Benha Journal of Applied Sciences (BJAS) **print: ISSN 2356–9751**
Vol. (7) Issue (1) (2022), (101- 107) **online: ISSN 2356–976x**
http://bjas.journals.ekb.eg

Evaluation of Nutritional Support of Critically Ill Patients Admitted To Pediatric Intensive Care and Its Correlation to Their Outcome

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Abstract

Background; Critically ill children have a high incidence of malnutrition on admission to the pediatric intensive care unit and low metabolic reserves. The aim of this study was to assess nutritional support to pediatric critically ill patients admitted to Pediatric Intensive Care Unit (PICU) and its correlation with their outcome as regarding to need for mechanical ventilation, acquired infection, metabolic complications, and mortality. Methods; This study was conducted on **75** pediatric critically ill patients admitted to PICU, 25 patients were supported by enteral nutrition. 25 patients with inadequate enteral nutrition were supported by complementary parenteral nutrition and **25** patients were supported by total parenteral nutrition due to their contraindications to EN.All included patients were subjected to full history taking, thorough clinical examination , laboratory investigations were done :complete blood picture, serum electrolytes (Na, K, Ca, Po4 and Mg), renal functions, liver functions, serum albumin and C reactive protein. Results; only 73.3% of patients in enteral nutrition group and 83.3% of complementary parenteral nutrition reach target calories on discharge from PICU in contrast to total parenteral nutrition group as all patients reach target caloric requirements on discharge from PICU.There were significant higher prevalence of metabolic complication, need of mechanical ventilation, mortality and higher mean values of length of hospital stay among high malnutrition risk cases. Conclusion; achievement of target caloric requirements during PICU stay improves outcome as regard need for mechanical ventilation, length of hospital stay and mortality, regardless of route of nutritional support.

Keywords: Nutritional Support, Critically Ill, PICU, Outcome**.**

1. Introduction

Nutrition is an important component of patient management in the Pediatric Intensive Care Unit (PICU). Critically ill infants and children may have an increased metabolic need, which predisposes them to nutritional deterioration during illness [1]**.**

Associations have been reported between poor nutritional status, decreased respiratory function, impaired wound healing, and immune and gastrointestinal dysfunctions**.** In addition, malnutrition has been identified as an independent factor for higher rate of nosocomial infections, which has become one of the most severe clinical outcomes associated with substantial morbidity and mortality, prolonged hospital stay and increased economic burden [2].

The American Society of Parenteral and Enteral Nutrition (A.S.P.E.N.) guidelines recommend that nutritional assessment on admission to the PICU is necessary to identify children at risk and to guide nutrition support in the PICU [3]**.**

Controversy persists about the optimal means of providing adjuvant nutritional support, Early enteral feeding approach has been preferred based on several guidelines with improved clinical outcomes compared with parenteral nutrition (PN) approach**.** However, critically ill patients often cannot meet their energy target due to various situations and interruptions, such as surgery or gastrointestinal intolerance. Therefore, parenteral nutrition approach was taken for critically ill patients [4]**.**

The current European and American guidelines for nutrition recommend early PN to prevent/correct malnutrition and to sustain appropriate growth when enteral nutrient (EN) supply is insufficient [5]**.**

The aim of this studywas to assess nutritional support to pediatric critically ill patients admitted to Pediatric Intensive Care Unit (PICU) and its correlation with their outcome as regarding to need for mechanical ventilation, acquired infection, metabolic complications, and mortality.

2. Patients and methods

This a prospective observational clinical study was conducted on 75 critically ill pediatric patients admitted into Pediatric Intensive Care Unit (PICU) of Banha University Hospital from January 2020 to August 2021.

Ethical scientific committee of the Faculty of Medicine, Banha University approved the study protocol and informed consent was taken from the parents before enrollment of their children in the study.

