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Are Enteral Feeding Adequate for Intensive Care Unit (ICU) Patients? A Cross-Sectional Study at AL-Khor Hospital – Hamad Medical Corporation – State of Qatar

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1. Abstract

1.1. Background

Malnutrition is a broad term that describes any imbalance in nutrition. In critical care, malnutrition rates vary between about 39% and 50% and it has a significant negative impact on a patient's ability to respond to medical treatment. Nutritional therapy plays a crucial role in the management of critically ill patients. These patients are provided with intensive care medicine to prevent further complications, including malnutrition, disease progression, and even death. Enteral nutrition is known to counteract the metabolic changes associated with critical illness that increase the risk for serious complications and poor clinical outcomes. Inadequate delivery of nutritional support and underfeeding persist in intensive care units despite the availability of guidelines and current research for best practice. Aims: This study aimed to prospectively study the adequacy of energy and protein intake of ICU patients receiving enteral feeding and its relationship with malnutrition risk. Methods: This cross-sectional study assessed thirty-five ICU patients on enteral feeding at AL-Khor hospital, state of Qatar, over five months from July to November 2024. The data were collected from patients' medical records, ICU nursing sheets, and clinical dietitian notes. Nutrition Risk Index (NRI) was used to assess nutritional status. Results: Among 35 patients analyzed, 37.2% & 25.7% had inadequate intake of energy and protein, respectively. Two-thirds of them had low albumin levels (< 35 mg/L). One-third, 33.3%, and approximately two-thirds, 62.8%, of patients were at severe and moderate risk of malnutrition, while only 5.5% were at no risk of malnutrition. 14.3% of patients are underweight (BMI < 18.5kg/m²). Conclusion: The present findings indicate that the current provision of nutritional care for ICU patients is inadequate to meet their dietary requirements and maintain their nutritional status. Malnutrition has a significant negative impact on patients' outcomes, and adequate delivery of enteral nutrition counteracts the metabolic changes associated with critical illness.

2. Introduction

Critically ill patients in the intensive care unit (ICU) are at risk of malnutrition. Energy, protein, and other nutrients should be supplied to patients through enteral feeding. The patient's underlying medical condition, nutritional status, and available route of nutrient delivery are key determinants in considering the type and amount of nutritional support [1]. Minimizing feeding technique–related complications, providing optimal nitrogen balance, maintaining lean body mass, and achieving better clinical outcomes can be achieved by administering nutrients optimally [2,3]. Preserving lean body mass, reducing metabolic responses to stress, preventing oxidative cell injury, and promoting immune responses, enteral nutrition in the critical care setting is crucial. Tropical feeds may maintain gut function, but in high-risk patients, more than 50-65% of the goal energy needs may be required to prevent further complications and mortality, as contended by the American Society for Parenteral and Enteral Nutrition (ASPEN). The average intake of patients in intensive care units (ICUs) in Canada was reported as 56% of calorie needs and 56.7% of protein needs by [4]. High gastric residual volume, patient discomfort, medical procedures, position changes by nursing, and technical issues with feeding access are the most common reasons leading to enteral feeding being stopped or held in critically ill patients. The average duration of enteral feeding interruptions is more than five hours per patient day, as reported [5]. The use of prokinetic medications, limiting repositioning, correcting gastric residual volume (GRV) measurements and protocols, using post-pyloric feedings, and introducing nutrition support protocols are strategies that have been proposed to resolve the obstacles in providing adequate nutrition in the ICU [5]. The prevalence of Malnutrition among hospitalized patients was reported to be 30-50% [6]. Enteral nutrition frequently fails to deliver sufficient nutritional requirements to the critically ill patients [7-9] reported that on average 37–68% of patients are fed less than their dietary requirements with enteral nutrition [10] reported that the average adequacy of energy intake in patients was 52% in an international multicenter observational study conducted in 158 ICUs from 20 countries [10]. Inadequate enteral feeding is a serious problem in critically ill patients because it leads to severe complications such as protein depletion, loss of lean body mass, including cardiac and respiratory muscles, delayed wound healing, impaired immune system, organ failure, and increased hospital length of stay [11-13].

