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Nutritional Audit in Critically Ill Patients and Compliance with Standard Guidelines-An Observational Study

Dr Nikita Singh[1], Dr Manjunatha R Kamath[2], Dr Prerana Hegde[3]
[1]Department of Anaesthesiology and Critical Care, K. S Hegde Medical Academy, Deralakatte, Mangaluru, Karnataka, India
[2]Department of Anaesthesiology and Critical Care, K. S Hegde Medical Academy, Deralakatte, Mangaluru, Karnataka, India
[3]Department of Nutrition and Dietetics, K. S Hegde Medical Academy, Deralakatte, Mangaluru, Karnataka, India

Abstract

Nutritional support is first line of treatment for patients in ICU. The generally accepted objectives of nutritional delivery in critically sick patients are to enhance patient outcome, prevent nutrient shortages, reduce problems related to nutrition supply and offer nutritional therapy appropriate for patient's state.[1] The study was conducted in ICU of Justice K. S Hegde Charitable Hospital, K. S Hegde Medical Academy, Mangaluru, India. 24 h nutrition intake in ICU patients was recorded. Collected data on nutrition provided was then used to calculate intake and recommended values. We also considered the number of patients getting oral and nasogastric feeds and assessed the difference in the amount of nutrition in them. There was total 144 participants. The participants' daily nutritional need was estimated using the European Society of Parenteral and Enteral Nutrition (ESPEN), American Society for Parenteral and Enteral Nutrition (ASPEN) and Indian Society of Critical Care Medicine (ISCCM) guidelines, The mean energy demand was of 1435.34 kcal, mean actual intake was 630.68 kcal/day deficit of 807.81 kcal/day. The mean protein requirement was 76.84 g/day, but consumed mean protein was 28.39 g/day with deficit of 48.48g/day. The mean fat requirement was 78.37 g/day, but actual consumed mean fat was 16 g/day with deficit of 62.37g/day. Difference between actual intake of macronutrients and recommended intake of macronutrients by standard guidelines was found, which was pointing towards an insufficient diet being consumed by patients. This iatrogenic malnutrition, if continued for a longer duration, may lead to malnutrition-related complications in patients in ICU.

Keywords: Malnutrition, ICU, Critically Ill, Standard Guidelines

Introduction

Nutritional support is the first line of treatment for patients in the ICU. The generally accepted objectives of nutritional delivery in critically sick patients are to enhance the patient outcome, prevent nutrient shortages, reduce problems related to nutrition supply, and offer nutritional therapy appropriate for the patient's state.[1] Implementing realistic strategies to enhance outcomes is crucial since critically ill patients have a significant risk of morbidity, death, and prolonged care requirements. Evolutionary survival systems extract energy from bodily tissue stockpiles, during acute sickness, to power life-sustaining activities. When energy and protein are given to critically ill patients, this risk is reduced, and the likelihood of recovery is enhanced. Sacrificing body reserves is detrimental and contributes to poor outcomes. As early as possible, the nutritional strategies are implemented, and the better the outcome.[2] Hospitalized patients cannot get enough nutrition to meet their energy needs. The ASPEN, ESPEN, and ISCCM all advocate for the early beginning of enteral nutrition (EN). It is debatable and currently being researched as to how many calories and grams of protein are to be provided for a critically unwell patient. Nevertheless, despite how much is recommended, numerous studies have shown that only around 50% of the recommended calories and protein are delivered in most intensive care units worldwide. [3,4,5,6]

The primary aims of this study are to evaluate the nutritional sufficiency of ICU patients within the first 24 hours of admission, specifically focusing on their intake of energy, protein, and carbohydrates. Additionally, the research aims to quantify the nutritional provision received by ICU patients within the initial 24 hours following admission. A comparative analysis will be conducted to assess any disparities between the actual nutritional intake of patients and the recommended guidelines for energy, calorie, protein, and fat consumption tailored for individuals in the intensive care unit. This investigation seeks to contribute valuable insights into the nutritional status of ICU patients early in their admission and the alignment of their dietary intake with established recommendations.