Inclusion criteria

Patients admitted to Pediatric Intensive Care Unit (PICU) with the following Criteria:

- Age: older than one month and less than 18 years.
- Length PICU stay was > 48 hours.

Exclusion criteria

- Age: < one month and > 18 years.
- Length PICU stay was ≤ 48 hours.
- Patients referred with nutritional regimen or metabolic disease e.g. patients on ketogenic diet and patients with inborn errors of metabolism.
- Did not give consent.
- All included Patients were categorized into three groups according to route of nutritional support:
- **Group (1):** 25 patients supported by enteral nutrition (EN).

- **Group (2):** 25 patients supported by Complementary /supplementary parenteral nutrition due to inadequate EN intake.
- **Group (3):** 25 patients supported by total parenteral nutrition (PN) as EN was contraindicated for them.

All patients were subjected to full history taking, complete clinical examination,, and investigations on admission and followed up weekly (or more if needed e.g. TPN monitoring) and included complete blood picture, random blood sugar, electrolytes: Na, K, Ca, Po4 and Mg, renal function (blood urea nitrogen and serum creatinine), liver function (AST and ALT), albumin, triglyceride and C reactive protein (CRP).

Nutritional support was started 48 hours after PICU admission. The patients' target caloric requirements were calculated using Schofield equation weight and height without stress **factor.** The route of nutritional support was selected according to medical condition, hemodynamic stability and feeding tolerance.

- **Group 1:** Included 25 patients with functioning GIT and had no contraindications to enteral nutrition and were supported by enteral nutrition alone
- **Group 2:** Included 25 patients with inadequate enteral nutrition (mean EN caloric delivery < 30 % of target and not expected to exceed > 60% of target on day 7 from admission) and were supported by complementary parenteral nutrition with the enteral nutrition to reach target caloric requirements with preservation of enteral feeding.
- **Group 3:** Included 25 patients who had absolute contraindications to enteral nutrition and were supported by total parenteral nutrition

Evaluation of outcome as regard:

- Length of hospital stay
- Need for mechanical ventilation
- Infection
- Metabolic complications
- Mortality

Statistical analysis

Results were collected, tabulated and statistically analyzed by an IBM compatible personal computer with SPSS statistical package version 23 (SPSS Inc. Released 2015. IBM SPSS statistics for windows, version 23.0, Armnok, NY: IBM Corp.). Two types of statistical analysis were done: Descriptive statistics e.g. was expressed in Number (No), percentage (%) mean ($\bar{x}$) and standard deviation (SD). Analytic statistics e.g. Mann Whitney's test was used for comparison of quantitative variables between two groups of not normally distributed data. ANOVA test was used for comparison of quantitative variables between more than two groups of normally distributed data. Kruskal Wallis test was used for comparison of quantitative variables between more than two groups of not normal distributed data. Chi-square test (χ^2) was used to study association between qualitative variables. P- value of < 0.05 was considered statistically significant.

3. Results

This study included 75 patients admitted to PICU, and were categorized into three groups according to route of nutritional support; **Group (1):**25 patients were supported by enteral nutrition (EN). **Group (2):** 25 patients were supported by Complementary /supplementary parenteral nutrition due to inadequate EN intake. **Group (3):** 25 patients were supported by total parenteral nutrition (PN) as EN was contraindicated for them.

The mean age of the studied group was 22.16±4.7 months, and consisted of 40 males and 35 females, 50.6% of them had a history of chronic diseases. There was no significant difference between the studied groups as regards their age, sex, or history of chronic disease. table (1)

On PICU admission 34.6% of cases were malnourished, however 73.3% had malnutrition risk by PYMS score , as regards PRISM score the mean score in the studied patients was 6.89±6.4, there were no significant differences between the studied groups. 15% of patients required MV on admission; all of them had parenteral nutrition. table (2)

Table (1) Demographic characteristics of patients among the studied groups on admission.