Several side effects of malnutrition, such as impaired immune function, loss of lean body mass, hinder wound healing, lengthen hospitalization, increase health care costs, and increase mortality, have been reported [6]. Therefore, to improve patient outcomes, it is imperative to prevent malnutrition. The interruption of tube feeding regimens for medical procedures, perceived gastrointestinal disturbances, and nursing needs to move the patient to avoid the development of pressure ulcers, as well as to clean the patient and their linens, are the primary obstacles to meeting the nutritional needs of patients receiving enteral nutrition [7]. Monitoring and evaluating nutritional intake are important factors in determining the adequacy of nutritional support and delivery. The delivery of enteral nutrition in critically ill patients in the USA is affected by multiple factors, including patient-related factors (age, gender, severity of disease, nutritional status, mechanical ventilation), tube location, feeding type and concentration, administration rate, initiation time, frequent interruption of enteral nutrition, and under-prescription by physicians [14-19]. Under-prescription of enteral nutrition and frequent disruption of enteral nutrition are considered important causes of underfeeding in the critically ill [9]. In Qatar, there is limited data about the adequacy of enteral nutritional intake. The development of dietary interventions to improve clinical outcomes and survival in enterally fed patients in Qatar requires identifying the adequacy of enteral feeding among ICU patients and the factors that affect adequate intake. Al-Khor Hospital – Hamad Medical Corporation (HMC) currently utilizes a 20-hour rate-based system protocol for continuous tube feedings. Clinical dietitians calculate energy and protein needs, while the selection of the appropriate tube feeding formula determines the goal volume. The physician then orders the delivery rate. It is anticipated that there will be an average of four hours of interrupted feeding due to medical procedures, patient repositioning, perceived intolerances, and equipment malfunctions. Therefore, the rate is infused for 20 hours per day if uninterrupted. The current rate-based protocols for enteral nutrition in critical care settings are inadequate for meeting patient nutritional needs, as reported by other research [7, 20, 21].

3. Methods

A prospective study was conducted in the adult ICU at AL-Khor General Hospital in the state of Qatar, from July to November 2024. The eligibility criteria for patients in the study were: 18 years or older, expected to be on enteral tube feeding nutrition for at least four days, and those receiving parenteral or oral feeding as the main energy source were excluded. Thirty-five patients who met the inclusion criteria and received enteral nutrition for at least the first four days after initiation were included in the analysis.

3.1. Adequacy of Energy and Protein Intake

Energy and protein intake were obtained daily from the patient's medical record. Energy intake was calculated as the volume of enteral formula received multiplied by formula density [22]. Enteral feeding adequacy was categorized as adequate when total energy intake was ≥75% of the requirement, and inadequate when total energy intake was < 75% of the requirement [22,8]. The Harris–Benedict equation (HBE), with a stress factor applied at enrollment, was used to calculate the energy requirements [23, 24]. For obese patients (BMI ≥ 30), adjusted body weight and the lowest value in the stress factor range were used to calculate the requirements [25]. Protein intake was obtained by daily review of the patient's medical records. Protein intake by the enteral route was calculated as the volume of enteral formula received multiplied by the protein content of the formula. Protein adequacy was categorized as adequate when total protein intake was ≥75% of the requirements and inadequate when intake was < 75 % of the requirements [22]. The American Dietetic Association's equation (ADA, 2000) was considered a reference for calculating protein requirements [26]. Inadequacy of energy and protein intake was caused by patient-related factors: (age, primary diagnosis), nutritional status [serum albumin, C-reactive protein (CRP), body mass index (BMI)], severity of disease and mechanical ventilatory support [18,27] and feeding method factors include type of feeding formula: an isocaloric formula or a calorically dense formula and the size of the feeding tube either 16 or 18 French feeding tubes [28,29]. The time to initiate enteral nutrition is another factor that affects the adequacy of enteral feeding, defined as the total time from admission to the ICU to the initiation of enteral feeding. The holding time of the feed, which is the duration between holding and restarting enteral feeding, is considered one of the factors that interrupt enteral nutrition [30]. The purpose of this study is to assess the adequacy of energy and protein in patients receiving enteral nutrition using the current 20-hour rate-based protocol in the ICU at AL-Khor Hospital-HMC in Qatar, and its relationship to malnutrition risk.

