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Original Article

Association between Dietary Intake and Nutritional status of Critically Ill Non-Invasive Ventilated Adult Patients in Malindi Referral Hospital, Kilifi County, Kenya

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Dietary intake, Malnutrition, Critically ill Non-invasive ventilated, Nutritional status, Malindi Sub-County Referral Hospital.

ABSTRACT

Background: Malnutrition among critically ill non-invasive ventilated adult patients is a significant concern, particularly in resource-limited settings such as Malindi Sub-County Referral Hospital, Kilifi County, Kenya. This study determines the association between dietary intake and nutritional status among these patients. Dietary intake adversely influences nutrition status outcomes. **Materials and Methods:** A cross-sectional, with an analytical component, study was conducted between July 2023 and May 2024 at Malindi Sub-County Referral Hospital. The study included 108 critically ill adult patients on non-invasive ventilation between 24 to 48 hours of admission, but only 103 were included in the final analysis. Five participants experienced acute complications, requiring transfer to intensive care for invasive ventilation. Participants were selected using the two-step purposive sampling. The first step was selecting all critically ill adult patients for study consideration. Step two was selecting all critically ill Non-invasive ventilated adult patients for inclusion in the study. The data was collected using a structured questionnaire with a component of 24 24-hour recall tool for dietary intake assessments. Descriptive and inferential statistical analyses were performed using SPSS 23.0. **Results:** The study found that 66% of the participants were severely malnourished (BMI < 18.5 kg/m²). The average calorie intake was 950 ± 471.8 Kcal, and 88.3% of participants consumed less than or equal to 15 grams of protein daily. There was a significant association between low dietary intake and malnutrition, with malnourished patients consuming fewer calories (M = 918.37 Kcal) and protein (M = 10.50 g) compared to their non-malnourished counterparts. Patients receiving specialized enteral diets or with a recommendation for nil per oral were significantly more likely to be classified as malnourished based on their SGA status (specialized enteral diets: OR = 6.852, $\chi^2 = 4.298$, $p = 0.036$; nil per oral: OR = 2.161, $\chi^2 = 8.070$, $p = 0.005$), indicating a strong link between these interventions and the risk of malnutrition. **Conclusion:** The study highlights a high prevalence of malnutrition among critically ill non-invasive ventilated adult patients, primarily due to suboptimal caloric and protein intake. Optimal nutritional interventions are necessary to enhance the dietary intake and overall nutritional status of these patients.

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INTRODUCTION

Malnutrition among critically ill adult patients remains a life-threatening issue that significantly negatively impacts patient outcomes (1). Critically ill adult patients on non-invasive ventilation have an increased risk of malnutrition due to the complex interplay of factors, which include increased metabolic demands, altered gastrointestinal function, and inadequate nutritional intake (2). Malnutrition among these patients contributes to prolonged length of stay in the hospital upon admission, higher healthcare costs, a high chance of morbidity, and increased mortality rates (3, 4). The physiological stress of critical illness often leads to a hypermetabolic state and accelerated catabolism, which exacerbates the breakdown of muscle and fat reserves to meet the body's energy needs (5). The catabolic response is further compounded by common symptoms among critically ill patients, such as gastrointestinal dysmotility, nausea, vomiting, and discomfort caused by non-invasive ventilation which reduces the patient's ability to consume adequate calories and protein (6).

Malnutrition in critically ill patients is often under-recognised and under-treated, despite its well-documented negative impact on clinical outcomes (7). Many non-invasively ventilated adult critically ill patients fail to meet their nutritional requirements, resulting in rapid deterioration of nutritional status (8). In critically ill settings, proper nutritional support plays a crucial role in patient recovery, immune function, and overall prognosis. Across sub-Saharan Africa, the prevalence of malnutrition among hospitalised adults varies widely, with estimates ranging between 8% and 85% depending on the tools used for assessment (9). In a multi-centre study in Kenya, 66.2% of patients were found to be at risk of malnutrition upon admission, and this number increased to 71.2% by discharge, indicating a progressive decline in nutritional status during hospitalisation (10). This deterioration has been linked to prolonged hospital stays and increased mortality. The current clinical nutrition guideline in Kenya was formulated in 2010 and emphasises the need for tailored nutritional interventions to meet the individualised needs of critically ill patients (10). However, the guideline is silent on critical care nutrition among critically ill non-ventilated patients in settings like Malindi Sub-County Referral Hospital with a 5 critical Care Unit and one high independent unit. The facility has challenges such as limited resources, insufficient trained personnel, and inadequate monitoring of nutritional intake, which often lead to suboptimal nutrition management. Data on the prevalence of malnutrition among critically ill adults on non-invasive ventilation in critical care settings is therefore urgently required to help in planning with limited capacity (11). This scenario also highlights the critical need to understand the dietary intake patterns and their association with the nutritional status outcomes of critically ill patients on non-invasive ventilation.