Methods

Data collection and compilation

After obtaining approval from the Institutional Ethics Committee (INST/EC/EC/036/2021-2022), eligible participants meeting the inclusion criteria were enrolled in the study. Within the initial 24 hours of their admission to the Intensive Care Unit (ICU), detailed records of their nutritional intake were meticulously documented for the subsequent 24-hour period. To ensure precision, a designated ICU nurse, who was unaware of the study objectives, employed measuring cups, spoons, a weighing scale, and recorded the timing and frequency of feed administered to each participant.

Data Assessment

Subsequently, the compiled data on nutritional provision were handed over to the institutional dietician. The dietician, equipped with expertise in nutritional analysis, conducted calculations to determine the participants' intake of total energy, carbohydrates, proteins, and fats. To benchmark this information, the postgraduate researcher involved in the study then referenced the recommended energy, caloric, protein, and fat intake for the participants' weight based on guidelines from ESPEN (European Society for Clinical Nutrition and Metabolism) and ISCCM (Indian Society of Critical Care Medicine). This comprehensive process ensures a thorough evaluation of the nutritional status of ICU patients in relation to established guidelines.

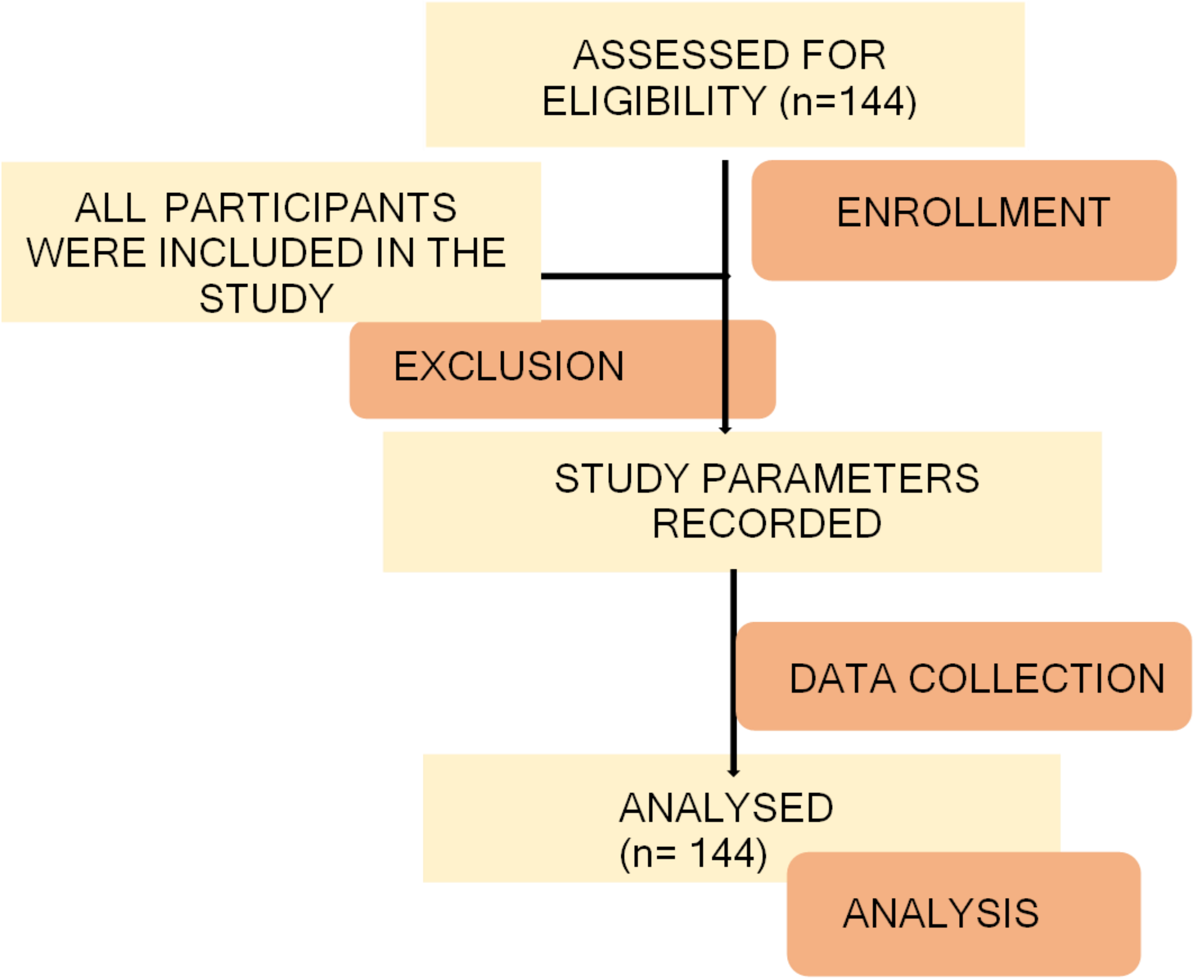

Figure 1: Consort flow diagram of the process involved in the present study.

The nutritional assessment in this study adhered to the recommendations outlined by both ESPEN and ISCCM guidelines. According to ESPEN, the optimal energy intake for critically ill patients ranges from 25 to 30 kcal/kg/day, with protein and fat intake recommended at 1.2 to 2 g/kg/day and 1.5 g/kg/day, respectively. ISCCM, on the other hand, suggests a protein requirement of 1.2 - 2 g/kg/day and calorie intake between 25 to 30 kcal/kg/day. Discrepancies between these guidelines and the actual nutritional intake were calculated, taking into account the mode of nutrition delivery (oral or nasogastric). The study also considered the number of

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patients receiving different feeding methods and evaluated variations in nutritional intake along with inclusion and exclusion criteria listed below,