3.2. Procedures

Once the physician prescribes the enteral feeding order, the clinical dietitian is informed, calculates the requirements, discusses with the physician, and approves the order. Commercially prepared enteral feeding will be implemented as the ICU enteral feeding protocol. Starting time and gastric residual volume at each feeding time were recorded by the nurse. Patient-related data, including initiation time, holding time, feeding method, energy, and protein prescribed and received via enteral route, were obtained daily by reviewing each patient's medical records.

This study was approved by the quality committee of Al-Khor Hospital.

3.3. Data Analysis

Data were analyzed with SPSS 15.0 (SPSS Inc., Chicago, IL, USA). < 0.05 was set as a level of significance. Independent T-test and chi-square tests were used for comparison between adequate and inadequate enteral feeding. Based on the percentage of energy and protein requirements met, Patients were categorized into two groups: adequately fed and inadequately fed. The adequacy of energy and protein intake frequency was assessed, and the percentage of patients in each group was calculated.

4. Results

Out of the 35 patients, 22 patients (62.8%) had inadequate energy; 13 patients (37.2%) had adequate energy intake (Figure 1a). Three-fourths (74.3%) of patients had sufficient protein intake, and 9 patients (25.7%) had inadequate protein intake during the entire study period (Figure 1b).

Twenty-four patients (68.5%) were malnourished according to mean serum albumin levels [< 35 g/dl], and only 11 patients (31.5 %) were well nourished Figure 2a. Based on the nutrition risk index (NRI): Fourteen patients (40%) were at severe risk of malnutrition, 19 patients (54.3%) were at moderate risk of malnutrition, and only 2 patients (5.7%) were at no risk of malnutrition Figure 2b. Based on the body mass index, approximately half of the patients (48.6%) were overweight, and only one patient (2.8%) was obese. Meanwhile, five patients (14.3%) were underweight, and 34.3% of patients were of a normal weight (Figure 2c). Most patients (24, 68.6%) received isocaloric enteral feeding formulas, 7 patients (20%) received hypercaloric formulas, and 4 patients (11.4%) received hypocaloric formulas. The starting time of enteral feeding was 2.5 days (range 1 – 4) after ICU admission. Inadequate energy intake is correlated with the severity of malnutrition. Only 2 patients (5.7%) had an adequate energy intake, with a severe risk of malnutrition, while 11 patients at severe risk of malnutrition (31.4%) received inadequate energy intake (Figure 3a). On the other hand, 6 patients (17.1%) at moderate risk of malnutrition received adequate energy intake, whereas 19 (54.3%) patients at moderate risk of malnutrition received inadequate energy; the adequacy of energy intake was significantly correlated with the severity of malnutrition risk (P = 0.001). Malnutrition risk was positively correlated with energy intake; 85.7% of inadequate energy intake were at severe and/or moderate risk of malnutrition compared with 22.8% of adequate energy intake (P = 0.001), Figure 3a. The adequacy of protein intake was significantly correlated with the risk of malnutrition; 82.8% of those with inadequate protein intake were at moderate or severe risk of malnutrition compared with 28.5% who received adequate protein intake (P< 0.05), Figure 3b.

