tube feeds				
Rice water cooked with egg white or fish or chicken and vegetables			30	0.5
Full cream milk			64	3.2
Low fat milk			50	3.2
Skimmed milk			40	3.2
Fresh fruit juices without sugar			24	0
Vegetable soup from stock packets			50	0.1
Chicken soup from stock packets			50	0.1
Vegetable juices			0	0
Coconut water			24	0

Data Analysis

Statistical analysis was performed using IBM SPSS Statistics 25. Descriptive data, including nutrition characteristics, nutrition delivery and 28-day mortality were presented as frequencies and percentages for categorical variables and as means and standards deviation or median (q1-q3) for continuous variables.

Univariate logistic regression was first used to determine contributors to 28-day mortality. Those factors with $p \leq 0.20$ were taken as covariates for multivariate logistic regression (7,12). In another model, nutrition delivery factors were tested by controlling to nutrition-related clinical characteristics with $p \leq 0.2$. The statistical significance level was set at $p \leq 0.05$. Variation Inflation Factor (VIF) used to measure multicollinearity was set at ≥ 0.19, and based on this energy dosage and protein dosage per day instead of per kg bowdy weight per day were taken for adjusted analysis.

RESULTS

A total of 561 patients were screened from April 2019 to March 2020. A total of 131 of them were eligible for the study, but only 115 (%) patients were recruited to the study (Fig 1). Patients were mainly excluded due to not being mechanically ventilated in the first 72 hours (29.7%) or having already been fed orally in the first 48 hours of ICU admission (24.5%) (Fig. 1).

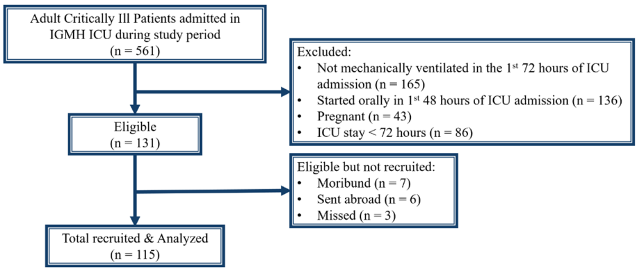

Fig. 1: Flowchart showing screening and Recruitment of Subjects for this research

Sociodemographics and Nutrition Characteristics

Patients in this study were on average at their age of 60s' with the majority of them female (53%) (Table II). Most patients were transferred from the emergency room (62.6%) and most were the medical cases (83.5%). The median LOS in the hospital before admission in ICU was 1.00 days, and median LOS in ICU and the average length of IMV was 10.00 days and 8.00 days, respectively (Table II).

The median number of comorbidities was 2.00. The mean highest RBG was 8.63±3.95 mmol/L, and the mean lowest RBG was 6.61±2.81 mmol/L. The mean total daily insulin dosage was 2.57±6.96 units. Mean APACHE II and SOFA scores were 22.19±7.74 and 9.39±5.54, respectively, indicating the high disease severity. About 54.8% of the subjects had mNUTRIC score above 5, indicating high nutrition risk (28).

Nutrition Delivery

The median time of initiating any form of nutrition was 13.00 hours since ICU admission. About 85.5% of the patients received enteral nutrition alone, 4.5% on PN alone and 10% of the subjects received both enteral and parenteral nutrition. The most common mode of feeding was bolus (91.4%). Continuous or cyclic feeding was given to only 8.6% of patients.

Intervention by dietitian was provided to 87.0% of the patients. Most of the patients received CF (86.7%) and a small proportion (4.8%) received BTF as the only source of nutrition. The BTF was provided as yoghurt drink, fresh apple juice, packet juice, coconut water, rice water, barley water, black tea, milk tea, and soups. Another 13.3% of the patients received BTF in combination with CF. The mean dosage of energy provided to the patients in the first 12 days of ICU admission was 681±395kcal per day or 11±7kcal/kg body weight /day, and the mean protein dosage in the same period was 30 grams per day or 0.53 g/kg body weight per day. The mean 24-hour accumulated GRV was 36.96±64.13ml. Motility agents were given to 40.9% of the patients.

28-day mortality

The clinical outcome measured in this study was 28-day mortality. 28-day mortality was 53.9%. Other clinical outcomes like the LOS in ICU and length of IMV were mentioned previously as nutrition characteristics.