Inclusion Criteria:
Patients admitted to the ICU for over 24 hours.
Patients with measurable weight upon admission.

Exclusion Criteria:
Discharge or death of the patient before completing data collection.
Presence of severe hepatitis or renal disease.
Patients undergoing dialysis.
Bilirubin levels exceeding 2mg/dl.
Patients kept nil per oral (NPO).
Patients with contraindications for enteral feeds.
Inadequate food intake or intolerance to provided food.

Sample Size Calculation
The sample size was estimated with the sample size was calculated at a 95% confidence interval and with a precision of 0.05. Therefore, the sample size of 384 was obtained from the below given formula.

$$n = \frac{z^2 pq}{d^2}$$

Assumption:
Z = statistic for a level of confidence (95%) = 1.96p = expected prevalence = 50.6% *
q = 1-p = 0.49
d = precision = 0.05; therefore,n= sample size = 384.10~ 384
*Caloric intake in medical ICU patients: Consistency of care with guidelines and relationship to clinical outcomes.

Due to Covid- 19 outbreak, it was not easy to collect such a large sample size. The statistician re-calculated the sample size, and a new sample size of 144 wasderived based on a 5% level of confidence, an estimated standard deviation ofenergy 91.65 (based on the pilot study), and an estimation error of 15.

Formula:

$n= [(Z_{1-\alpha/2}\sigma)/d]^2$
Where following were the assumptions:
$Z_{1-\alpha/2}$ =1.96
Standard deviation= 91.65d= estimation error =15

Statistical Analysis
The data were processed and analysed using IBM Statistical Package for Social Sciences, (SPSS) software version 22.0. Shapiro-Wilk test was used to test for the normality of the data. The results of continuous measurements were measured using numbers and percentages. Chi-square and unpaired t-tests were used to compare the measurements. Any other suitable statistical tests were computed during data analysis if required. In addition, descriptive statistics Mean and Standard Deviation were calculated.

Results
A total of 144 participant's 24h nutritional intake was recorded after completing 24h of ICU admission. The majority of individuals belonged to the age group of 60-70 years (n= 35). Out of 144 participants, 66% were male participants (n = 93) and 34% werefemale participants (n = 47).