Some recent studies have shown that critically ill patients on Non-invasive ventilation who fail to achieve their nutritional targets in terms of caloric and protein intake are more likely to experience severe malnutrition, delayed recovery, and higher rates of complications (12, 13). Inadequate protein intake is associated with muscle wasting and impaired immune function, while insufficient caloric intake can prolong the hypermetabolic state, worsening overall health outcomes (15). Despite the clear link between dietary intake and nutritional status, there remains a significant gap in the literature regarding the specific impact of nutrition on critically ill patients under non-invasive ventilation in low-resource settings. This study seeks to fill this gap by examining the association between dietary intake and nutritional status outcomes among critically ill non-invasive ventilated adult patients at Malindi Sub-County Referral Hospital. The study aimed to assess the dietary intake of critically ill non-invasive ventilated patients in Malindi Sub-County Referral Hospital, determine the nutritional status of these patients using Body Mass Index (BMI) with Subjective Global Assessment (SGA) component and analyze the association between dietary intake (caloric and protein consumption) and the nutritional status outcomes of the patients.

MATERIALS AND METHODS

Study Area

The study was conducted in Malindi sub-county referral hospital located in Malindi constituency in Kilifi County, Kenya. According to the Kenya Bureau of Statistics, report 2019, the Malindi Sub-County has the highest population size of 333,226 compared to the 8 sub-counties in Kilifi County. According to the Kenya Bureau of Statistics report, 2019 Malindi Sub-County referral hospital is the only health facility within the County with a newly constructed Critical Care unit with a bed capacity of 5 beds serving. The newly constructed critical Care unit was not fully operational during the study, despite being the only unit serving the entire county, which has a population size of 1,453,787, with a projection of 1,858,772 by the year 2027 (Kenya Bureau of Statistics, 2019). Also, the facility receives critically ill adult patients requiring Non-invasive ventilation from the neighbouring counties such as Taita Taveta, Tana River and Lamu. The facility offers specialised services where critically ill Non-invasive ventilated adult patients are admitted to the high independent unit, renal unit, burns unit, surgical and medical wards in order to accommodate the demand.

Study Design

The study adopted a cross-sectional study design to collect and analyse quantitative data between July 2023 and May 2024. This design was particularly useful for identifying dietary intake and associated nutritional outcomes among the study participants.

Study Population

The study population was critically ill adult patients above 18 years old admitted to the Malindi sub-county referral hospital.

Eligibility Criteria

The study included critically ill Non-invasive ventilated adult Patients who were above 18 years. These were patients who had been admitted to high independent units, Medical wards, and specialised units within 24 to 48 hours at Malindi Sub-County Referral Hospital. Written informed consent was obtained from them or from their legal guardians in order to participate in the study.

Sampling Technique

Kilifi County and Malindi Sub-County Referral Hospital were purposively selected as the study site. This was followed by two stages of purposive selection of critically ill adult patients. After the first step, 108 critically ill Non-invasive ventilated adult patients above 18 years old admitted to the units were purposively selected for inclusion in the study. The sampling considered the patients

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who were within 24 to 48 hours of admission for the purpose of data collection. The data collection exercise was started after patients read and agreed willingly to give consent to participate in the study. The initial sample size was calculated using the Fisher et al. (1983) formula, which is widely acceptable for large populations, typically assuming a **95% confidence level**, a **5% margin of error**, and greater than **80% statistical power**. This produced an initial estimate of **384 participants**, designed to reduce the risk of **Type II errors** and ensure the study could detect meaningful effects if present. However, given that non-invasive ventilation patients are a small population for this study, a finite population correction was applied to adjust the sample size accordingly. This adjustment reduced the required sample size to **108 participants**, aligning the study's design with the available population size while maintaining the desired statistical power and confidence levels.