Association of Nutrition Characteristics and Delivery with 28-day mortality

Univariate logistic regression showed that LOS in ICU (p = 0.027) and intervention by a dietitian (p = 0.040) was significantly associated with 28-day mortality (Table III). Variables with a non-significant trend (p ≤ 0.20) with 28-day mortality were: sex (p = 0.068), SOFA (p = 0.105), mNUTRIC score in category (p = 0.131), mean GRV (p = 0.097), mean energy received in kcal/kg/day (p = 0.120), mean protein received in g/kg/day (p = 0.074), mean energy received in kcal/day (p = 0.184) and mean protein received in g/day (p = 0.087).

None of the variables was significantly associated with 28-day mortality in the multivariate logistic model (Table IV). However, there was a trend towards higher mortality for patients with shorter ICU LOS (Adj OR 0.948, 95% CI 0.899-1.001; p = 0.053), larger mean GRV (Adj OR 1.007, 95% CI 0.998-1.016; p = 0.106), and not received intervention from a dietitian (Adj OR 0.347, 95% CI 0.070-1.729; p = 0.196).

DISCUSSION

This study investigated nutrition characteristics and delivery in relation to 28-day mortality in mechanically ventilated patients. Although non of the factors contributed to 28-day mortality in the unadjusted analysis, trend towards higher mortality was observed in the adjusted analysis in patients with shorter length of stay in ICU, larger gastric residual volume, no intervention by a dietitian.

Patients in this study were comparatively older than those in India, with a mean age of 61 years and 54 years in Maldivian and Indian ICUs, respectively (10). Similarly, compared with a similar studies on other Asian countries, mean age was higher in this study (7,8). Although most of the patients in this study were transferred from the emergency room (62.6%), some were brought into this ICU after being admitted for several days in any one of the regional hospitals.

Patients in the study done in Israel had a similar disease severity (APACHE score 22), although their mortality was lower than the current study (17). India and Australia reported lower disease severity using APACHE II scores of 17.4 and 18.82, respectively (2,10) and SOFA score 3.8 (10). In the study done in Malaysia, patients were more severely ill than the present study (7). In the study done in the Netherlands, APACHE II score was lowest (17.9) in non-septic patients and highest (25.4) in septic patients. The overall APACHE score in their study was 23.0, slightly higher than this study (4).

Nutrition risk as measured using mNUTRIC in this study had a similar percentage to the study done in a Malaysian government hospitals with mNUTRIC 54.8% and 55.8%, respectively, in the high nutrition risk group

Table II: Association of Nutrition Characteristics and Nutrition Delivery with 28-day Mortality