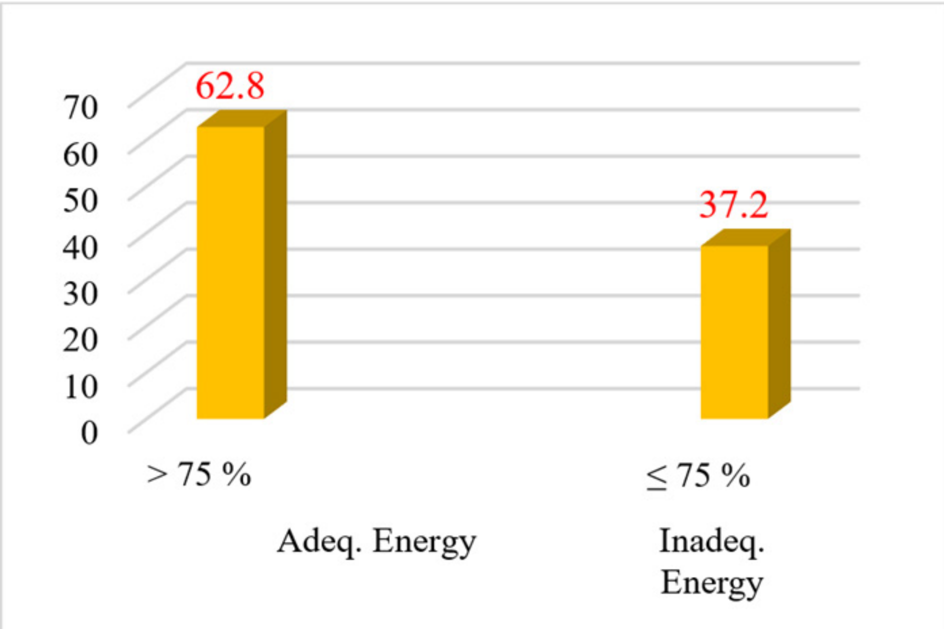

Figure 1a: Adequacy of Energy Intake.

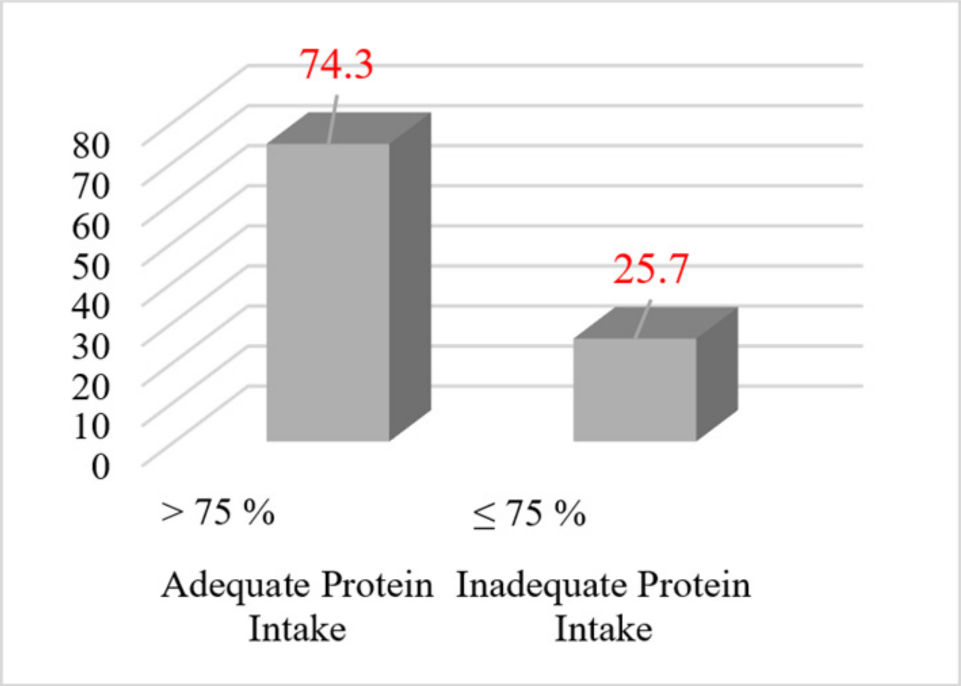

Figure 1b: Adequacy of Protein Intake.

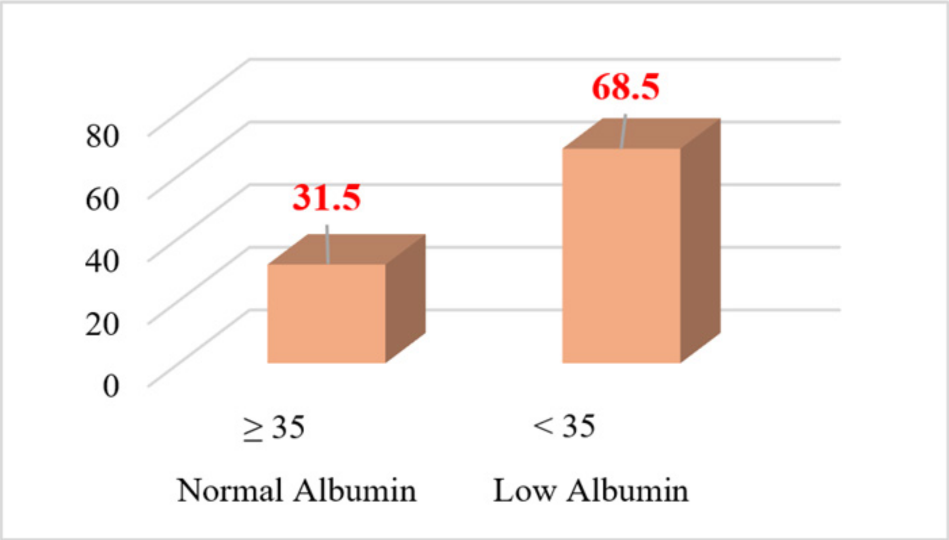

Figure 2a: Malnutrition based on Albumin Level.