Data Collection Instruments and Procedure

Data for this study was collected using a structured questionnaire with components of the standard Nutrition Risk Screening tool- 2002, Patient-generated Subjective Global Assessment tools, which were adopted and modified for the purpose of collecting data for nutrition status assessment. The 24-hour dietary recall tool was selected for use in this study to assess energy and protein intake among critically ill non-invasive ventilated adult patients. This tool has been proven effective in assessing the nutritional status and dietary intake of critically ill patients, as evidenced by its application in similar contexts. According to Bakshi *et. al* (14), nutrition screening and assessment tools, including the 24-hour dietary recall, are widely used in intensive care settings to accurately capture dietary intake and ensure proper nutritional management for patients with critical conditions. Their effectiveness in these settings is supported by their ability to provide detailed insights into a patient's recent dietary habits, essential for managing the nutritional needs of critically ill patients.

Data Analysis and Management

Data were analysed using the Statistical Package for Social Sciences (SPSS 23.0) Software. Descriptive statistics were used to analyse and present data on the dietary intake and nutritional status of the patients. T-test statistics were used to perform inferential statistics to compare the dietary intake and nutritional status of the patients.

Ethical Considerations

The study was reviewed and approved by the Kenyatta University Health Ethics Committee-Ref No: PKU/2781/11906. A research permit to conduct the study was obtained from the National Commission of Science, Technology and Innovation (NACOSTI), Ref No: 612675. Other approvals were sought from the Ministry of Health, Kilifi County. Permission to conduct the study was obtained from the hospital administrator. The researcher complied with the ethical guidelines and standards for conducting research on human subjects. The researcher obtained written informed consent from the study participants. The risks and benefits of participating in the study were explained to the participants. The researcher ensured privacy and confidentiality of the data and information obtained from the participants, and no data on personal identifiers was collected. Participation in the study was purely on a voluntary basis.

RESULTS AND DISCUSSION

Socio-Demographic Characteristics of the Participants

As summarised in Table 1, the results show a relatively balanced distribution of the gender, with males comprising 54.4% (n=56) and females 45.6% (n=47). The marital status shows that the majority of the participants were married at 56.3% (n=58), while 28.2% (n=29) were single. In terms of their education level, those with tertiary education constituted 19.4% (n=20), secondary education 26.2% (n=27), primary education 26.2% (n=27), and 28.2% (n=29) did not have any basic education. The religious affiliation of the participants was predominantly Christian at 51.5% (n=53), while Muslims were 41.7%

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(n=43). Regarding the participants' professional status, the largest group, 56.2% (n=58), were self-employed individuals, followed by salaried employees at 29.2% (n=30) and those in casual employment at 14.6% (n=15).

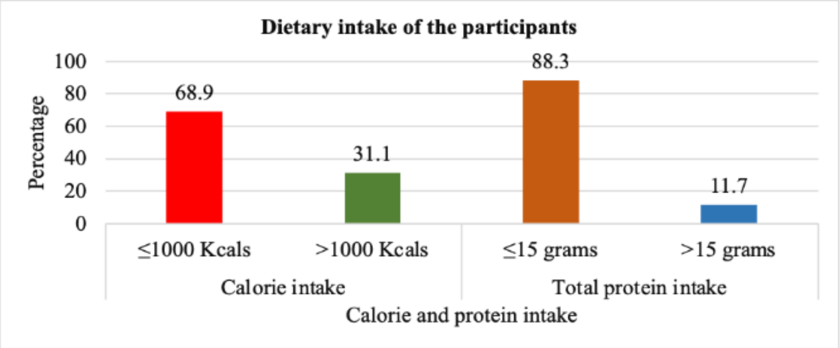
Table 1: Socio-demographic Characteristics of the Participants.

	N(103)		
Characteristics	**Category**	**n**	**%**
Gender of the patient	Male	56	54.4
	Female	47	45.6
Marital status	Married	58	56.3
	Single	29	28.2
	Windowed/ Divorced	16	15.6
	Tertiary education	20	19.4
Highest education level attained	Secondary education	27	26.2
	Primary education	27	26.2
	No basic education	29	28.2
Religion	Christian	53	51.5
	Islam	43	41.7
	Hindu and others	7	6.8
Profession	Salaried employed	30	29.2
	Casual employment	15	14.6
	Unemployed/Self-employed	58	56.2

