Collage of Health Science

School of Medicine

Department of Pediatric and Child Health

Nutritional Outcome measure of Critically Ill Children after Schofield formula intervention in Pediatric Intensive Care Unit, Tikur Anbessa Specialized Hospital: Prospective observational Cohort study

By: Meklit Deju, MD

Advisor: Dr. Muluwork Denberu (Associate Professor of Pediatrics and Child health)

Co- Advisor: Dr. Melat Tesfaye (Assistant Professor of Pediatrics and Child health

This research thesis is submitted to the Research and Community service office in partial fulfillment of the requirements for the Specialty for Certificate in Pediatrics and Child Health

Feb, 2024

ADDIS ABABA ETHIOPIA

Abstract

Background: In critically ill pediatric patients, under nutrition plays a major role in high mortality rates, longer hospital stays, higher risk of hospital-acquired infections, and higher medical expenses.

Objective: To assess the nutritional outcome measure of critically ill children in pediatric intensive care unit after Schofield formula intervention in Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia, 2024

Methods: Prospective cohort observational study was employed to investigate anthropometric effect after Schofield formula intervention. The categorical variables in the study were presented with using frequency, percentage, and compared between groups using the chi-square test. Since our sample size was less than 50 and with the normal distribution of continuous variables, we have used Shapiro-Wilk test. The mean and standard deviation calculated for normality distributed data while median and interquartile range calculated for skewed data. Paired sample T test was used to compare the mean difference for parametric variables while Wilcoxon Singed Rank test was employed for nonparametric data. Pearson correlation analysis was conducted to assess the strength and nature of the linear relationship between the independent and postintervention BMI. In this study, a multivariate linear regression model was utilized to predict the value of the dependent variable Y (post BMI) based on several independent variables

Results: The study was done in 25 participants, the median age of the participants in this study was 9(±IQR=5.5) years. Female accounted 16/25(64%) and urban 15/25 (60%).

. The most underlying cause of critical illness was brain tumor 9/25 (36%) and sever infection 6/25(24%). The majority of patients (68%) initiated feeding within 48 hours, and 96% began feeding within 72 hours of admission to PICU. The median length of ICU stay was 5 days (±IQR=6.5). Analyzing the anthropometric changes post-intervention, we observed a statistically significant difference in mean post-treatment BMI (16.5 ± 2.1) compared to preadmission BMI (16.04 ± 2.2) with a p-value of 0.007. It was observed that for each additional year in age, postinterventional BMI decreased by a factor of 1.14 (p=0.000). Interestingly, the timing of feeding initiation within 48 hours of admission to PICU emerged as a particularly influential factor, showing a substantial 2.2 times increase in postinterventional BMI (p=0.001).

Conclusion: The use of the Schofield formula intervention has shown statistically significant improvements in post-intervention BMI and weight outcomes. Moreover, this study has gone a step further by developing a prediction model for post-intervention BMI, demonstrating an impressive predictive accuracy of approximately 84%. These findings not only underscore the effectiveness of the Schofield formula intervention but also highlight the potential of predictive modeling in optimizing outcomes in BMI management.

Acknowledgment

First and foremost, I want to express my gratitude to Almighty God for giving me the strength to complete this work. My sincere appreciation also extends to the Department of Pediatrics and Child Health at Addis Ababa University College of Health Sciences for providing the funding and for granting me this chance**.** The pediatric critical care and intensivist Dr. Muluwork Dinberu and Dr. Melat Tesfaye, who served as my advisers, have my warmest gratitude for their excellent advice and for taking the time to read through my work. I am incredibly appreciative for their helpful criticism and recommendations as I worked on this research. .

Contents

Abstract ii

Acknowledgment iv

List of Tables 6

CHAPTER ONE: INTRODUCTION 1

1.1. Background 1

1.2. Statement of the problem 2

1.3. Significance of the study 4

CHAPTER TWO: LITERATURE REVIEW 5

CHAPTER THREE: OBJECTIVES 7

3.1 General Objective 7

3.2. Specific objectives 7

CHAPTER FOUR: METHODOLOGY 8

4.1 Study Area 8

4.2 Study Design 8

4.4. Population 8

4.4.1. Source Population 8

4.4.1. Study Population 8

4.5. Sample Size Determination and Sampling Technique 9

4.6 Inclusion &Exclusion Criteria 9

4.6.1. Inclusion criteria: 9

4.6.2. Exclusion criteria: 9

4.7 Study Variables 9

4.7.1. Dependent Variable 9

4.7.2. Independent variables 9

4.8 Data Collection 10

4.9 Data Processing & Analysis 10

4.10. Operational Definitions 11

4.11 Ethical Considerations 11

CHAPTER FIVE: Results 12

5. Results 12

CHAPTER SIX: DISCUSSION AND RECOMMENDATION 17

6.1. Discussion 17

6.2. Recommendation 18

Reference 19

List of Tables

Table 1:Socio-demographics and Clinical profile of participant patients admitted in Pediatrics ICU, TASH Ethiopia 2024 12
Table 2:Anthropometric changes after Schofield formula intervention in patients admitted pediatrics ICU in TASH, Ethiopia 2024. 13
Table 3:Standardized and Unstandardized coefficients in Multivariate Linear regression analysis to identify predictors for postintervention BMI in pediatrics ICU admitted Patients in TASH, Ethiopia 2024 15
Table 4:Model summary (Predictors: (Constant), time of feeding, ways of feeding, Sex, Residency, comorbidity, Admission weight, MV required, Duration of ICU stay, Age) 16
Table 5:ANOVA model (Independent variables: time of feeding, ways of feeding, Sex, Residency, comorbidity, Admission weight, MV required, Duration of ICU stay, Age, Dependent Variable: Post intervention BMI) 16