Table 1: Demographic Distribution.

Age (years)	Number of Participants
20-30	17
30-40	9

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40-50	30	
50-60	20	
60-70	35	
70-80	23	
80-90	9	
90-100	1	
Age Distribution		
Gender	**Number**	**Percent**
Male	95	66
Female	49	34
Total	144	100
Sex Distribution		

When the energy requirement was calculated for the participants using ESPEN guidelines, it was found that the minimum energy required was 900 kcal/ day and the maximum requirement was 2000 kcal/ day with a mean energy requirement of 1435.34 (SD = 250.70). When ISCCM guidelines were applied to the same, the minimum energy requirement was 900 kcal/ day, and the maximum energy requirement was 2000 kcal/ day with a mean energy requirement of 1438.49 (SD = 249.98). But the actual intake of energy recorded was a minimum of 181.20 kcal/ day to a maximum of 938.80 kcal/ day with a mean calorie intake of 630.68 kcal/ day which forms only about 43.8% of dietary requirement. There is a mean caloric deficit of 807.81 kcal/ day.

Table 2: Comparison of mean fat consumption per day by study participants with standard guidelines (P-value < 0.01).

Energy (Kcal)	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Difference**
ESPEN	900	2000	1435.34	250.7	
ISCCM	900	2000	1438.49	249.96	
INTAKE	181.2	938.8	630.68	221.87	**- 807.81**
Comparison of energy consumption per day by study participants with standard guidelines					
P-value < 0.01					
Protein(g/day)	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Difference**
ESPEN	48	112.5	76.84	11.6	
ISCCM	48	112.5	76.84	11.6	
INTAKE	4.56	161.5	28.39	25.44	**-48.45**
Comparison of mean protein consumption per day by study participants with standard guidelines					
P-value < 0.01					
Fat (g/day)	**Minimum**	**Maximum**	**Mean**	**Standard Deviation**	**Difference**
ESPEN	22.5	120	78.37	27.08	
INTAKE	3.54	47.8	16	11.98	**-62.37**

When it comes to the protein intake of the participants, according to ESPEN guidelines, the minimum protein requirement calculated was 48 g/ day and the maximum was 112.5 g/ day. When ISCCM guidelines were applied for the same, the calculated protein requirement was 48 g/ day, and the maximum was 112.5 g/ day. The actual protein intake of participants was recorded as a minimum intake of 4.56 g/ day and a maximum intake of 161.50 g/day with mean intake coming to that 28.39 g/ day which forms only 37% of the daily recommended requirement. There was a mean protein deficit of 48.45 g/ day.

When it comes to the fat intake of the participants, according to ESPEN guidelines, the minimum fat requirement calculated was 22.5 g/ day and a maximum of 120 g/ day with a mean requirement of 78.37 g/day. The actual fat intake of participants was recorded as a minimum intake of 3.54 g/ day and a maximum intake of 47.8 g/day with the mean intake coming to that 16 g/ day which forms only 33% of the daily recommended requirement. There was a mean fat deficit of 62.37 g/ day.

Table 3: Comparison of energy intake between the oral route of administration and nasogastric route of administration (P-value <0.001).

Route of Nutrition	**Number**
Nasogastric feeds	58
Oral feeds	86

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Route of Nutrition administration		
Recommended Average Energy Intake	**Oral Route**	**NASO-Gastric ROUTE**
ESPEN	1434	1422
ISCCM	1434	1422
Actual intake	751.5	477.9
e standard deviationof actual intake	211.9	132.8

Out of 144 participants, 60% (n= 86) were orally fed and 40% (n= 58) were fed via nasogastric tube. On comparing energy intake in oral and nasogastric routes of nutritional administration, participants who consumed orally had more mean energy intake of 751.5 kcal/day as compared to participants who consumed via nasogastric tube, with a mean intake of 477.9 kcal/day. There was more caloric consumption observed in the oral group as compared to the nasogastric group.

Table 4: Comparison of protein intake between the oral route of administration and nasogastric route of administration (P-value = 0.24).