Variables		Enteral N N		Complementary PN		Parenteral N		Total		Test	p-value
		N=25	%	N=25	%	N=25	%	N=75	%		
Age (month)	**Mean± SD**	24.13±3.24		23.79±1.9		24.36±5.7		22.16±4.7		F=1.81	0.833
Sex	**Male**	15	60%	12	48%	13	52%	40	53.3%	χ^2= 1.16	0.559
	Female	10	40%	13	52%	12	48%	35	46.7%		
History of chronic disease		12	48%	16	64%	10	40%	38	50.6%	χ^2= 4.77	0.074
Past History of: Prematurity											
Bad nutritional Delayed		0	0%	1	4%	2	8%	3	4%	χ^2= 2.9	0.092
development		3	12%	5	20%	1	4%	9	12%		
Recurrent infection		6	24%	5	20%	5	20%	16	21.3%		
		3	12%	5	20%	2	8%	10	13.3%		

SD = standard deviation, χ2= chi-square test, K= Kruskall-Wallis test, F=ANOVA test

Table (2) Clinical and nutritional characteristics of patients among the studied groups on admission**.**

Variables		Enteral N N=25	%	Complementary PN N=25	%	Parenteral N N=25	%	Total N=75	%	Test	p-value
PYMS classification	**No risk (0-1)**	9	36%	7	28%	4	16%	20	26.7%	$\chi2$= 8.75	**0.013***
	Malnutrition Risk (≥ 2)	16	64%	18	72%	21	84%	55	73.3%		
PYMS score	**Mean± SD**	2.67±1.67		3.70±1.73		3.43±1.43		3.1±1.42		K=3.32	**0.041***
	Median	2		4		4		4			
	Range	0-5		1-6		1-7		0-7			
Malnutrition **		6	24%	10	40%	10	40%	26	34.6%	$\chi2$=2.3	0.435
PRISM score:	**Mean± SD**	7.07±4.71		7.63±7.48		6.27±8.03		6.89±6.4		K=0.62	0.743
	< 10	15	60%	17	68%	18	72%	50	66.7%	$\chi2$= 0.76	0.683
	≥ 10	10	40%	8	32%	7	28%	25	33.3%		
MV on admission		0	0%	0	0%	12	48%	12	15%	$\chi2$=7.4	0.023*

Malnutrition ** defined as WHO Z score BMI<−2SD in > 2 years and z score, WT/L<−2SD in < 2 years.

There was no significant difference between the studied groups regarding Hb, WBCs, platelets, CRP, or Albumin on admission. table (3)

Table (3) laboratory investigations on admission for the studied groups.

Variables		Enteral N	Complementary PN	Parenteral N	Total	Test	p-value
Hb (gm/dl)	**Mean± SD**	10.28±2.24	10.71±1.90	9.62±2.10	10.20±2.11	K=2.05	0.135
	Median	10.15	10.85	9.7	10		
	Range	5.4-15.0	5.6-14.4	3-13.4	3-15		
WBCs	**Mean± SD**	14.98±10.14	13.78±14.81	10.58±5.70	12.45±11.16	K=1.35	0.140
(*1000/ul)	**Median**	12.2	11.75	9.8	12		
	Range	1.1-48	3-44	0.4-23	0.4-74		
Platelets	**Mean± SD**	369.7±222.6	376.2±221.6	430.7±225.6	358.9±230.7	K=2.03	0.121
(*1000/ul)	**Median**	303.5	307	435	318.5		
	Range	21-904	16-806	36-971	16-971		
CPR (mg/l)	**Mean± SD**	62.09±86.48	55.08±52.18	48.33±57.54	55.17±66.59	K=0.32	0.730
	Median	24	48	48	48		
	Range	0-318	0-220	0-251	0-318		
Albumin	**Mean± SD**	3.61±1.04	3.65±0.60	3.61±0.93	3.62±0.87	K=0.02	0.983
(gm/dl)	**Median**	3.9	3.7	4.0	3.8		
	Range	0.7-4.9	2.3-4.8	0.7-4.9	0.7-4.9		

K: Kruskall-Wallis test

The nutritional support was started in the third day of PICU admission in 88% of cases and median of target requirements achievement on the seventh day. All patient received PN reached the target calories followed by complementary PN group while EN group was the least one in reaching the target (100%, 80% & 68% respectively). table (4)

Table (4) Time of initiation and reach of target calories for the studied groups.