CHAPTER ONE: INTRODUCTION

1.1. Background

Acute pediatric critical illness, as defined by the World Health Organization, includes severe issues with the airway, breathing, or circulation, as well as sudden deterioration in consciousness(1). This can involve conditions such as apnea, upper airway blockage, hypoxemia, central cyanosis, intense respiratory distress, inability to feed, shock, severe dehydration, significant bleeding requiring transfusion, unconsciousness, or seizures(1). Critical illnesses of children have contributed a significant burden of hospitalization, mortality, disability, and medical cost worldwide. During critical illness, the body's metabolic response to acute factors such as trauma, infection, or surgery triggers neuroendocrine, metabolic, and immunological changes. Key features include heightened protein turnover resulting in elevated hepatic protein synthesis and a negative protein balance, insulin resistance leading to hyperglycemia, and increased lipolysis(2, 3)

Ensuring the delivery of optimal nutrition therapy is a crucial objective in critical care settings. It involves a meticulous evaluation of energy requirements and the administration of essential nutrients through suitable channels, both essential steps in attaining this goal(4). Inadequate nutrient provision during critical illness can lead to a decline in nutritional health, contributing to increased risks of multiple organ dysfunction, complications, prolonged hospital stays, and higher mortality rates (4-7). Enteral nutrition (EN), which involves feeding through the gastrointestinal tract, is the preferred method for delivering nutrients to critically ill children with a functioning gut(6, 8, 9). Based on a synthesis of observational research and expert opinions, it is advised to conduct weight and height/length assessments upon admission to the Pediatric Intensive Care Unit (PICU). Utilizing z scores for Body Mass Index (BMI) for age (weight for length for children under 2 years) or weight for age can help identify patients with significant deviations from normal values. Additionally, for children under 36 months of age, it is essential to record head circumference measurements as part of the comprehensive assessment process(10, 11). (Citation) Utilizing a standardized protocol enables prompt initiation of nutrition therapy by administering crucial elements such as energy, proteins, lipids, micronutrients, and vitamins in

accurate amounts through appropriate delivery routes. This approach facilitates the timely achievement of energy targets in pediatric critically ill patients(4, 12-14). Numerous international clinical guidelines concur on the critical importance of early initiation of feeding in improving survival rates and reducing adverse outcomes in critically ill patients(15). For instance, the European Society of Pediatric and Neonatal Intensive Care (ESPNIC) issued 32 clinical recommendations emphasizing the significance of nutrition support in critically ill children, with early feeding initiation being a top priority(15). Similarly, the American Society for Parenteral and Enteral Nutrition also advocates for the early initiation of feeding in cases of critical illness(16), Protein delivery is crucial in pediatric critical care to prevent a negative protein balance, especially in the early phase of illness. In critically ill pediatric patients, protein requirements are increased due to the catabolic state and the need for tissue repair and growth. The aim is to provide at least 1.5 grams of protein per kilogram of body weight per day to meet these increased needs(11).

1.2. Statement of the problem

Critical illnesses of children have contributed a significant burden of hospitalization, mortality, disability, and medical cost worldwide(1). Children with critical illness are particularly vulnerable to undernutrition, which can be attributed to factors such as the severity of their disease, the need for mechanical ventilation, and various other medical interventions(1). Undernutrition in critically ill pediatric patients is a significant factor contributing to high mortality rates, prolonged hospitalization, increased risk of hospital-associated infections, and elevated medical costs(15, 16). Estimates suggest that the prevalence of undernutrition ranges from approximately 15% to 65%, depending on the country's level of development and the specific care setting(2, 17, 18). An examination of 293 pediatric patients across neonatal and pediatric intensive care units in the Netherlands revealed a 24% prevalence of malnutrition(19). A meta-analysis encompassing 15 studies involving 4,331 critically ill pediatric patients revealed

a pooled prevalence of malnutrition at 37%, accompanied by significant statistical heterogeneity(20). (Better to use study done in developing country than developed world) Notably, high-income countries reported a lower pooled prevalence of malnutrition among critically ill children, estimated at 30%(20). To address the significant issue of undernutrition in pediatric patients with critical illnesses admitted to the Neonatal Intensive Care Unit (NICU), multiple international guidelines advocate for the early initiation of Schofield formula enteral feeding within 48 hours(3, 21). This proactive approach aims to reduce mortality rates, hospital stays, infection risks, and financial burdens associated with the care of these vulnerable patients. The adoption of early initiation of enteral feeding has been inconsistent across different regions due to varying capacities, protocol-driven practices, and policy implementation(2, 22, 23). In a multi-center prospective study conducted in Turkey with 614 patients, it was reported that 72.3% of patients achieved early enteral nutrition by initiating it within 48 hours of admission to the intensive care unit(23). In a study conducted at multiple centers in Brazil, 363 critically ill patients were assessed, revealing that 76.4% were started on feeding within the first 48 hours(22).