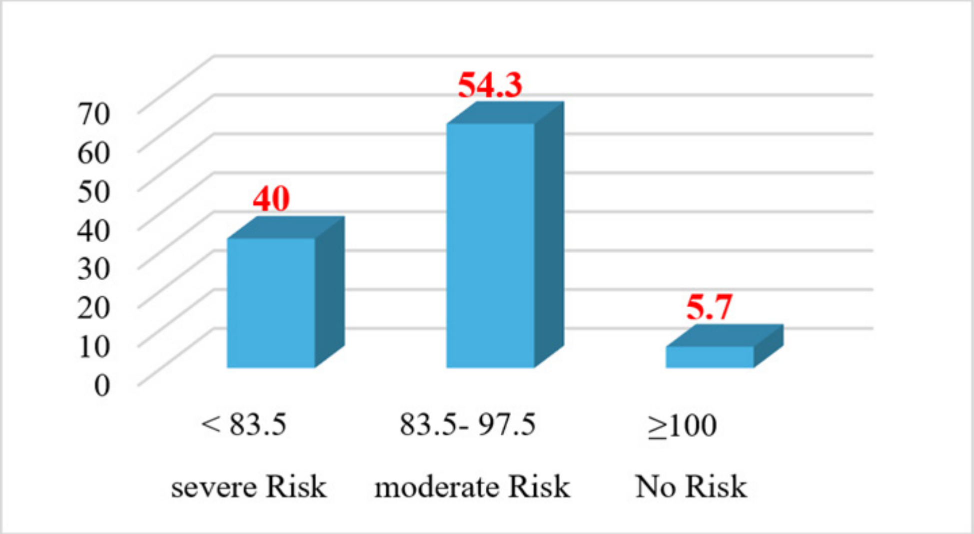

Figure 2b: Malnutrition based on Nutritional Risk Index (NRI).

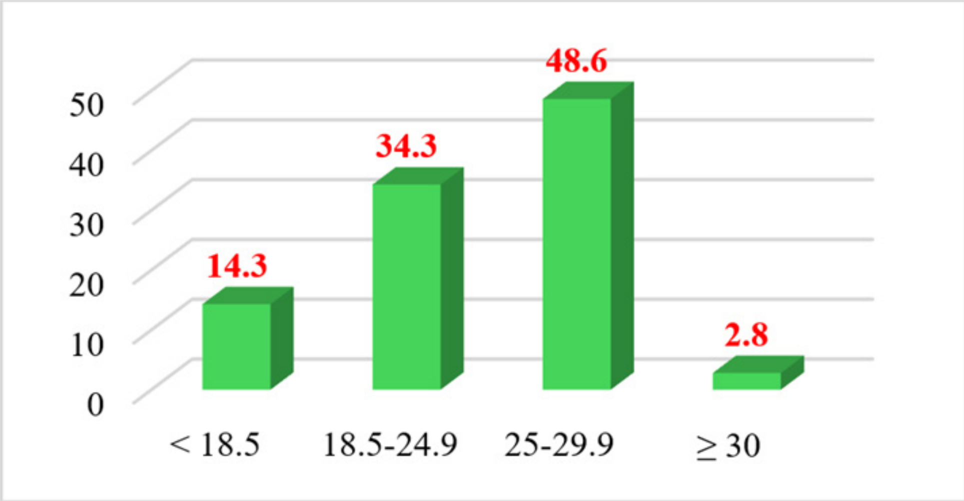

Figure 2c: Malnutrition based on Body Mass Index (BMI).