Variables		Enteral N N=25	%	Complementary PN N=25	%	Parenteral N N=25	%	Total N=75	%	Test	p-value
Initiation at day:	**2**	0	0%	2	8%	5	20%	7	9.3%	$\chi2$= 1.75	0.313
	3	25	100%	21	84%	20	80%	66	88%		
	>3	0	0%	2	8%	0	0%	2	2.7%		
Reach of target calories*	**Yes**	17	68%	20	80%	25	100%	62	82.7%	$\chi2$= 8.08	0.012*
	No	8	32%	5	20%	0	0%	13	17.3%		
Day of target calories reach	**Mean± SD**	6.67±4.46		7.57±3.01		6.17±2.90		6.76±3.54			
	Median	7		8		7		7		K=1.27	0.287
	Range	6-15		6-14		6-10		6-15			

***target calories calculated for each patient based on schofield equation weight/height, SD = standard deviation, $\chi2$= chi-square test, K= Kruskall-Wallis test,**

After one week of admission to PICU, weight was the same in 69.4% of cases. There was a significant difference as regards the prevalence of metabolic complications as it was absent in complementary PN and in parenteral N groups while present in 20% of Enteral N group. There was a significant difference as regards the use of mechanical ventilation where no cases used MV in PN group while 24% and 20% in complementary PN and in EN groups respectively need MV. There was a statistical difference between groups as regards mortality as it was 16% in complimentary group PN, and 24% in parenteral NN group, while no mortality was detected in Enteral N group. However, there was no significant difference between groups regarding acquiring sepsis. table 5

Mean duration of PICU stay was 13.37 days in enteral N group, and 19.13 days in complementary N group , and prolonged up to 27.2 days in parenteral N group, p<0.001. Also, the mean duration of MV was 6.71 days in enteral N group, and 9.44 days in complementary N group , and prolonged up to 17.33 days in parenteral N group, p<0.001.Weight on discharge increased in 5.3% of cases and decreased in 18.7% in cases. Despite change of weight WT/L & BMI of cases did not change. Overall mortality rate was 26.7%. Upon discharge: there was no significant difference between the studied groups as regards change of weight, sepsis or mortality rate. table 6

There were significant higher prevalence of metabolic complication, need of mechanical ventilation, mortality and higher mean values of length of hospital stay among high malnutrition risk cases who did not reach target calories than those who reached target (p-value = <0.001, 0.001, = <0.001 and 0.009 respectively). On the other hand, all patients with no malnutrition risk reach target calories and only two cases needed mechanical ventilation and died (5.6%). table (7)

Table (5) Clinical parameters for the studied groups after one week.

Variables		Enteral N		Complementary PN		Parenteral N		Total		Test	p-value
		N=25	%	N=25	%	N=25	%	N=75	%		
Weight	**Decreased**	5	20%	2	8%	2	8%	9	12%	$\chi2$= 11.7	0.073
	Increased	1	4%	2	8%	1	4%	4	5.3%		
	Same	19	76%	17	68%%	16	64%	52	69.4%		
	NA	0	0%	4	16%	6	24%	10	13.3%		
Metabolic complication**		5	20%	0	0%	0	0%	5	6.7%	$\chi2$=8.37	0.015*
Need of MV		6	24%	5	20%	0	0%	11	14.7	$\chi2$=7.44	0.039*
Sepsis:		4	16%	5	20%	7	28%	16	21.3%	$\chi2$=1.22	0.433
Mortality within the 1st week		0	0%	4	16%	6	24%	10	13.3%	$\chi2$=7.44	0.041*

NA: not applicable (due to death during the first week),*: significant, ** metabolic complication: include 2 cases with hypocalcaemia, 2 cases with hypokalemia and 1 case with hypernatremia. $\chi2$= chi-square test,

Table (6) Clinical and nutritional outcomes among studied groups on discharge.