To the best of my knowledge there is limited evidence on the nutritional impact of Schofield formula feeding for critically ill pediatric patients in the ICU. Therefore, this study assessed the effects of Schofield formula on anthropometric changes and factors influencing post-intervention body mass index.

1.3. Significance of the study

The study on the nutritional outcomes of critically ill children admitted to the ICU and the significance of early feeding holds substantial importance for various stakeholders in the healthcare domain. Understanding the impact of early feeding on nutritional outcomes provides healthcare workers with valuable insights into optimizing patient care. It enables them to make informed decisions regarding nutritional interventions, ensuring enhanced recovery and improved health outcomes for critically ill children under their care. The study serves as a foundation for researchers by accentuating the impact of early feeding practices on the nutritional outcomes of critically ill children. It stimulates further research avenues, encouraging the exploration of innovative interventions, best practices, and potential areas for improvement in nutritional care within the ICU setting. By driving research initiatives, this study contributes to advancing knowledge and promoting evidence-based approaches in pediatric critical care nutrition. Overall, the study on the significance of early feeding in the nutritional outcomes measure of critically ill children admitted to the ICU plays a crucial role in guiding healthcare providers, advancing research agendas, and ultimately enhancing the quality of care and health outcomes for pediatric patients in critical care settings.

CHAPTER TWO: LITERATURE REVIEW

Acute pediatric critical illness is sever medical issues that able to airway, breathing, or circulation, as well as sudden deterioration in consciousness (1).A diverse array of medical and surgical conditions can precipitate critical illness in pediatric patients, necessitating pediatric intensive care unit (PICU) intervention to manage their complex healthcare needs(1). The multifaceted nature of these critical conditions underscores the vital role of PICU care in providing comprehensive monitoring, specialized treatment, and tailored interventions to ensure the best possible outcomes for children facing challenging medical scenarios. In a nationwide prospective study carried out in Turkey, data from 614 patients admitted to the PICU within a one-month period revealed that 76.2% of patients were admitted for medical reasons, while 12.2% underwent emergency surgery(23). A comprehensive review of 361 patients at Tikur Anbessa Specialized Hospital revealed that the primary causes of admission to the Neonatal Intensive Care Unit (NICU) was identified as septic shock (27.14%), followed by meningitis (18.56%), and congestive heart failure (CHF) (12.19%). Notably, the study highlighted an overall NICU mortality rate of 43.8%, emphasizing the critical nature of these conditions and the challenges they present in managing pediatric critical care situations(24). Prior to admission to the intensive care unit (ICU), conducting thorough pre-ICU screening of nutritional status plays a pivotal role in assessing the holistic needs of pediatric patients requiring critical care(3, 15). Alongside this, ensuring adequate nutritional supplementation with the appropriate dosage and timing emerges as a cornerstone of ICU management for critically ill children(3, 15). This encompasses tailoring nutrition plans to meet individual requirements, promptly addressing deficiencies, and closely monitoring nutritional intake to optimize patient outcomes and support recovery in the ICU setting(3, 15).

Undernutrition in critically ill pediatric patients is a significant factor contributing to high mortality rates, prolonged hospitalization, increased risk of hospital-associated infections, and elevated medical costs(15, 16). Numerous studies have explored the prevalence of undernutrition in critically ill pediatric patients admitted to neonatal intensive care units (NICUs), revealing varying rates across different regions. Estimates suggest that the prevalence of undernutrition ranges from approximately 15% to 65%, depending on the country's level of development and the specific care setting(2, 17, 18). An examination of 293 pediatric patients across neonatal and

pediatric intensive care units in the Netherlands revealed a 24% prevalence of malnutrition. When categorizing patients based on the duration of malnutrition, findings indicated that 15% experienced acute malnutrition, 20% dealt with chronic malnutrition, and 24% presented a combination of acute and chronic malnutrition(19). A meta-analysis encompassing 15 studies involving 4,331 critically ill pediatric patients revealed a pooled prevalence of malnutrition at 37%, accompanied by significant statistical heterogeneity(20). Notably, high-income countries reported a lower pooled prevalence of malnutrition among critically ill children, estimated at 30%(20). Analysis of 243 children admitted in Tikur Anbesa PICU reported that prevalence of acute malnutrion was approximately 39% which is one the heights malnutrition in the world(25). To mitigate the widespread issue of undernutrition and its consequential outcomes like increased mortality, hospital admissions, and susceptibility to infections, various international guidelines strongly advocate for the early initiation of enteral feeding(3, 11, 15).