Dietary Intake of the Participants

The dietary intake data of the participants for calories shows that the majority of participants (68.9%) consumed less than or equal to 1000 Kilocalories, while 31.1% consumed more than 1000 calories, and the mean total calorie intake was 950 ± 471.8 Kcal. In their total protein intake majority of participants (88.3%) consumed less than or equal to 15 grams of protein, while only 11.7% consumed more than 15 grams of protein. The mean total protein intake was 11.6 ± 5.1 grams. There was a statistically significant difference in the means from total calorie intake (t (101) = -1.409, p = 0.045) between the malnourished participants (M = 918.37 Kcal, SD = ±486.31 Kcal) and those who were not malnourished (M = 1,083.20 Kcal, SD = ±389.03 Kcal). This indicates that malnourished participants consumed fewer calories on average compared to those who were not malnourished. The results equally indicated a statistically significant difference from the means of total intake of protein and BMI status (t (101) = -0.062, p = 0.039). The findings also indicated a statistically significant difference between (t (101) = -1.179, p = 0.018) total intake of protein between malnourished (M =10.50g, SD = ±4.45g) and non-malnourished participants (M = 11.94g, SD = ±7.05g). This implies that malnourished individuals had lower average protein intake compared to non-malnourished individuals. The data was summarised as shown below:

Figure 1: Calorie and Protein Intake



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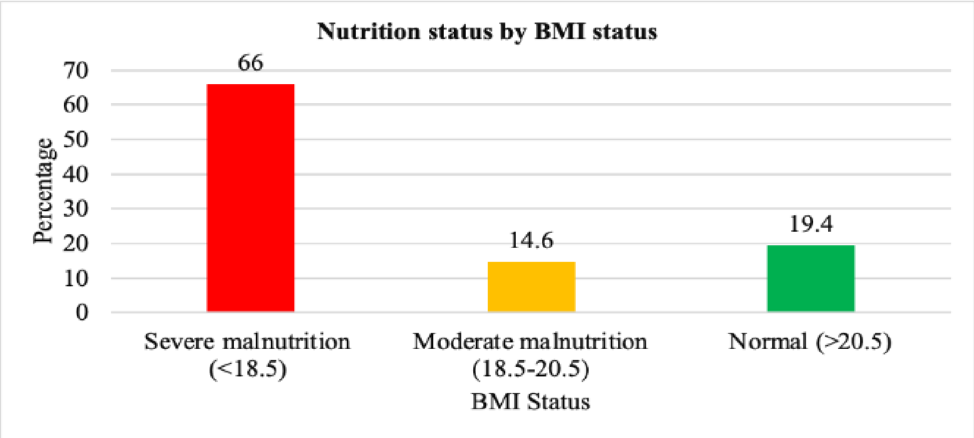
Nutrition Status of the Participants

Nutritional Status by BMI Categorisation

Figure 2 shows the nutritional status of patients categorised by their BMI status. A significant majority, 66%, of the participants were classified as severely malnourished, with a BMI of less than 18.5 Kg/m^2. A proportion of 14.6% of the participants had moderate malnutrition with their BMI ranging between 18.5 to 20.5 Kg/m^2. However, 19.4% of the participants had a normal nutritional status, with a BMI >20.5 Kg/m^2 at a p=0.001. This data highlights a notable prevalence of severe malnutrition among the patients assessed.

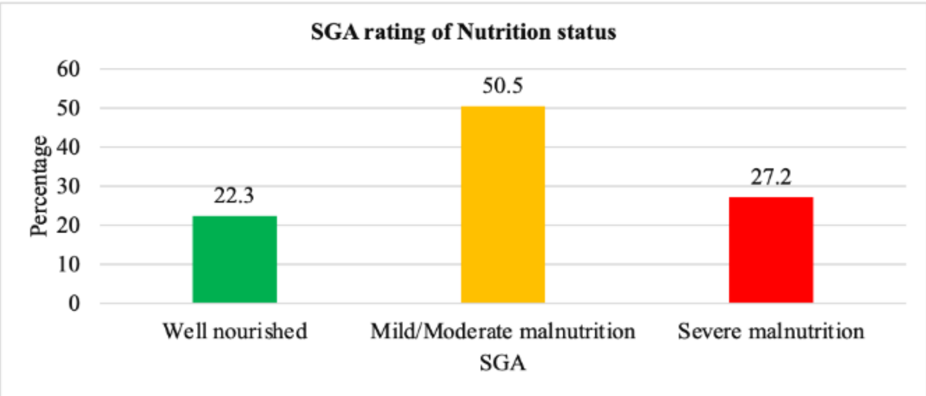
Figure 2: Nutrition Status by the BMI Status



Nutrition Status as per the Subjective Global Assessment

Figure 3 demonstrates the distribution of patients' nutritional status according to the SGA rating. The chart categorises the nutrition status of the participants into three groups: well-nourished, mild/moderate malnutrition, and severe malnutrition. The results indicate that 27.2% of the participants had severe malnutrition, 50.5% had mild to moderate malnutrition, and 22.3% were well nourished.