Variables		Enteral N N		Complemen tary PN		Parenteral N		Total		Test	p-value
		N=25	%	N=25	%	N=25	%	N=75	%		
Weight	**Decreased**	7	28%	4	16%	3	12%	14	18.7%	$\chi2$= 10.8	0.066
	Increased	1	4%	2	8%	1	4%	4	5.3%		
	Same	14	56%	12	36%	13	56%	39	52%		
	NA*	3	12%	7	28%	8	32%	18	24%		
WT/L (< 2 years)	**<-2**	10	40%	8	32%	9	36%	27	36%	$\chi2$= 10.6	0.063
or	**>+2**	2	8%	2	8%	2	8%	6	8%		
BMI(> 2 years)	**Normal**	13	52%	15	60%	14	56%	42	56%		
Duration of MV (Mean± SD)		6.71±4.3		9.44±5.14		17.33±8.33		13.44±6.31		K= 5.23	0.001*
PICU stay /day (Mean± SD)		13.37±7.37		19.13±25.58		27.20±10.07		21.90±17.59		K= 7.51	0.001*
Sepsis		4	16%	5	20%	8	32%	17	22.7%	$\chi2$=1.22	0.433
Mortality		5	20%	7	28%	8	32%	20	26.7%	$\chi2$=3.44	0.141

*** Significant, **Wt. on discharge: compared to admission weight, $\chi2$= chi-square test,**

Table (7) Relationship between adequacy of nutritional support and outcome parameters.

Variables	Target calories reach				Test	p-value
	Yes		No			
	N=62	%	N=13	%		
Sepsis	7	11.3%	10	76.9%	$\chi2$= 13.6	**<0.001***
MV	5	8%	6	46.1%	$\chi2$=10.7	**<0.001***
Metabolic complication	0	0%	5	38.5%	$\chi2$=12.7	**<0.001***
Mortality	13	20.9%	7	53.9%	$\chi2$= 7.3	**0.041***
Length of hospital stay/ days (Mean± SD)	10.4±5.34		29.1±11.7		U= 9.5	**<0.001***

4. Discussion

In the current study, On PICU admission 34.6% of cases were malnourished, however 73.3% had malnutrition risk by PYMS score, as regards PRISM score there were no significant differences between the studied groups.

In the same way **Caggiano et al,**[6], reported that 29% of cases were underweight (weigh for age Z-score < −2), Children with malnutrition required more antibiotic treatment ($p < 0.05$), but they did not show significant differences from other patients in terms of severity, deaths, comorbidities, or the need for medical intervention and length of stay.

Also **El Koofy et al,**[7], who studied the effect of high fat dietary modification and nutritional status on the outcome of critically ill ventilated children, observed that malnutrition was highly prevalent (defined as World Health Organization z scores ≤ -2 standard deviation [SD]) in terms of the following parameters: weight-for-age (n=35, 68.6%), weight-for-length (n=32, 62.7%) and BMI-for-age (n=31, 60.8%).

Underweight could be a symptom of an underlying disease or reason for admission that relates to mortality risk. Underweight children may also have impaired immune function that could limit their defence against infections. Furthermore, critically ill children are at risk of further nutritional deterioration during their illness course due to disease or barriers to nutrient delivery in the Intensive Care Unit [1]**.**

In this study, as regards PRISM score, the mean score in the studied patients was 6.89±6.4, there were no significant differences between the studied groups. (PRISM done within 24 hour of PICU admission) before starting nutritional support and this was proved by no significant difference on mortality among groups despite different routes of nutritional support.