CHAPTER THREE: OBJECTIVES

3.1 General Objective

- To assess the nutritional outcome measure of critically ill children in pediatric intensive care unit after Schofield formula in Tikur Anbesa Specialized Hospital, Addis Ababa, Ethiopia, 2024

3.2. Specific objectives

- To assess the nutritional outcome measure of critically ill children in pediatric intensive care unit after Schofield formula intervention
- To identify potential complications associated with enteral feeding.
- To assess factors affecting post Schofield formula intervention BMI for critically ill children.

CHAPTER FOUR: METHODOLOGY

4.1 Study Setting

The study was conducted at TASH, pediatric intensive care unit. TASH, established in 1974, is the largest referral and teaching hospital in Addis Ababa, Ethiopia. TASH provides diagnosis and treatment for approximately 400,000 patients each year. This hospital serves the community with specialty and subspecialty services. It has more than 1500 clinical and academic staff. The hospital can accommodate inpatient services with more than 800 beds. The pediatric intensive care ward has 6 beds in it and patients who have both medical and surgical conditions are admitted and treated. Data collection was conducted from August 30, 2023 – Jan 30, 2024

4.2 Study Design

The study was conducted using a hospital-based prospective observational study design using a validated standardized questionnaire.

4.4. Population

4.4.1. Source Population

The source population comprised all pediatric intensive care unit patients admitted with critical illnesses at Tikur Anbessa.

4.4.1. Study Population

The study population encompasses all children aged above 1 year and below 14 years, admitted to the pediatric intensive care unit, who receive Schofield formula intervention.

4.5. Sample Size Determination

All pediatric patients who was admitted at PICU during the study period, who fulfill the inclusion criteria where involved. And convenient sampling method was used.

4.6 Inclusion &Exclusion Criteria

4.6.1. Inclusion criteria:

Patients admitted to the pediatric intensive care unit (PICU)

Patients receiving enteral feeding

Patients aged between 1 and 14 yrs.

Patients with a length of stay in the PICU of at least 48 hours.

4.6.2. Exclusion criteria:

Patients with a history of gastrointestinal surgery or disease that affects enteral feeding

Patients with severe malnutrition or failure to thrive prior to admission

Patients with medical condition with double vasopressor

4.7 Study Variables

4.7.1. Dependent Variable

- Discharge of weight,
- Discharge MUAC
- Post intervention BMI,
- Post intervention albumen

4.7.2. Independent variables

- Age,
- Sex
- Maternal educational level
- preadmission weight

- Preadmission MUAC)
- Preadmission Albumen

4.8 Data Collection

A structured questionnaire was developed from different literatures(3, 22, 23). The questioner was pretested with 5% of the sample and modified based on the result of the pilot study. The data was collected by the primary investigator.

4.9 Data Processing & Analysis

The categorical variables in the study were presented w. ith using frequency, percentage, and compared between groups using the chi-square test. Since our sample is less than 50 the normal distribution of continuous variables was assessed using Shapiro-Wilk test. The mean and standard deviation were calculated for normality distributed data while median and interquartile range calculated for skewed data. Paired sample T test was used to compare the mean difference for parametric variables while Wilcoxon Singed Rank test was employed for nonparametric data. Multicollinearity test performed for categorical, continuous and binary variables. Multicollinearity measured by variance inflation factor (VIF) and tolerance. When a VIF was below five and tolerance was above 0.1, variables were forwarded to multivariable binary logistic regression analysis. Variables with a VIF score of ≥ 5 to 10 and tolerance below 0.1 were excluded from the final model. Pearson correlation analysis was conducted to assess the strength and nature of the linear relationship between the independent and postintervention BMI. In this study, a Multivariate linear regression model was utilized to predict the value of the dependent variable Y (postintervention BMI) based on several independent variables (Age, sex, Preadmission weight, residency, Presence of comorbidities, Duration of ICU stay, mechanical ventilation, Ways of feeding, and time of feeding). Prior to constructing the model, six hypotheses needed verification:

1. The presence of a linear relationship between the independent and dependent variables, which can be assessed through scatter plots.

2. The presence of multicollinearity, a condition that can significantly impact the regression coefficients.

3. The independence of residuals, which can be evaluated using the Durbin-Watson statistical test.

4. The constancy of variance in residuals, which can be verified by plotting standardized residuals against standardized predicted values.

5. The normal distribution of residuals, which can be confirmed through a quantile-quantile (Q-Q) plot.

6. The absence of outliers, with Cook's distance values below 1 indicating their non-existence.

4.10. Operational Definitions

- **Early enteral feeding:** The practice of initiating and providing nutrition through the gastrointestinal tract as soon as possible.

4.11 Ethical Considerations

The proposal was submitted and clearance was sought from the ethical committee of Department of pediatrics and child Health Addis Ababa University. The ethical please put the approval number consideration of informed consent is critical when it comes to Schofield formula enteral feeding in the PICU. Parents or guardians was fully informed about the benefits and risk of Schofield formula enteral feeding including potential complications. They were informed about alternative options and the potential outcomes of withholding or delaying enteral feeding. For children older than 12 years ascent was taken. All information collected from patients' records has been kept strictly confidential and the names of children was not included in the questioners.