Figure 3: Nutrition Status by SGA Rating



Associations between Dietary Intake and BMI Status

The results in Table 2 show the independent t-tests results examining the associations between total calorie intake, total protein intake, and BMI status. The results show that there was a statistically significant difference in the means of total calorie intake ($t(101) = -1.409$, $p = 0.045$) between the malnourished participants (M = 918.37 Kcal, SD = ±486.31 Kcal) and those who were not malnourished (M = 1,083.20 Kcal, SD = ±389.03 Kcal). This indicates that malnourished participants consumed fewer calories on average compared to those who were not malnourished.

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There was also a statistically significant difference in the means of total protein intake and the BMI status (t (101) = -0.062, p = 0.039). There was a statistically significant difference (t (101) = -1.179, p = 0.018) in total protein intake between malnourished (M =10.50g, SD = ±4.45g) and non-malnourished participants (M = 11.94g, SD = ±7.05g). This implies that malnourished individuals had lower average protein intake compared to non-malnourished individuals. The results for the SGA rating show that there was no statistically significant difference (t (101) = -1.534, p = 0.128) in total calorie intake between malnourished (M = 988.37 Kcal, SD = ± 447.38 Kcal) and non-malnourished individuals (M = 818.22 Kcal, SD = ±538.38 Kcal).

Table 2: Associations Between Dietary Intake Indicators, BMI Status, and SGA

Dietary intake	BMI status	n	Mean	SD	t	df	F	Sig.
Total calorie intake	Malnourished	83	918.3723	486.3057	-1.409	101	4.113	**0.045**
	Not Malnourished	20	1083.195	389.0285				
Total protein intake	Malnourished	83	11.6	5.54698	-0.062	101	4.376	**0.039**
	Not Malnourished	20	11.68	2.98674				
	SGA rating							
Total calorie intake	Not malnourished	23	818.2174	538.3785	-1.534	101	0.128	0.149
	Malnourished	80	988.3725	447.3812				
Total protein intake	Not malnourished	23	11.935	7.05101	-1.179	101	0.241	**0.018**
	Malnourished	80	10.5043	4.44705				

DISCUSSION

The finding that most patients consumed less than or equal to 1,000 Kcal is consistent with Arnaout et al. (16), who identified that inadequate calorie intake during non-invasive ventilation (NIV) may be a result of critical illness-related factors such as hypermetabolism, which leads to increased energy requirements. This suggests that insufficient calorie intake is a consequence of the critical illness itself, which drives elevated energy expenditure. A study by Hartl et al. (17), using a large international database, demonstrated that maintaining a standard protein intake during the late acute phase of critical illness improved patient outcomes. The causal relationship in this study highlights that appropriate protein intake during this phase can reduce complications and improve recovery compared to an exclusively low-protein diet. Similarly, inadequate calorie and protein consumption during NIV was due to both the hypermetabolic state associated with critical illness and the challenges in gastrointestinal motility, which directly impaired patients' ability to ingest sufficient nutrition (18,19). This shows that critical illness and related symptoms contribute to the inadequate intake observed. Reeves et al. (20) also identified that patients receiving NIV often had insufficient energy and protein intake, attributing this to the mechanical challenges of NIV, which can cause discomfort and reduce oral intake. This suggests that NIV itself plays a direct role in limiting patients' ability to consume adequate nutrition. Finally, chronic critical illness and the resulting metabolic changes lead to an increased demand for nutrition, with insufficient intake exacerbating complications (6). The study indicates that the hypermetabolic state, alongside gastrointestinal issues, creates a nutritional gap that contributes to poor patient outcomes. The non-invasive ventilation (NIV) can also cause discomfort and make oral intake challenging.