	Total (n = 115)	Survived (n = 54)	Expired (n = 61)	p-value
Age	61.57±17.26	60.28±18.85	62.66±15.85	0.464
Sex				0.100
Male	54 (47.0)	20 (37.7)	34 (54.8)	
Female	61 (52.0)	33 (62.3)	28 (45.2)	
Source of admission				1.000
ER	72 (62.6)	33 (62.3)	39 (62.9)	
Other wards	43 (37.4)	20 (37.7)	23 (37.1)	
Admission Category				0.700
Medical	96 (83.5)	43 (81.9)	53 (85.5)	
Surgical	19 (16.5)	10 (18.9)	9 (14.5)	
No. of days in hospital before ICU admission	1.00(0.00 – 1.00)	1.00(0.00–1.50)	1.00(0.00 – 1.00)	0.874
No of days in ICU	10.00 (6.00 – 17.00)	11.00 (6.00–28.00)	9.00 (5.75 – 16.00)	0.080
No of day on IMV	8.00 (5.00 – 16.00)	8.00 (5.00–18.50)	7.50 (5.00 – 15.00)	0.935
Number of inotropes in the first 72 hours	0.00 (0.00 – 1.00)	0.00 (0.00– 1.00)	0.50 (0.00– 1.00)	0.454
Mean highest RBG, mmol/L	7.8±4.0	7.7±4.0	7.8±4.1	0.859
Mean lowest RBG, mmol/L	5.8±2.6	6.0±2.7	5.7±2.5	0.464
Mean Insulin Unit (total Insulin in 24 hours)	0.00 (0.00 – 0.67)	0.00 (0.00 – 1.54)	0..00 (0.00 – 0.54)	0.506
Body weight, kg	62.14±16.02	60.22±13.62	63.77±17.76	0.238
Body Mass Index (kg/m^2)	25.5±6.19	24.93±5.17	25.91±6.95	0.396
Number of comorbidities	2.00 (1.00 – 4.00)	2.00 (1.00– 4.00)	2.00 (1.00–4.00)	0.745
Disease Severity				
APACHE II	22.19±7.74	21.32±8.66	22.94±6.84	
SOFA	9.04±3.74	8.45±4.01	9.55±3.44	
Modified NUTRIC Score	4.79±2.19	4.43±2.43	5.10±1.93	0.113
Low score	52 (45.2)	28 (52.8)	24 (38.7)	
High score	63 (54.8)	25 (47.2)	38 (61.3)	
Time of initiating EN / PN in days	13.00 (5.00 – 29.00)	14.00 (5.75 – 32.75)	11.00 (5.00 – 29.00)	0.508
Rout of Nutrition				0.611^
EN	94 (81.7)	46 (86.8)	48 (77.4)	
PN	5 (4.3)	2 (3.8)	3 (4.8)	
EN+PN	11 (9.6)	4 (7.5)	7 (11.3)	
No Nutrition	5 (4.3)	1 (1.9)	4 (6.5)	
* Mode of EN				0.304^
Bolus Feeds	96 (91.4)	44 (88.0)	52 (94.5)	
Continuous / Intermittent	9 (8.6)	6 (12.0)	3 (5.5)	
* Type of Feed				0.926^
Blended Tube Feeds	5 (4.8)	2 (4.0)	3 (5.5)	
Commercial Feeds	86 (81.9)	42 (84.0)	44 (80.0)	
Mixed	14 (13.3)	6 (12.0)	8 (14.5)	
Administration of motility agent	47(40.9)	21(39.6)	26(41.9)	0.951
Mean GRV, ml	34.68±59.21	24.28±44.55	43.57±68.46	0.073
Intervention by Dietitians				0.058
Yes	100 (87.0)	50(94.3)	50(80.6)	
No	15 (13.0)	3 (5.7)	12 (19.4)	
Mean energy dosage in kcal / day	681.15±395.37	734.26±357.61	635.75±422.57	0.184
Mean protein dosage in g / day	30.23±18.97	33.52±17.67	27.41±19.71	0.085
Mean energy dosage in kcal/kg bodyweight / day	11.42±6.67	12.47±0.29	10.52±7.04	0.119
Mean protein dosage in g/kg body weight / day	0.51±0.32	0.56±0.29	0.46±0.33	0.072

ER: Emergency Room, ICU: Intensive Care Unit, IMV: Invasive Mechanical Ventilation, RBG: Random Blood Glucose
APACHE (Acute Physiological and Chronic Health Evaluation), SOFA (Sequential Organ Failure Assessment), ICU (intensive Care Unit), mNUTRIC (modified Nutritional Risk In Critically ill, GRV: Gastric Residual Volume, EN (Enteral Nutrition), PN (Parenteral Nutrition),
*Timing of initiating nutrition (n = 111), Mode of EN (n = 105), Type of feed (n = 105)
^Fisher's Exact test

Table III: Univariate Logistic regression analysis to determine factors associated with 28-day mortality