CHAPTER FIVE: Results

5. Results

Analysis of the nutritional outcome in 25 pediatric patients admitted to pediatric ICU was looked for in our study. Accordingly, the majority of the patients were female, accounting 16/25(64%) of the study with the median age of the patients in this study was 9(±IQR=5.5) years. The most common underlying cause of critical illness was brain tumor 9/25 (36%) and sever infection 6/25(24%). Approximately 32% of the patients presented with comorbidities, while 28% of the participants required mechanical ventilation to support organ function. The majority of patients 17/25 (68%) initiated feeding within 48 hours, and 96% began feeding within 72 hours. Additionally, 56% of patients started feeding via a nasogastric tube (NGT**)**. The median length of hospital stay was 21 days (±IQR=15), while the median duration of ICU stay was 5 days (±IQR=6.5).

Table 1:Socio-demographics and Clinical profile of participant patients admitted in Pediatrics ICU, TASH Ethiopia 2024

Item	**Variables**	**Frequency**	**Percent**
Age	Median ±IQR	9(±IQR=5.5)	
Sex	Female	16	64
	Male	9	36
Residence	Rural	10	40.0
	Urban	15	60.0
Comorbidity	Yes	8	32.0
	No	17	68.0
Maternal Education	No formal education	7	28.0
	Primary	5	20.0
	Secondary	10	40.0
	college and above	3	12.0
Admission Diagnosis	Brain Tumor Related	9	36.0
	Infection Related	6	24.0
	Urologic Related	3	12.0
	Hematologic problems/ malignancy Related	3	12.0
	GBS	1	4.0
	GDD	1	4.0
	Foreign Body	1	4.0

	Epileptic encephalopathy related aspiration	1	4.0
Mechanical Ventilation required	Yes	7	28.0
	No	18	72.0
Ways of feeding	NGT	14	56.0
	Oral	11	44.0
Feeding started	within 48hr	17	68.0
	48-72hr	7	28.0
	72-96	1	4.0
Complication identifies	Diarrhea	3	12.0
	Vomiting	5	20.0
	None	17	68.0
Duration of ICU	Median ±IQR	5(±IQR=6.5)	
Total length of hospital stays	Median ±IQR	21(±IQR=15)	

Analyzing the anthropometric changes post-intervention, we observed a statistically significant difference in mean post-treatment BMI (16.5 ± 2.1) compared to preadmission BMI (16.04 ± 2.2) with a p-value of 0.007. Similarly, there was a significant mean difference in post-intervention weight compared to preadmission weight (p=0.02). However, there was no statistical difference between preadmission MUAC and Albumin levels compared to post-intervention MUAC and Albumin levels.

Table 2:Anthropometric changes after Schofield formula intervention in patients admitted pediatrics ICU in TASH, Ethiopia 2024.

Variables	Admission (mean±SD)	Discharge (mean±SD)	P
Weight	21.6(±SD=5.5)	22.16(±SD=5.6)	0.02*
MUAC	15.98(SD=1.6)	16.13(SD=1.6)	0.137
BMI	16.04(SD=2.2)	16.52(SD=2.1)	0.007*
Albumen	2.92(SD=0.21)	2.90(0.16)	0.687

Modeling to predict Postintervention BMI

Pearson correlation analysis was conducted to investigate the strength and nature of the linear relationship between the independent and dependent variables. In this study, a Multivariate linear regression model was utilized to predict the value of the dependent variable Y (postintervention BMI) based on several independent variables (Age, Gender, Preadmission weight, residency, Presence of comorbidities, Duration of ICU stay, mechanical ventilation, Ways of feeding, and time of feeding). The result of Durbin-Watson test was 2.02 and it was between the acceptable range of (1.5; 2.5) to demonstrate the independence of residual. All observations had a Cook's distance of less than 1, indicating the absence of outliers in the dataset that could potentially distort the accuracy of the coefficient estimates. The model was capable to explain 84.2% of postintervention BMI variability. The statistical model accurately predicted post-intervention BMI, as indicated by a significant F statistic ($F(9,15) = 8.86$, $p < 0.000$) with an R-squared value of 0.842. The multivariate linear regression analysis undertaken in our study revealed intriguing findings regarding the factors influencing postinterventional BMI. It was observed that for each additional year in age, postinterventional BMI decreased by a factor of 1.14 (p=0.000), indicating a potential impact of aging on body mass index post-intervention. Furthermore, an increase of 1kg in admission weight was associated with 0.525 times increase in postinterventional BMI (p=0.000), suggesting a direct relationship between initial weight and subsequent BMI outcomes. The presence of comorbidities was also found to be a significant factor, with 1.3 times increase in postinterventional BMI (p=0.024) noted in individuals with underlying health conditions. Interestingly, the timing of feeding initiation within 48 hours PICU admission emerged as a particularly influential factor, showing a substantial 2.2 times increase in postinterventional BMI (p=0.001). These results underscore the complex interplay of various factors in shaping postinterventional BMI outcomes, highlighting the importance of considering multiple variables in the context of clinical interventions (Table 3)

Postintervention BMI predication model written as follow.

$$Postintervention\ BMI = 7.17 - 1.15 * age + 0.016 * sex + 0.948 * residency + 0.525 * admission\ weight - 0.249 * MV\ requirement + 1.32 * comorbiidty + 0.024 * ICU\ stay + 0.248 * ways\ of\ feeding * 2.184 * Time\ of\ fedding$$