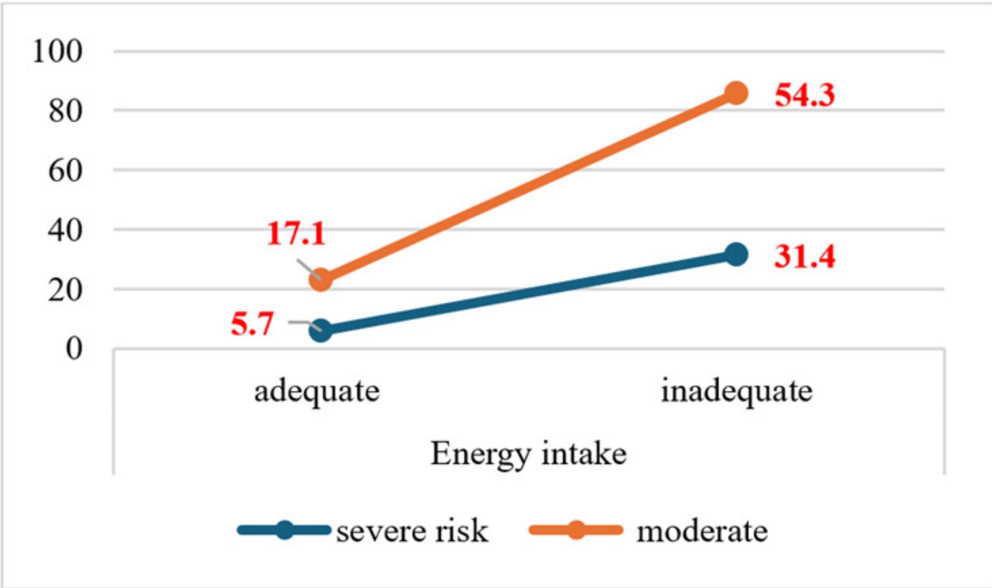

Figure 3a: Adequacy of energy intake with risk of malnutrition.

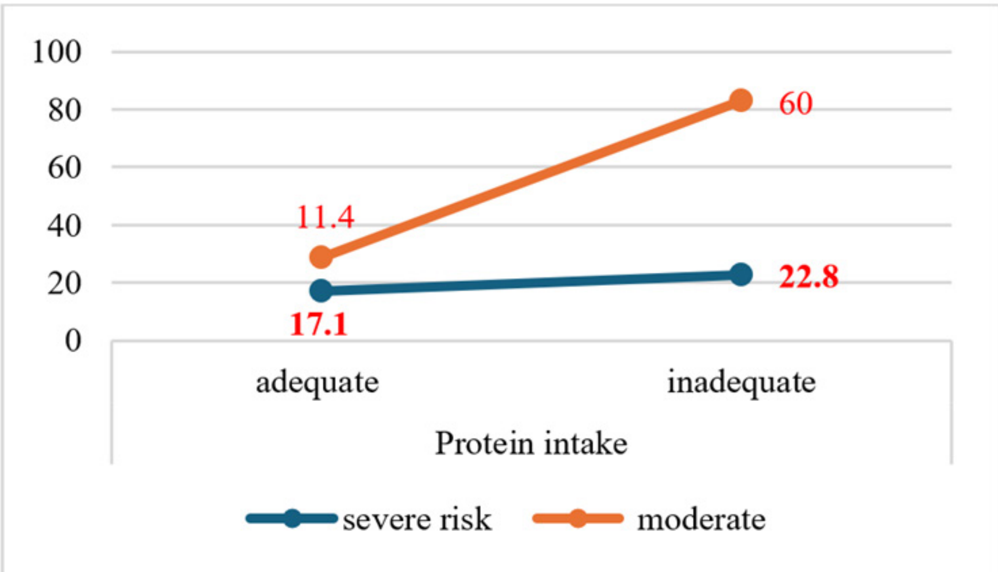

Figure 3b: Adequacy of protein intake and the risk of malnutrition.