The relatively high prevalence of malnutrition among patients, as indicated by a BMI of less than 18.5 kg/m², aligns with findings from Narayan *et al*. (21), who reported that the prevalence of malnutrition among critically ill patients ranges between 38% and 78%. This high prevalence is largely driven by protein-energy malnutrition, which can be directly linked to the catabolic

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response induced by critical illness. During critical illness, the body significantly increases muscle protein breakdown to meet the heightened demand for amino acids required for acute-phase protein synthesis and immune responses, resulting in reduced lean body mass and lower BMI. This process is a direct cause of muscle wasting and malnutrition (21). Additionally, critically ill patients often struggle with inadequate nutritional intake due to a combination of hypermetabolism, gastrointestinal dysfunction, and catabolic conditions, which diminishes appetite and reduces the ability to consume and absorb sufficient calories and protein, creating a persistent negative energy balance. This inadequate intake, in turn, leads to weakened immune function, increased susceptibility to infections, delayed wound healing, and prolonged recovery times. Furthermore, Sanaie *et al*. (22) demonstrated that a lower BMI in critically ill patients is directly associated with an increased risk of mortality and poor functional outcomes at the time of discharge, highlighting the critical impact of nutritional status on recovery and survival.

The physical examination results indicating muscle wasting and subcutaneous fat loss among critically ill patients suggest varying degrees of malnutrition, with most cases being mild but some severe. This muscle wasting is primarily caused by the hypermetabolic and catabolic responses triggered by critical illness, which drive rapid muscle protein breakdown and reduce protein synthesis to meet increased energy and amino acid demands (23). Reduced physical activity further compounds this muscle loss, as immobilisation leads to muscle disuse atrophy, decreased muscle protein synthesis, and accelerated muscle degradation. The consequences of this rapid muscle loss are significant, as patients experiencing greater muscle mass loss within the first week of ICU stay are at a higher risk of prolonged ICU stay and increased mortality (24, 25, 26) found a significant association between the loss of adipose tissue and increased mortality in critically ill patients, further emphasizing the impact of catabolic processes on patient outcomes. The breakdown of muscle and fat in these patients reflects the body's attempt to meet the elevated energy demands of critical illness, which, when combined with prolonged inactivity, significantly contributes to poor functional outcomes and increased mortality risk (27, 28).

Malnourished participants consumed fewer calories and had lower protein intake on average compared to those who were not malnourished. A similar study by Osooli et al. (1) reported that the majority of critically ill patients who had been admitted to the ICU and put on enteral feeding did not receive up to 80% of the protein and energy target, thus developing malnutrition. Various issues have been associated with this observation. Malnutrition leads to a reduced appetite, thus making it difficult for patients to consume adequate calories and protein, and this is exacerbated by the underlying illness or its treatment, which may cause nausea, vomiting, or altered taste sensations (29). Critically ill patients who are malnourished often experience gastrointestinal symptoms such as intolerance to enteral nutrition, delayed gastric emptying, or malabsorption, and these issues can cause a reduction in caloric and protein intake.

Limitations of the Study

The study did not track changes in nutritional status or dietary intake over time, which would have provided more comprehensive insights into the progression of malnutrition and the effectiveness of any interventions. Additionally, the study's cross-sectional design limits the ability to establish causality between dietary intake and nutritional status outcomes since it only provides a snapshot of the situation at a particular point in time.

CONCLUSION AND RECOMMENDATIONS

Conclusion

The study revealed a high prevalence of malnutrition among critically ill non-invasive ventilated adult patients, with a significant proportion experiencing severe malnutrition, as indicated by both BMI and SGA scores. There was a clear association between inadequate

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calorie and protein consumption and poor nutritional status, with malnourished patients demonstrating significantly lower average calorie and protein intakes compared to their non-malnourished counterparts. This underscores the critical importance of adequate nutrition in the recovery and overall clinical outcomes of critically ill patients. These findings highlight the urgent need for improved nutritional interventions and monitoring in this vulnerable patient population.

Recommendations

To address the high rates of malnutrition identified in this study, the following concrete steps are recommended:

- **Implementation of Nutritional Monitoring Protocols:** Establish standardised protocols for routine monitoring of nutritional intake, including daily calorie and protein tracking sheets and weekly assessments using tools like 24-hour dietary recall and Subjective Global Assessment (SGA). These protocols should include clear guidelines for early identification and intervention in malnourished patients.

- **Capacity Building for Healthcare Providers:** Provide ongoing training and capacity building for healthcare providers on the nutritional management of critically ill patients, emphasising the importance of timely nutritional interventions and individualised patient care.

- **Integration of Nutritional Support into Clinical Pathways:** Develop clinical pathways that incorporate regular nutritional assessments and interventions as a standard part of the care process for critically ill non-invasive ventilated patients. This should include the use of multidisciplinary teams to optimise nutritional support and improve patient outcomes.

- **Cost-Effective Strategies for Low-Resource Settings:** Given the resource constraints in many healthcare facilities, prioritise cost-effective nutritional interventions, such as the use of locally available nutrient-dense foods to develop a critical care therapeutic feeds menu, and leverage existing resources to reduce costs without compromising care quality.