The PRISM score is a measure of illness severity based on abnormalities found on bedside examination and with laboratory assessment. PRISM III score is very useful in estimating the risk of mortality, prognosis and to evaluate quality of care. PRISM III score is one of the main indicators used in PICU. There are 14 parameters (physiological and laboratory) and each parameter records highest severity value in first 24 hours. [8]**.**

In the current study, 15% of patients required MV on admission; all of them had parenteral nutrition. Our results came near to previous studies as in the study by**Sahoo et al,** [9]**,** A total of 1172 patients were admitted to PICU, 101 (8.6%) patients required MV. and in the study by **Albuali et al**, [10], who reported that the incidence rate of mechanical ventilation among children admitted to the PICU within the last 5 years was 28.90% (n = 400). While in the study by **Mukhtar et al**, [11], 307 (50.7%) patients required MV support for >24hr.

In our study, nutritional support was started in the third day of PICU admission in 88% of cases and median of target requirements achievement on the seventh day. All patient received PN reached the target calories followed by complementary PN group while EN group was the least one in reaching the target (100%, 80% & 68% respectively).

Similarly, in **Woodcock et al.,** [12]**,** reported that EN is associated with a significantly higher incidence (75%) of failure to achieve target intakes than TPN (25%), $p<0.001$.

Fluid restriction, feeding intolerance and interruption of EN for procedures are some of the factors responsible for energy and protein deprivation in managing pediatric critical illness. On average, nearly half the patients in most reports fail to reach nutrition goals, with 37%–70% of prescribed energy delivered prior to discharge from the PICU [13]**.**

In the current study, after one week of admission to PICU, weight was the same in 69.4% of cases. There was a significant difference as regards the prevalence of metabolic complications as it was absent in complementary PN and in parenteral N groups while present in 20% of Enteral N group. There was a significant difference as regards the use of mechanical ventilation where no cases used MV in PN group while 24% and 20% in complementary PN and in EN groups respectively need MV. There was a statistical difference between groups as regards mortality as it was 16% in complimentary group PN, and 24% in parenteral NN group, while no mortality was detected in Enteral N group. However, there was no significant difference between groups regarding acquiring sepsis.

In the study by **Mehta et al,** [13]**,** Enteral nutrition was used in 67% of the patients and was initiated within 48 hrs of admission in the majority of patients. Enteral nutrition was subsequently interrupted on average for at least 2 days in 357 of 500 (71%) patients. Mean (sd) percentage daily nutritional intake (enteral nutrition) compared to prescribed goals was 38% (34) for energy and 43% (44) for protein. A higher percentage of goal energy intake via enteral

nutrition route was significantly associated with lower 60-day mortality (Odds ratio for increasing energy intake from 33.3% to 66.6% is 0.27 [0.11, 0.67], p = 0.002). Mortality was higher in patients who received parenteral nutrition (odds ratio 2.61 [1.3, 5.3], p = 0.008).

However, **Woodcock et al,** [12], reported that the incidence of other feed-related complications was also significantly higher in both EN groups compared with the receptive TPN groups. The complications associated with TPN were fluid overload (21/267, 7.9%) and metabolic, such as hyperglycemia, hyperkalemia, and abnormal liver function (10/267, 3.7%). In the patients receiving EN the most frequent such complications were diarrhea (30/231, 13.0%) and large volume nasogastric aspirates (27/231, 11.7%). Other complications included vomiting and abdominal bloating.

In this study, There was no significant difference between mean PYMS at admission and at 1 week after admission, (there was no detected deterioration in nutritional status one week after admission).

