Nutritional parameters on admission are predictive of Pediatric Intensive Care Unit (PICU) length of stay in critically ill children

Julia C. Ventura, RD, MSc[1]; Daniela B. Hauschild, RD, PhD[1]; Luna D. A. Oliveira, RD, MSc[1]; Nilesh M. Mehta, MD[2]; Yara M. F. Moreno, RD, PhD[1]

[1] Graduate Program in Nutrition, Federal University of Santa Catarina; Florianópolis, SC, Brazil; [2] Boston Childrens Hospital, Boston, MA, United States

Background: Malnutrition is prevalent in critically ill children admitted to the PICU. Nutritional status on admission may predict clinical outcomes in this population. We aimed to examine clinical and nutritional variables on admission that are predictive of PICU length of stay (LOS).

Methods: Prospective single-center study including children aged 1 month to 15 years who were admitted for at least 48 hours to a medical and surgical PICU in Southern Brazil. Patients who died within 72 hours of admission were excluded. Clinical, demographic, anthropometric, biochemical and nutritional therapy (NT) parameters were recorded at PICU admission. Nutritional status was evaluated by the z-score of weight, body mass index (BMI), mid-upper arm circumference (MUAC) and triceps skinfold thickness. Early NT (within 24 hours of admission) and NT prior to PICU admission were recorded. Duration of mechanical ventilation, PICU and hospital LOS and 60-days and hospital mortality were recorded. Crude and adjusted (for sex, age, Pediatric Index of Mortality 2 and Complex Chronic Conditions) Cox proportional hazards regression analyses were used to investigate the association between predictive variables and time to discharge alive from the PICU. P-value <0.05 was considered significant.

Results: 199 eligible children (median age 23.1 months, 63% male) admitted between July 2013 and February 2016 were included. Based on BMI-for-age z-score, 18% of the children were malnourished and 12% were overweight/obese at PICU admission. Complex chronic condition was present on admission in 23% of the cohort. The median PICU LOS was 7 days and 60-days mortality rate was 12% (Table 1). After adjustment for sex, age, severity of illness, and presence of complex chronic condition, weight-for-age (HR 0.47; 95%CI: 0.29; 0.76; p=0.002) and MUAC-for-age (HR 0.45; 95%CI: 0.21; 0.97; p=0.041) < -2 z-score on admission were associated with a longer time to PICU discharge alive (Table 2). Although NT prior to admission was associated with time to discharge from PICU on crude analysis, this relationship was not sustained on adjusted analysis (Table 2).

Conclusions: Nearly a third of the critically ill children admitted to a PICU in Southern Brazil present with malnutrition. Undernutrition at PICU admission, assessed by a variety of anthropometric parameters, was associated with higher PICU LOS. Future

studies must explore the role of anthropometric variables in the development of a nutrition screening tool that predicts PICU LOS and other relevant clinical outcomes in critically ill children.

Keywords: Length of Stay. Pediatric Intensive Care Units. Nutritional Status. Nutrition Therapy.

Financial Support received from: A masters and doctorate scholarships to Ventura JC, Hauschild DB and Oliveira LDA were awarded by the Coordination for the Improvement of Higher Education Personnel (CAPES). A Doctoral Dissertation Research Award to Ventura JC was awarded by Fulbright Commission.

Table 1 - Baseline characteristics of 199 critically ill children.

Characteristics	**n (%) or Median (IQR)**
Sex, male	126 (63%)
Age, months	23.1 [3.9; 89.1]
PIM2 score, %	4.2 [1.3; 15.7]
Diagnostic category	
Clinical	153 (77%)
Surgical	46 (23%)
Complex Chronic Condition	45 (23%)
Edema at PICU admission	18 (9%)
BMI-for-age category	
Malnourished (< -2 z-score)	33 (18%)
Nourished	133 (70%)
Overweight/obese (> +2 z-score)	23 (12%)
NT prior PICU admission	79 (40%)
NT within 24 h	127 (65%)
Length of stay in PICU, days	7 [4; 12]
Mechanical ventilation in PICU	162 (81%)
Hospital acquired infection	49 (25%)
60-days Mortality	24 (12%)
Hospital Mortality	27 (14%)

PIM2: Pediatric Index of Mortality 2; PICU: Pediatric Intensive Care Unit; BMI: Body Mass Index; NT: nutrition therapy by enteral or parenteral route. IQR: interquartile range

Table 2 – Cox Regression analysis – association between predictive variables and PICU time to discharge alive (days) in critically ill children (n=199).

Variable	Crude analysis		Adjusted analysis [+]	
	HR (95%CI)	**p**	**HR (95%CI)**	**p**
BMI-for-age		0.644		0.177
≥ -2 z-score	Reference		Reference	
< -2 z-score	0.90 (0.59; 1.39)		0.71 (0.43; 1.17)	
Weight-for-age		**0.004**		**0.002**
≥ -2 z-score	Reference		Reference	
< -2 z-score	0.53 (0.34; 0.82)		0.47 (0.29; 0.76)	
MUAC-for-age		**0.026**		**0.041**
≥ -2 z-score	Reference		Reference	
< -2 z-score	0.46 (0.24; 0.91)		0.45 (0.21; 0.97)	
TSF-for-age		0.297		0.199
≥ -2 z-score	Reference		Reference	
< -2 z-score	0.68 (0.34; 1.39)		0.60 (0.27; 1.31)	
Albumin, g/dL		0.177		0.291
≥ 3.0 g/dL	Reference		Reference	
< 3.0 g/dL	0.81 (0.59; 1.10)		0.84 (0.61; 1.16)	
NT prior PICU admission*	0.71 (0.52; 0.98)	**0.036**	0.76 (0.54; 1.06)	0.104
NT within 24 h	1.09 (0.80; 1.50)	0.573	1.06 (0.76; 1.46)	0.757
NT Route				
Fasting	Reference		Reference	
EN or EN+PN	1.49 (0.93; 2.37)	0.096	1.43 (0.85; 2.41)	0.175
PN	1.21 (0.68; 2.15)	0.510	1.30 (0.72; 2.32)	0.380

[+] Adjusted for sex, age, PIM2 and Complex Chronic Conditions.
[*] Receive enteral nutrition or parenteral nutrition prior to PICU admission.
HR: hazard ratio; 95% CI: 95% confidence interval; BMI: body mass index; MUAC: mid-upper arm circumference; TSF: triceps skinfold thickness; NT: nutrition therapy; PICU: Pediatric Intensive Care Unit; EN: Enteral Nutrition; PN: parenteral nutrition.