- **Policy Review and Development:** Review and update existing Kenyan clinical nutrition guidelines, year, 2010 to specifically address the needs of critically ill non-invasive ventilated Adult patients. This should include clear benchmarks for nutritional intake, nutritional fluids monitoring protocols, and outcome evaluation.

- **Further Research:** Conduct longitudinal studies to assess the long-term impact of targeted nutritional interventions on patient recovery, quality of life, and overall health outcomes. This will provide a stronger evidence base for refining clinical guidelines and practice.

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Conflict of Interest Statement

The authors have no conflict of interest to declare.

Availability of Data Statement

The data is available from the corresponding author on reasonable request.

REFERENCES

Osooli, F., Abbas, S., Farsaei, S., & Adibi, P. (2019). Identifying critically ill patients at risk of malnutrition and underfeeding: A prospective study at an academic hospital. *Advanced Pharmaceutical Bulletin, 9*(2), 314- 320. https://doi.org/10.15171/apb.2019.037

Smith, E., Ridley, E. J., Rayner, C. K., & Chapple, L. S. (2022). Nutrition management for critically ill adult patients requiring non-invasive ventilation: A scoping review.

Nutrients, 14(7), 1446. https://doi.org/10.3390/nu14071446

Gholi, Z., Rezaei, M., Vahdat Shariatpanahi, Z., et al. (2024). Malnutrition elevates delirium and ICU stay among critically ill older adult COVID-19 patients. *Frontiers in Medicine, 11*, 1259320. https://doi.org/10.3389/fmed.2024.1259320

Bellanti, F., Lo Buglio, A., Quiete, S., & Vendemiale, G. (2022). Malnutrition in hospitalized old patients: Screening and diagnosis, clinical outcomes, and management. *Nutrients, 14*(4), 910. https://doi.org/10.3390/nu14040910

Preiser, J. C., Ichai, C., Orban, J. C., & Groeneveld, A. B. (2014). Metabolic response to the stress of critical illness. *British Journal of Anaesthesia, 113*(6), 945-954. https://doi.org/10.1093/bja/aeu187

Ladopoulos, T., Giannaki, M., Alexopoulou, C., et al. (2018). Gastrointestinal dysmotility in critically ill patients. *Annals of Gastroenterology, 31*(3), 273-281. https://doi.org/10.20524/aog.2018.0250

Saunders, J., & Smith, T. (2010). Malnutrition: Causes and consequences. *Clinical Medicine, 10*(6), 624- 627. https://doi.org/10.7861/clinmedicine.10-6-624

Javid, Z., Shadnoush, M., Khadem-Rezaiyan, M., et al. (2021). Nutritional adequacy in critically ill patients: Result of PNSI study. *Clinical Nutrition, 40*(2), 511-517. https://doi.org/10.1016/j.clnu.2020.05.047

Visser, J., Cederholm, T., Philips, L., & Blaauw, R. (2024). Prevalence and related assessment practices of adult hospital malnutrition in Africa: A scoping review. *Clinical Nutrition ESPEN, 63*, 121- 132. https://doi.org/10.1016/j.clnesp.2024.06.015. Epub 2024 Jun 22. PMID: 38943652.

Ministry of Health, Kenya. (2024). *Enhanced capacity building for health workers on managing acute malnutrition*. Ministry of Health. https://www.health.go.ke/index.php/enhanced-capacity-building-health-workers-managing-acute-malnutrition-kenya

Ritter, C. G., Medeiros, I. M., Pádua, C. S., & Others. (2019). Risk factors for protein-caloric inadequacy in patients in an intensive care unit. *Revista Brasileira de Terapia Intensiva, 31*(4), 504- 510. https://doi.org/10.5935/0103-507X.20190067

Sharon, T., Nayak, S. G., Shanbhag, V., & Hebbar, S. (2024). An observational study of nutritional assessment, prescription, practices, and its outcome among critically ill patients admitted to an intensive care unit. *Indian Journal of Critical Care Medicine, 28*(4), 364-368. https://doi.org/10.5005/jp-journals-10071-24676

Ersoy, U., Kanakis, I., Alameddine, M., & Others. (2024). Lifelong dietary protein restriction accelerates skeletal muscle loss and reduces muscle fibre size by impairing proteostasis and mitochondrial homeostasis. *Redox Biology, 69*, 102980. https://doi.org/10.1016/j.redox.2023.102980