5. Discussion

This is the first Qatari cross-sectional study of such scale assessing enteral feeding adequacy in ICU patients and its relation to malnutrition risk. The results demonstrate that nutritional care management for patients receiving enteral feeding in the ICU was inadequate for energy and protein. Adequate nutrition delivery is imperative in critically ill patients to reduce morbidity and mortality [31]. Obstacles to achieving sufficient energy and protein delivery in critically ill patients include poor appetite, increased metabolic demand, gastrointestinal intolerance, and difficulty swallowing [32]. Although initiating tube feeding in these patients may appear to ensure adequate nutrition, research suggests that most critically ill patients on tube feeding do not meet nutritional needs [33]. Some identified reasons for inadequate tube feeding delivery include stoppage time for procedures/surgeries, tube feeding intolerances such as vomiting or high residuals, and poor compliance with tube feeding protocols [33]. Interruptions in tube feedings result in underfed patients because the protocol in most hospitals is to deliver enteral nutrition at a constant hourly rate with no way to make up for any stoppage time; in other words, total volume to meet nutritional needs is divided by 24 hours in a day. A potential solution to this obstacle is a volume-based feeding protocol in which the patient is prescribed a total volume of tube feeding throughout the day rather than a set volume at an hourly rate [33]. In this protocol, the hourly rate can be adjusted if the patient has any interruptions, thereby ensuring the goal volume and, thus, goal energy and protein intake are met. This protocol, however, places a greater burden on the nursing staff to adjust rates as needed. Some hospitals have attempted to improve tube feeding delivery by calculating the goal rate over fewer than 24 hours to account for stoppage time or increasing the goal volume by a percentage to make up for stoppage time [34-36]. The current policy at AKH hospital in Qatar is to calculate the goal tube feeding rate over 20 hours to account for an expected four hours per day of downtime per patient. The purpose of this study was to determine if the current protocol is sufficient to meet nutritional needs or if a volume-based feeding protocol should be considered to improve tube feeding delivery. Although exact percentages continue to be debated, ASPEN guidelines for critical care medicine indicate that tube-fed patients who receive >80% of estimated energy and protein needs have better clinical outcomes than those who receive less [37]. Three-fourths (62.8%) of ICU patients at AL-Khor hospital received more than 75% of their prescribed calorie requirements, and 74.3% of those patients received 75% of their protein requirements via tube feedings over the study period (3 months). These results are consistent with other similar studies investigating tube feeding delivery in the ICU setting, which reported an average of 60-65% of energy and protein needs being delivered [7, 33, 38]. Together, these studies suggest that current tube feeding protocols are insufficient to meet ASPEN guidelines of exceeding 80% of goal nutrition needs. As expected, tube feedings were interrupted in more than half of all patients due to identifiable reasons. Delivery of nutrients is more than a goal, given the 20-hour delivery policy at AL-Khor Hospital. This is because some patients may receive the recommended volume/hour for more than 20 hours [36]. Some studies also found some incidence of overfeeding in a study like this one. In a 24-bed ICU within a similarly sized 220-bed hospital, a 20-hour tube feeding policy was implemented to assess its impact on tube feeding delivery. The research team found that a 20-hour feeding protocol improved the average delivery of tube feeding from 79% in the control group to 97% in the experimental group. However, it should be noted that the study lasted for only six weeks and relied solely on nursing documentation in the electronic medical record rather than examining pumps for actual tube feeding volume delivery. A large margin of human error would be expected in this method of obtaining tube feeding delivery volumes, as it requires nurses to record tube feeding intake every hour for 24 hours and does not account for short periods of tube feeding interruptions. To our knowledge, this study is the first to identify energy and protein adequacy of enteral feeding among intensive care unit patients in the state of Qatar. Our findings showed that 62.8% and 74.3% of patients met 75% of their energy and protein requirements during their enteral feeding duration. These results are consistent with a study by O'Leary, Kelley et al. (2005) that found 68% of patients who were on enteral feeding had inadequate energy and protein intake [8].

5.1. Acknowledgments

We thank all the participants and all the nursing staff for taking part. Thanks also to those involved in planning this study.

5.2. Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest in the research, authorship, and/or publication of this article.

Conclusion: ICU patients do not receive adequate energy and protein when fed enterally. This study revealed two primary reasons for underfeeding energy: under-prescription of energy and prolonged interruption of prescribed enteral nutrition. Despite underfeeding being a major concern in the enteral feeding of critically ill patients, there is unanimous agreement that nutritional support is vital for positive clinical outcomes for patients. The continuous evaluation of enteral nutritional intake adequacy is crucial for early detection of underfeeding and timely intervention to mitigate problems with the provision of adequate nutrition. Evaluation of enteral nutritional inadequacy and identifying the causative factors provides a foundation for interventions designed to improve enteral nutrition practices. Enteral feeding protocols should be well-developed to prevent and/or compensate for the interruptions of enteral feeding. The protocols need to be standardized for the prescription of enteral nutrition and include monitoring the adequacy of enteral intake in ICU patients.

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