Variable	OR (95% CI)	p-value
Age	1.008 (0.987 – 1.030)	0.460
Sex		
Male	2.004 (0.949 – 4.231)	0.068
Female		
Source of Admission		
ER	0.973 (0.456 – 2.076)	0.944
Other wards		
Admission Category		
Medical	1.370 (0.511 – 3.672)	0.532
Surgical		
Length of stay in hospital before admission in ICU	0.998 (0.944 – 1.056)	0.957
Length of stay in ICU	0.950 (0.908 – 0.994)	0.027
Length of IMV	0.977 (0.933 – 1.022)	0.309
Number of Inotropes	1.334 (0.700 – 2.540)	0.381
Mean Highest RBG	1.000 (0.995 – 1.006)	0.857
Mean Lowest RBG	0.997 (0.989 – 1.005)	0.460
Mean daily Insulin Dosage	1.016 (0.970 – 1.063)	0.506
Body weight on admission, kg	1.015 (0.990 – 1.040)	0.242
Body Mass index (kg/m^2)	1.027 (0.965 – 1.093)	0.397
Number of comorbidities	1.019 (0.843 – 1.233)	0.844
APACHE II	1.028 (0.979 – 1.080)	0.266
SOFA	1.084 (0.983 – 1.194)	0.105
mNUTRIC Score – categorized		
High Score	1.773 (0.844 – 3.728)	0.131
Low Score		
Time of initiating nutrition	0.996 (0.979 – 1.014)	0.682
Rout of Nutrition		
Total EN	0.261 (0.028 – 2.422)	0.237
Total PN		
EN + PN		
Mode of EN		
Bolus	2.364 (0.558 – 10.005)	0.243
Continuous / Cyclic		
Type of feed		
Commercial Feeds	0.698 (0.111 – 4.391)	0.702
Blended Tube feeds		
Mixed		
Administration of motility agents	0.909 (0.431 – 1.917)	0.801
Mean GRV	1.006 (0.999 – 1.014)	0.097
Intervention by Dietitian	0.250 (0.066 – 0.940)	0.040
Mean energy dosage, kcal / day	0.999 (0.998-1.000)	0.184
Mean protein dosage in, g/day	0.983 (0.963 - 1.003)	0.087
Mean energy dosage in kcal per kg body weight / day	0.956 (0.903 – 1.012)	0.120
Mean protein dosage in grams per kg bodyweight / day	0.340 (0.104 – 1.110)	0.074

ER: Emergency Room, ICU: Intensive Care Unit, IMV: Invasive Mechanical Ventilation, RBG: Random Blood Glucose
APACHE (Acute Physiological and Chronic Health Evaluation), SOFA (Sequential Organ Failure Assessment), mNUTRIC modified Nutritional Risk In Critically ill, GRV: Gastric Residual Volume, EN (Enteral Nutrition), PN (Parenteral Nutrition)

Table IV: Multivariate Logistic Regression Analysis to determine factors associated with 28-day mortality

	Odds ratio (95% CI)	p-value
Sex	1.843 (0.811 – 4.187)	0.144
Length of Stay in ICU	0.948 (0.899 – 1.001)	0.053
SOFA Total Score	1.055 (0.952 – 1.170)	0.308
Mean GRV	1.007 (0.998 – 1.016)	0.106
Intervention by Dietitian	0.347 (0.070 – 1.729)	0.196
Mean energy dosage in kcal per kg body weight / day	1.230 (0.894 – 1.693)	0.203
Mean protein dosage in g / kg bodyweight / day	0.15 (0.000 – 12.172)	0.218
Mean protein dosage in grams per kg bodyweight / day	0.340 (0.104 – 1.110)	0.074

ICU: Intensive Care Unit, SOFA: Sequential Organ Failure Assessment, GRV: Gastric Residual Volume

(7). Nutrition risk was not included in the study done in India (10). As mentioned in the problem statement, most studies done in the south Asian countries did not look into nutrition characteristics and delivery of the patients.

The average time of initiation of nutrition of any form in this study was the 13th hour of admission in ICU, with nutrition being started for 88.3% of the patients in the first 48 hours of admission in ICU. This is a good indication as most international guidelines recommend initiating nutrition in 24 to 48 hours of admission in ICU for hemodynamically stable patients (29,30). A note must be taken that there was a small percentage of patients, 4.3%, who did not receive any types of nutrition therapy in the first 12 evaluable nutrition days of ICU admission. The results addressed the need to have nutrition intervention for all critically ill patients. From the rest, 81.7% received only EN, 4.3% received only PN, and 9.6% received the combination of enteral and parenteral nutrition. This is also very much in agreement with the ASPEN guideline, which recommends choosing enteral nutrition over parenteral nutrition whenever possible (29). Although international guidelines recommend continuous or intermittent feeding over bolus feeding in ICU (29,30), most patients (91.4%) were given bolus feeds.

In addition, 4.8% and 13.3% of the patients were given BTF as the only types of feeds or combined with CF, respectively. With BTF out of practice in modern countries, it was stated in our previous review that BTF is mentioned in the nutrition guidelines of some of the South Asian countries (19).