Recommended Average Protein Intake (g/day)	**Oral Route**	**NASO-Gastric ROUTE**
ESPEN	76.6	76.6
ISCCM	76.6	76.6
Actual intake	33.2	21.7
The standard deviationof actual intake	29.66	13.15
Comparison of protein intake between the oral route of administration and nasogastric route of administration		
P- value= 0.0072		
Recommended Average Fat Intake (mg/day)	**Oral Route**	**NASO-Gastric Route**
ESPEN	79.01	27.68
Actual intake	12.05	14.24
Standard deviationof actual intake	8.21	14.24

On comparing protein intake in oral and nasogastric routes of nutritional administration, participants who consumed orally had more mean protein intake of 33.2 g/day as compared to participants who consumed via nasogastric tube, with a mean protein intake of 21.7 g/day. There was more protein consumption observed in the oral group as compared to the nasogastric group.

On comparing fat intake in oral and nasogastric routes of nutritional administration, participants who consumed via nasogastric route had more mean fat intake of 14.24 g/day as compared to participants who consumed orally, who had a mean fat intake of 12.05 g/day. There was more fat consumption observed in the nasogastric group as compared to the oral group.

Discussion

Nutrition of critically ill patients in the ICU is a crucial component of the treatment to reduce morbidity and mortality. Nevertheless, it tends to be neglected most of the time; preference is given to other options, such as aggressive pharmacological therapy and interventions available. Nutrition plays a vital role in helping the patient’s immune system, which is necessary for fighting the infection and thusaids in the early recovery of the patient.

This audit sheds light on the mismatch between the average nutritional requirement of the patients as per recommendations and the actual intake of nutrition by the admitted patient. In this audit, the calculated sample size was 384 participants, but due to covid pandemic, the sample size was recalculated as 144 participants. The food consumed by the participants was recorded after they completed 24 h of ICU admission for the next 24 h. After recording the data, it was broken down into energy, protein, and fat components, which were calculated using the National Institute of Nutrition book. This was then compared with the energy, protein and fat requirement calculated using standard guidelines from ESPEN and ISCCM in accordance with the patient's weight. On comparing the recommended energy intake with the actual energy intake in participants, collected data showed that, on average, the participants only met 43.8% of the energy requirement by standard guidelines and were deficient in energy. When participant’s protein intake was compared to standard guidelines, it showed that it met only 37% of the recommended intake. This pointed towards a protein deficit in diet consumption.

According to the ESPEN guidelines, the actual fat intake of the participants was less and only met 33% of the standard recommendation showing a fat- deficient diet too. When the data of comparison between routes of nutrition administration was analysed, it was found that 58 participants were given a diet via the nasogastric route and 86 participants got their diet via the oral route. Mean energy consumption in the oral route group (n= 751.5 Kcal/day) was more than that seen in the nasogastric route group (n= 477.9 Kcal/day). Mean protein intake in the oral group (n= 33.2 g/day) was more than that of the nasogastric group (n= 21.7 g/day). Mean fat intake in the oral group (n= 12.05 g/day) was less than that of the nasogastric route group (n= 14.24 g/day).

Overall, the above results imply that an unbalanced diet given to the study participants may lead to malnutrition in critically ill patients. Therefore, there is a need to pay particular attention to the diet of critically ill patients in the ICU, and they should have a diet plan customised to their needs.

Patients in the intensive care unit often have malnutrition as the patient suffering from an acute illness cannot move or swallow food. These patients frequently have muscle atrophy and malnutrition. Malnutrition can be exacerbated by advanced age and comorbidities. It is strongly linked to adverse outcomes, including higher ICU patient morbidity and mortality. Thus, nutritional support is essential for critically sick patients, which shall be early, and advanced EN formulations concentrated in proteins appear to ensure a higher survival rate.[6] In literature, Alberda et al. conducted a multi-centre study in which more than2770 ICU patients who were mechanically ventilated were taken as a study group. The decision of the best dietary prescription was left up to the discretion of the respective practitioner. They noted that the average adherence to nutritional recommendations for protein and calories was only 56% and 59.2%, respectively. They concluded that the reasons for these inadequate nutritional needs include lower dietary intake brought on by poor gastrointestinal tolerance or metabolic issues, as well as feeding withdrawal necessary by clinical examinations and blood tests.[7]