Table 3:Standardized and Unstandardized coefficients in Multivariate Linear regression analysis to identify predictors for postintervention BMI in pediatrics ICU admitted Patients in TASH, Ethiopia 2024

Variables	Unstandardized coefficient			t	Sig	95%CI of B	
	B	Standard error	standardized coefficient			Lower	Upper
Constant	7.171	2.961	Beta	2.422	.029	.860	13.482
Age	-1.147	.173	-1.745	-6.619	.000	-1.516	-.778
Sex	.016	.541	.004	.030	.976	-1.136	1.169
Residency	.948	.493	.223	1.924	.074	-.102	1.998
Admission weight	.525	.106	1.352	4.953	.000	.299	.751
MV requirement	-.249	.951	-.054	-.262	.797	-2.275	1.777
Comorbidity	1.324	.529	.297	2.504	.024	.197	2.452
Duration of ICU stay	.024	.084	.064	.287	.778	-.156	.204
ways of feeding	.248	.315	.118	.789	.443	-.423	.919
Time of Feeding Started	2.184	.539	.489	4.053	.001	1.036	3.333

a. Dependent Variable: Postintervention BMI
b. 1=male, 1=rural, 1=yes for MV,1 =yes for comorbidty,1=NGT feeding, 1=feeding within 48hr

Table 4:Model summary (Predictors: (Constant), time of feeding, ways of feeding, Sex, Residency, comorbidity, Admission weight, MV required, Duration of ICU stay, Age)

R	R Square	Adjusted R Square	Std. Error of the Estimate	df1	df2	Sig. F Change
.917[a]	.842	.747	1.07013	9	15	.000

Table 5:ANOVA model (Independent variables: time of feeding, ways of feeding, Sex, Residency, comorbidity, Admission weight, MV required, Duration of ICU stay, Age, Dependent Variable: Post intervention BMI)

Model	Sum of Squares	df	Mean Square	F	Sig
Regression	91.340	9	10.149	8.862	.000[b]
Residual	17.178	15	1.145		
Total	108.517	24			

Df=degree of freedom of source, F=f-statistics

CHAPTER SIX: DISCUSSION AND RECOMMENDATION

6.1. Discussion

This study examines the impact of implementing the Schofield formula as an intervention for critically ill patients in the ICU, and aims to create a predictive model for estimating post-intervention BMI. This study revealed that 68% of critically ill patients admitted to the ICU initiated feeding within 48 hours, with 96% starting feeding within 72 hours. The results of this study differed from those of other studies, possibly due to variations in disease severity, ICU resources, staff expertise, and adherence to feeding protocols. In a multi-center prospective study conducted in Turkey with 614 patients, it was reported that 72.3% of patients achieved early enteral nutrition by initiating it within 48 hours of admission to the intensive care unit(23). In a study conducted at multiple centers in Brazil, 363 critically ill patients were assessed, revealing that 76.4% were started on feeding within the first 48 hours(22). Several international guidelines suggest that anthropometric screening should be conducted upon admission, with enteral nutrition starting within 24-48 hours in hemodynamically stable children with a functioning gastrointestinal tract, unless contraindications such as vomiting, abdominal distension, or gastrointestinal hemorrhage are present. This strategy, known as early enteral nutrition, aims to achieve a positive protein balance of at least 1.5 grams of protein per kilogram of body weight per day. Providing 54-58 kcal/kg/day is considered the minimum requirement to maintain protein balance and prevent catabolism(3, 11, 21).

Through our observations, we have noted that the implementation of the Schofield formula intervention has significantly influenced short-term anthropometric changes in BMI. This intervention has demonstrated its efficacy in not only averting undernutrition but also in reducing the likelihood of related issues such as hospital-acquired infections, lengthier hospital stays, and the need for mechanical ventilation. Nevertheless, there was no statistical disparity between preadmission MUAC and Albumin levels in comparison to post Schofield formula intervention MUAC and Albumin levels. Nevertheless, prior research has indicated that early implementation of feeding interventions did not result in statistically significant differences in BMI, MUAC, and weight-for-age measurements(23). In addition to investigating the impact of the Schofield formula intervention on BMI, this study utilized multivariable linear regression analysis to explore various factors influencing post-intervention BMI outcomes. Interestingly, the timing of

feeding initiation within 48 hours emerged as a particularly influential factor, showing a substantial 2.2 times increase in postinterventional BMI. It was observed that for each additional year in age, postinterventional BMI decreased by a factor of 1.14. Based on these observations, it appears that the Schofield formula intervention tends to have a more pronounced impact on younger children. While the Schofield formula intervention has been acknowledged for its positive impact and is endorsed by numerous international guidelines, there remains a noticeable scarcity of data regarding the anthropometric effects on critically ill patients in the ICU. This study strongly advocates for further research to be carried out using a substantial sample size. Additionally, it highlights the necessity of conducting external validation of the predictive model for post-intervention BMI in pediatrics critical illness

Conclusion: The use of the Schofield formula intervention has shown statistically significant improvements in post-intervention BMI and weight outcomes. Moreover, this study has gone a step further by developing a prediction model for post-intervention BMI, demonstrating an impressive predictive accuracy of approximately 84%. These findings not only underscore the effectiveness of the Schofield formula intervention but also highlight the potential of predictive modeling in optimizing outcomes in BMI management.