In the study by **Allard et al,** [14]. At admission, 49% of patients were well nourished (SGA A), 37% were moderately malnourished (SGA B) and 14% were severely malnourished (SGA C). From admission to discharge, 34% remained well-nourished, 29% remained malnourished (SGA B or C), 20% deteriorated and 17% improved. Of the 409 patients, 373 had weight measurements at admission and discharge: 92 (25%) had ≥5% weight loss. Multivariate models showed that after adjusting for covariates, decline in nutritional status from SGA A to B/C or SGA B to C (HR: 0.62, CI: (0.44, 0.87); HR: 0.35, CI: (0.20, 0.62) respectively) and weight loss ≥5% (HR: 0.52; CI: 0.40, 0.69) were significantly associated with longer LOS.

In the present study, Mean duration of PICU stay was 13.37 days in enteral N group, and 19.13 days in complementary N group , and prolonged up to 27.2 days in parenteral N group, p<0.001. Also, the mean duration of MV was 6.71 days in enteral N group, and 9.44 days in complementary N group , and prolonged up to 17.33 days in parenteral N group, p<0.001.Weight on discharge increased in 5.3% of cases and decreased in 18.7% in cases. Despite change of weight WT/L & BMI of cases did not change. Overall mortality rate was 26.7%. Upon discharge: there was no significant difference between the studied groups as regards change of weight, sepsis or mortality rate.

This was in agreement with **Grippa et al.,** [15]**,** who showed that duration of mechanical ventilation was 3–11.5 days with significant relation with malnutrition as patients classified as malnourished had longer duration of mechanical ventilation.

In the same way, **Bagri et al,**[4], observed no significant difference between mortality rates and number of ventilated children in the three study groups. Children who were severely malnourished had significantly prolonged PICU stay as well as duration of mechanical ventilation

Various studies have reported several adverse effects of malnutrition on respiratory function. Besides affecting ventilatory drive and pulmonary defense mechanisms, malnutrition depletes energy reserve, causes loss of muscle mass, and may lead to electrolyte disturbances including hypophosphatemia which can be associated with reduced muscle contractile strength [16]**.** Oxidative stress as a result of micronutrient deficiencies secondary to malnutrition may worsen and play an important role in ventilator-induced diaphragmatic dysfunction. Respiratory muscle weakness may prolong respiratory failure and delay the weaning from mechanical ventilation [4]**.**

Mortality rates reported in developing countries varied from 9.8-35%, often these patients arrived late with multiple complications leading to death despite the best available therapy [17]**.** In the present study, the mortality rate was 26.7%, which come in line with **Ballot et al.,** [18] study in South Africa done from January 2015 to December 2017 showed that mortality rate was 27.1% and with **Grippa et al.,** [15]study with 27.8% mortality. However in the study by **Valavi et al,**[19], The mean duration of hospitalization was 3.3 (SD = 3.7) days. The mortality rate was 16.5%.

5. Conclusion

Achievement of target caloric requirements during PICU stay improves outcome as regard need for mechanical ventilation, length of hospital stay and mortality, regardless of route of nutritional support. We recommend that nutritional plan must be tailored to each patient according to nutritional state, disease severity and patient tolerance when oral intake cannot be resumed after 48 hour of admission.

References

[1] L. N. Tume *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.*, vol. 46, pp. 411–425, 2020.

[2] T. Fivez *et al.*, "Impact of withholding early parenteral nutrition completing enteral nutrition in pediatric critically ill patients (PEPaNIC trial): study protocol for a randomized controlled trial," *Trials*, vol. 16, pp. 1–9, 2015.

[3] C. Y. Chong, "Prevention of nosocomial bacterial infections in pediatrics and neonatology," *J. Microbiol. Immunol. Infect.*, vol. 48, p. S12, 2015.

[4] N. K. Bagri, B. Jose, S. K. Shah, T. D. Bhutia, S. K. Kabra, and R. Lodha, "Impact of malnutrition on the outcome of critically ill children," *Indian J. Pediatr.*, vol. 82, pp. 601–605, 2015.