Bakshi, N., Khurana, A., & Ferozi, S. (2024). Nutrition screening and assessment among critically ill patients. In M. Jalili (Ed.), *Nutrition during intensive care* (Chapter 16). IntechOpen. https://doi.org/10.5772/intechopen.1007337

Bakshi, N., Khurana, A., & Ferozi, S. (2024). Nutrition screening and assessment among critically ill patients. In M. Jalili (Ed.), *Nutrition during intensive care* (Chapter 16). IntechOpen. https://doi.org/10.5772/intechopen.1007337

Arnaout, M., Marincamp, A., Reffiena, M., & Others. (2015). Systematic evaluation of intakes in patients receiving non-invasive ventilation. The STARVE study. *Intensive Care Medicine Experimental, 3*(Suppl 1). https://doi.org/10.1186/2197-425X-3-S1-A827

Hartl, W. H., Kopper, P., Bender, A., & Others. (2022). Protein intake and outcome of critically ill patients: Analysis of a large international database using piece-wise exponential additive mixed models. *Critical Care,* *26*(1), 7. https://doi.org/10.1186/s13054-021-03870-5

Chapple, L. A., Gan, M., Louis, R., & Others. (2020). Nutrition-related outcomes and dietary intake in non-mechanically ventilated critically ill adult patients: A pilot observational descriptive study. *Australian Critical Care,* *33*(3), 300-308. https://doi.org/10.1016/j.aucc.2020.02.008

Reeves, A., White, H., Sosnowski, K., & Others. (2014). Energy and protein intakes of hospitalised patients with acute respiratory failure receiving non-invasive ventilation. *Clinical Nutrition,* *33*(6), 1068-1073. https://doi.org/10.1016/j.clnu.2013.11.012

Rosenthal, M. D., Vanzant, E. L., & Moore, F. A. (2021). Chronic critical illness and PICS nutritional strategies. *Journal of Clinical Medicine,* *10*(11), 2294. https://doi.org/10.3390/jcm10112294

Narayan, S. K., Gudivada, K. K., & Krishna, B. (2020). Assessment of nutritional status in the critically ill. *Indian Journal of Critical Care Medicine, 24*(Suppl 4) https://doi.org/10.5005/jp-journals-10071-23617

Sanaie, S., Hosseini, M. S., Karrubi, F., Iranpour, A., & Mahmoodpoor, A. (2020). Impact of body mass index on the mortality of critically ill patients admitted to the intensive care unit: An observational study. *Anesth Pain Med*, *11*(1). https://doi.org/10.5812/aapm.108561

Hrdy, O., Vrbica, K., Kovar, M., et al. (2023). Incidence of muscle wasting in the critically ill: A prospective observational cohort study. *Sci Rep*, *13*(742). https://doi.org/10.1038/s41598-023-28071-8

Mayer, K. P., Thompson Bastin, M. L., Montgomery-Yates, A. A., et al. (2020). Acute skeletal muscle wasting and dysfunction predict physical disability at hospital discharge in patients with critical illness. *Crit Care*, *24*(637). https://doi.org/10.1186/s13054-020-03355-x

Lee, Z. Y., Ong, S. P., Ng, C. C., et al. (2020). Acute skeletal muscle wasting and dysfunction predict physical disability at hospital discharge in patients with critical illness. *Crit Care*, *24*(637). https://doi.org/10.1186/s13054-020-03355-x

Dusseaux, M. M., Antoun, S., Grigioni, S., et al. (2019). Skeletal muscle mass and adipose tissue alteration in critically ill patients. *PLoS One*, *14*(6). https://doi.org/10.1371/journal.pone.0216991

Ndahimana, D., & Kim, E. K. (2018). Energy requirements in critically ill patients. *Clin Nutr Res*, *7*(2), 81-90. https://doi.org/10.7762/cnr.2018.7.2.81

Hardy, E. J., Inns, T. B., Hatt, J., et al. (2022). The time course of disuse muscle atrophy of the lower limb in health and disease. *J Cachexia Sarcopenia Muscle*, *13*(6), 2616-2629. https://doi.org/10.1002/jcsm.13067

Fielding, R. A., Landi, F., Smoyer, K. E., et al. (2023). Association of anorexia/appetite loss with malnutrition and mortality in older populations: A systematic literature review. *J Cachexia Sarcopenia Muscle*, *14*(2), 706-729. https://doi.org/10.1002/jcsm.13186