An excellent percentage (87.0%) of the patients received intervention by a dietitian in this ICU. Inadequate time given by dietitians to train and educate nurses on how to manage feeds and inadequate dietitian coverage during weekends were some of the main barriers to enteral nutrition in ICU (31). Since most of the patients in this ICU received intervention by a dietitian, it is predicted that this barrier would not exist. However, it is crucial to note how nutrition was given to those whom dietitians did not give intervention. In a hospital with dietitians and ICU being the place where nutrition is of utmost importance, it is very critical to provide planned nutrition to the patients.

Mean daily energy dosage (681±395kcal per day or 11±7kcal/kg body weight /day) and mean daily protein dosage (30 grams per day or 0.53 g/kg body weight per day) fed to the patients in the evaluable nutrition days as counted as 12 days from the day of admission in ICU were comparatively lower in this study than what is in the guidelines. According to ASPEN, 25 – 30kcal / kg body weight / day and 1.2 – 2.0 g / kg body weight / day (29), and according to ESPEN 1.3g / kg body weight / day of protein (30) needs to be provided. The mean energy and protein dosage per day in this study were similar to the secondary analysis of RCT conducted in Australia and New Zealand (25,26). In addition, the maximum amount of protein provision in this study was 1.2 g / kg body weight per day, which is the lower recommended amount in ICU (29).

Mortality in this study is much higher than the available data from South Asian Countries (10,11). Mortality in this study is also higher than mortality in Asian Countries (7–9). Patients in this study had a higher disease severity, that might also explained the high mortality rate among the study population. Although disease severity in this ICU was higher than what as reported from India, disease severity in this research was not as high as what was being reported in Malaysia (7,10).

The reason why mortality is higher in this study could be because of older age. It could also be due to the absence of an intensivist. An intensivist is a specialist in treating ICU patients. ICU patients are exceptionally different compared to the other patients admitted to a hospital. Hence, they require specialized care under the supervision of an intensivist (32). However, in this study, we observed patients were treated by doctors of different other specialities, which highlighting the needs of having the specific intensivist and their team to improve practice.

While some of these studies indicate the association of disease severity with mortality as measured using APACHE II score (2,33), other show association of disease severity and mortality using SOFA score to measure disease severity (16,17). In the study done in Netherlands, disease severity was associated with mortality, and septic patients had higher disease severity as measured using APACHE score. Septic shock causes organ failure which will increase chances of death due to imbalanced in homeostasis (4). This emphasizes the importance of having an intensivist in this ICU to identify which area of intensive care management needs more attention to reduce risk of mortality.

Although not statistically significant, higher daily energy and higher daily protein dosage showed a trend towards lowered 28-day mortality in the unadjusted model. This trend disappeared after adjusting for sex, LOS in ICU, SOFA score, and mNUTRIC. These findings were similar to the findings in the secondary analysis of Randomized Control Trial in Australia and New Zealand (25,26).

This study also found that those who did not receive intervention by a dietitian had higher chances of mortality. This was statistically significant in the unadjusted model but not significant in the adjusted model. Guidelines and reviews giving an estimation of energy, protein and nutritional requirements, the best fit for each patient can be done after assessment and calculation for those individual patients (34). Studies suggest evidence-based algorithms to improve nutritional support in ICU can improve patient outcomes (35). In an integrated quality improvement intervention program conducted in a 32-bed medical ICU, the presence of intensive care dietitian provided significant additional progress related to early introduction and route of feeding, and achieved in optimal energy balance (36).

One of the limitations of this study was the difference in protein dosage in two group not being very distinct, and the group with higher protein not being provided according to recommendations. Another limitation of this study was not being able to get an accurate energy and protein content of blended tube feeds. There was no consistency in the recipes.

CONCLUSION

This study found out that non of the nutrition characteristics or delivery were related to 28-day mortality in this ICU. Patients in this study were much older and had higher disease severity than those in other South Asian Countries. Most of the patients in this ICU received intervention from a dietitian. Most of the patients did not receive a protein dosage according to what is being recommended in international ICU nutrition guidelines. 28-day mortality in this ICU was much higher than similar studies. LOS in ICU and intervention by a dietitian had a significant contribution to 28-day mortality in the unadjusted regression analysis.

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