In our study, we compared the standard guidelines of the ESPEN and the ISCCM nutritional recommendations with the actual nutrition intake by the study participants. We found that, on average, study participants only met 43.8% of the energy requirement, 37% of the protein requirement and 33% of the fat intake recommended by the standard guidelines.

Wøien and Bjork (2006) conducted a study to determine if a feeding algorithm may make patients in intensive care receive better nutritional support. During the first three days after being admitted to the intensive care unit, nutritional data from 21 normally fed critically ill patients (controls) were gathered for this prospective study. Following the implementation of a nutritional assistance algorithm,nutritional information from the critically ill patients who participated in this intervention (intervention group, n = 21) was gathered. The total number of calories recommended vs. consumed at the start of enteral nutrition delivery, enteral vs parenteral nutrition, and the use and size of enteral feeding tubes were among the information gathered. The research supports that an algorithm for nutritional support enhanced the supply of nutrients to seriously ill individuals. Concerning enteral nutrient delivery, the algorithm performed best. The primary source of the effect was an earlier and faster increase in enteral nutrition supply, which was carried out by nurses based on better doctor orders. They opined that parenteral and enteral nutrition might help patients receive the right amount of nourishment.[8]

With the results obtained from our study, it is imperative that we also should implement a feeding algorithm in ICU to provide better nutritional support to the patients. Reid (2006) conducted a prospective observational study to assess the nutritional support provided to critically ill patients and compared the same to estimated requirements. They found that the study participants received 81% energy and 76% protein intake compared to the estimated requirements. They concluded that adequate nutritional intake is present in the study group.[9]

In contrast, our study points toward an unbalanced diet being provided to the study participants. Krishnan et al. (2003) conducted a prospective cohort study comparing the caloric intake of critically ill patients with recommendations of the American College of Chest Physicians. The study was conducted in the ICU of two teaching hospitals, and participants were adults with an ICU stay of at least 96 h. With the data collected, they found that the average caloric intake among 187 participants was meeting only 50.6% of the recommendations made by the American College of Chest Physicians. They concluded that study participants were underfed when compared to recommendations by the American College of Chest Physicians.[10] This study has similar findings to that of our study.

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The majority of the studies quoted had a longer duration of study as compared to our study, which may imply that a longer duration of stay may gradually improve nutrition intake or help in better planning of nutrition administration in critically ill patients, thus improving the overall outcome. The major strength of our study is a resource-accessible study that is simple to replicate. It also provides an understanding of the mismatch present between the daily requirement and actual consumption of adequate nutrition and points toward a need for a diet kitchen which will provide a patient-specific diet. The most obvious limitation of our study is that a more considerable duration of the study period is required to study the extent of nutritional deficiency in patients and there is also a need to study the clinical outcomes of nutritional deficiency in critically ill patients. We had considered the calories, proteins, and fats of cooked items as we were unable to assess the raw material used in the diet provided.

Conclusion

We conclude that when provided to critically ill patients, adequate nutritional support will help in the early recovery of patients, decrease morbidity and mortality rates and reduce the overall length of hospital stay. Thus, more emphasis may be needed to improve nutrition delivery to critically ill patients. There is a disparity recorded between the recommended nutritional intake and the actual intake by the patient. If continued for a longer duration, this might lead to malnutrition in critically ill patients, which indirectly may increase the morbidity and mortality in ICU care.

Authors Contribution

Study concept, Study protocol, writing of the first draft of the manuscript: NS, Data analysis: PH, Interpretation of data: MRK, critically editing and revising the manuscript and final approval: all authors.

Declaration

None of the authors has any financial interest related to the conduct, interpretation, or presentation of this study.

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