6.2. Recommendation

When it comes to enhancing nutritional outcomes, especially in relation to weight and BMI, the use of the Schofield formula intervention has showcased high efficacy. For health care providers, integrating the Schofield formula intervention into nutritional management protocols can lead to significant improvements in patient outcomes. It is recommended to consider the implementation of the Schofield formula intervention as a valuable tool in promoting healthy weight management and BMI optimization among patients. The study also important for the policy makers which able to advocate for the incorporation of the Schofield formula intervention into healthcare practices can be pivotal in improving overall nutritional outcomes at a broader scale. By recognizing and supporting the efficacy of this intervention, policy makers can contribute to better health outcomes for individuals in various healthcare settings. Researchers are encouraged to focus on validating the predictive model for post-intervention BMI derived from the Schofield formula intervention. External validation of this model can not only bolster the reliability of the

intervention but also pave the way for more accurate predictions in clinical settings. By conducting robust validation studies, researchers can contribute to the advancement of evidence-based practices in the field of nutritional management. Furthermore, it is emphasized that future studies should be repeated with a substantial sample size to ensure the robustness and generalizability of the findings. Large-scale studies can provide more comprehensive insights into the impact of the Schofield formula intervention on nutritional outcomes, thus enhancing the credibility and applicability of the intervention in diverse healthcare contexts.

Reference

1. WHO. Updated Guideline: Paediatric Emergency Triage, Assessment and Treatment. Geneva: World Health Organization (2016).
2. Moreno YMF, Ventura JC, de Almeida Oliveira LD, Silveira TT, Hauschild DB. Undernutrition in critically ill children. Pediatr Med 2020;3:22.
3. Tume, L.N., Valla, F.V., Joosten, K. et al. Nutritional support for children during critical illness: European Society of Pediatric and Neonatal Intensive Care (ESPNIC) metabolism, endocrine and nutrition section position statement and clinical recommendations. Intensive Care Med 46, 411–425 (2020). https://doi.org/10.1007/s00134-019-05922-5.
4. Mehta NM, Bechard LJ, Cahill N, Wang M, Day A, Duggan CP, Heyland DK. Nutritional practices and their relationship to clinical outcomes in critically ill children--an international multicenter cohort study*. Crit Care Med. 2012 Jul;40(7):2204-11. doi: 10.1097/CCM.0b013e31824e18a8. PMID: 22564954; PMCID: PMC3704225.
5. Elke G, Wang M, Weiler N, Day AG, Heyland DK. Close to recommended caloric and protein intake by enteral nutrition is associated with better clinical outcome of critically ill septic patients: secondary analysis of a large international nutrition database. Crit Care. 2014 Feb 10;18(1):R29. doi: 10.1186/cc13720. PMID: 24506888; PMCID: PMC4056527.
6. Mehta NM, Bechard LJ, Zurakowski D, Duggan CP, Heyland DK. Adequate enteral protein intake is inversely associated with 60-d mortality in critically ill children: a multicenter, prospective, cohort study. Am J Clin Nutr. 2015 Jul;102(1):199-206. doi: 10.3945/ajcn.114.104893. Epub 2015 May 13. PMID: 25971721; PMCID: PMC4480666.