[5] U. G. Kyle, A. Akcan-Arikan, R. A. Orellana, and J. A. Coss-Bu, "Nutrition support among critically ill children with AKI," *Clin. J. Am. Soc. Nephrol.*, vol. 8, pp. 568–574, 2013.

[6] S. Caggiano ."Factors that negatively affect the prognosis of pediatric community-acquired pneumonia in district hospital in Tanzania," *Int. J. Mol. Sci.*, vol. 18, pp. 623, 2017.

[7] N. M. El Koofy, H. I. Rady, S. M. Abdallah, H. M. Bazaraa, W. A. Rabie, and A. A. El-Ayadi, "The effect of high fat dietary modification and nutritional status on the outcome of critically ill ventilated children: single-center study," *Korean J. Pediatr.*, vol. 62, pp. 344, 2019.

[8] R. Bora, "Prediction of mortality by pediatric risk of mortality (PRISM) III score In NGMC pediatric intensive care unit," *J. Nepalgunj Med. Coll.*, vol. 17, pp. 5–9, 2019.

[9] B. Sahoo, M. K. Jain, B. Thakur, R. Mishra, and S. Patnaik, "Demographic Profile and Outcome of Mechanically Ventilated Children in a Tertiary Care Hospital of a Developing Country.," *J. Nepal Paediatr. Soc.*, vol. 38, pp. 2-12, 2018.

[10] W. H. Albuali . "Use of a Mortality Prediction Model in Children on Mechanical Ventilation: A 5-Year Experience in a Tertiary University Hospital," *J. Multidiscip. Healthc.*, vol. 13, pp. 1507, 2020.

[11] B. Mukhtar, N. R. Siddiqui, and A. Haque, "Clinical characteristics and immediate-outcome of children mechanically ventilated in PICU of Pakistan," *Pakistan J. Med. Sci.*, vol. 30, pp. 927, 2014.

[12] N. P. Woodcock, D. Zeigler, M. D. Palmer, P. Buckley, C. J. Mitchell, and J. MacFie, "Enteral versus parenteral nutrition: a pragmatic study," *Nutrition*, vol. 17, pp. 1–12, 2001.

[13] N. M. Mehta . "Nutritional practices and their relationship to clinical outcomes in critically ill children—an international multicenter cohort study," *Crit. Care Med.*, vol. 40, pp. 2204, 2012.

[14] J. P. Allard . "Decline in nutritional status is associated with prolonged length of stay in hospitalized patients admitted for 7 days or more: A prospective cohort study," *Clin. Nutr.*, vol. 35, pp. 144–152, 2016.

[15] R. B. Grippa, P. S. Silva, E. Barbosa, N. L. Bresolin, N. M. Mehta, and Y. M. F. Moreno, "Nutritional status as a predictor of duration of mechanical ventilation in critically ill children," *Nutrition*, vol. 33, pp. 91–95, 2017.

[16] J. F. S. e Meneses, H. P. Leite, W. B. de Carvalho, and E. Lopes Jr, "Hypophosphatemia in critically ill children: prevalence and associated risk factors," *Pediatr. Crit. Care Med.*, vol. 10, pp. 234–238, 2009.

[17] A. Haque and S. Bano, "Improving outcome in pediatric intensive care unit in academic hospital in Pakistan," *Pakistan J. Med. Sci.*, vol. 25, p. 605, 2009.

[18] D. E. Ballot, T. Ramdin, D. A. White, and J. Lipman, "A comparison between raw and predicted mortality in a paediatric intensive care unit in South Africa," *BMC Res. Notes*, vol. 11, pp. 1–6, 2018.

[19] E. Valavi, M. Aminzadeh, E. Shirvani, L. Jaafari, and S. Madhooshi, "The Main Causes of Mortality in Pediatric Intensive Care Unit in South West of Iran," *Zahedan J. Res. Med. Sci.*, vol. 20, pp. 54-64, 2018.