7. Cahill NE, Dhaliwal R, Day AG, Jiang X, Heyland DK. Nutrition therapy in the critical care setting: what is "best achievable" practice? An international multicenter observational study. Crit Care Med. 2010 Feb;38(2):395-401. doi: 10.1097/CCM.0b013e3181c0263d. PMID: 19851094.
8. Mikhailov TA, Kuhn EM, Manzi J, Christensen M, Collins M, Brown AM, Dechert R, Scanlon MC, Wakeham MK, Goday PS. Early enteral nutrition is associated with lower mortality in critically ill children. JPEN J Parenter Enteral Nutr. 2014 May;38(4):459-66. doi: 10.1177/0148607113517903. Epub 2014 Jan 8. PMID: 24403379.
9. Mehta NM. Feeding the gut during critical illness--it is about time. JPEN J Parenter Enteral Nutr. 2014 May;38(4):410-4. doi: 10.1177/0148607114522489. Epub 2014 Feb 11. PMID: 24519365.
10. Mehta NM, Skillman HE, Irving SY, Coss-Bu JA, Vermilyea S, Farrington EA, McKeever L, Hall AM, Goday PS, Braunschweig C. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Pediatric Critically Ill Patient: Society of Critical Care Medicine and American Society for Parenteral and Enteral Nutrition. Pediatr Crit Care Med. 2017 Jul;18(7):675-715. doi: 10.1097/PCC.0000000000001134. PMID: 28691958.
11. Tume L.N., Valla F.V., Joosten K., Jotterand Chaparro C., Latten L., Marino L.V., Macleod I., Moullet C., Pathan N., Rooze S., et al. Nutritional Support for Children during Critical Illness: European Society of Pediatric and Neonatal Intensive Care (ESPNIC) Metabolism, Endocrine and Nutrition Section Position Statement and Clinical Recommendations. Intensive Care Med. 2020;46:411–425. doi: 10.1007/s00134-019-05922-5.
12. Meyer R, Harrison S, Sargent S, Ramnarayan P, Habibi P, Labadarios D. The impact of enteral feeding protocols on nutritional support in critically ill children. J Hum Nutr Diet. 2009 Oct;22(5):428-36. doi: 10.1111/j.1365-277X.2009.00994.x. Erratum in: J Hum Nutr Diet. 2009 Dec;22(6):614. PMID: 19743981.
13. Clifford ME, Banks MD, Ross LJ, Obersky NA, Forbes SA, Hegde R, Lipman J. A detailed feeding algorithm improves delivery of nutrition support in an intensive care unit. Crit Care Resusc. 2010 Sep;12(3):149-55. PMID: 21261571.
14. Petrillo-Albarano T, Pettignano R, Asfaw M, Easley K. Use of a feeding protocol to improve nutritional support through early, aggressive, enteral nutrition in the pediatric intensive care unit. Pediatr Crit Care Med. 2006 Jul;7(4):340-4. doi: 10.1097/01.PCC.0000225371.10446.8F. PMID: 16738503.
15. Tume LN, Ista E, Verbruggen S, Jotterand Chaparro C, Moullet C, Latten L, Marino LV, Valla FV. Practical strategies to implement the ESPNIC Nutrition Clinical recommendations into PICU practice. Clin Nutr ESPEN. 2021 Apr;42:410-414. doi: 10.1016/j.clnesp.2021.01.005. Epub 2021 Jan 28. PMID: 33745616.
16. Goday PS, Braunschweig C. Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Pediatric Critically Ill Patient: Society of Critical Care Medicine and American Society for Parenteral and Enteral Nutrition. Pediatr Crit Care Med. 2017 Jul;18(7):675-715. doi: 10.1097/PCC.0000000000001134. PMID: 28691958.
17. Amirjani, S., Ahmadizadeh, N., Behzad, A. et al. Undernutrition and 60-day mortality in critically ill children with respiratory failure: a prospective cohort study. BMC Pediatr 23, 271 (2023). https://doi.org/10.1186/s12887-023-04087-x.
18. de Souza Menezes F, Leite HP, Koch Nogueira PC. Malnutrition as an independent predictor of clinical outcome in critically ill children. Nutrition. 2012;28(3):267–70.
19. Hulst J, Joosten K, Zimmermann L, Hop W, van Buuren S, Büller H, Tibboel D, van Goudoever J. Malnutrition in critically ill children: from admission to 6 months after discharge. Clin Nutr. 2004 Apr;23(2):223-32. doi: 10.1016/S0261-5614(03)00130-4. PMID: 15030962.
20. Abera EG, Sime H. The prevalence of malnutrition among critically ill children: a systematic review and meta-analysis. BMC Pediatr. 2023 Nov 21;23(1):583. doi: 10.1186/s12887-023-04419-x. PMID: 37986053; PMCID: PMC10662698.
21. Rohani P, Alimadadi H, Mirrahimi B, Yaghmaie B, Hashemis SM, Ahmadizadeh SN, et al. Nutritional section position statement and clinical practice recommendations for children admitted to intensive care unit. Iran J Pediatr. (2022) 32:e119824. doi: 10.

5812/ijp-119824.
22. Ventura JC, Oliveira LDA, Silveira TT, Hauschild DB, Mehta NM, Moreno YMF; PICU-ScREEN Study Group. Admission factors associated with nutritional status deterioration and prolonged pediatric intensive care unit stay in critically ill children: PICU-ScREEN multicenter study. JPEN J Parenter Enteral Nutr. 2022 Feb;46(2):330-338. doi: 10.1002/jpen.2116. Epub 2021 May 1. PMID: 33818806.
23. Misirlioglu M, Yildizdas D, Ekinci F et al. . Evaluation of nutritional status in pediatric intensive care unit patients: the results of a multicenter, prospective study in Turkey. Front Pediatr. 2023 Aug 3;11:1179721. doi: 10.3389/fped.2023.1179721. PMID: 37601138; PMCID: PMC10436004.
24. Seifu A, Eshetu O, Tafesse D, Hailu S. Admission pattern, treatment outcomes, and associated factors for children admitted to pediatric intensive care unit of Tikur Anbessa specialized hospital, 2021: a retrospective cross-sectional study. BMC Anesthesiol. 2022 Jan 6;22(1):13. doi: 10.1186/s12871-021-01556-7. PMID: 34991462; PMCID: PMC8734244.
25. Teka SG, Kebede RA, Sherman C. The prevalence of malnutrition during admission to the pediatric intensive care unit, a retrospective cross-sectional study at Tikur Anbessa Specialized Hospital, Addis Ababa, Ethiopia. Pan Afr Med J. 2022 Jan 27;41:77. doi: 10.11604/pamj.2022.41.77.31284. PMID: 35382053; PMCID: PMC8956830.