Prevalence and association of cost and hospital malnutrition in Pediatric Intensive Care Unit Sanglah Hospital during 2015

Daisy Suriadji, Dyah Kanya Wati, I Gusti Lanang Sidiartha, Ida Bagus Suparyatha, I Nyoman Budi Hartawan

Abstract

***Background*: Early nutritional screening and adequate enteral nutrition for critically ill patients, started 24 hours after admission in pediatric intensive care unit (PICU) are accepted to improve health outcomes. Malnutrition prior to admission worsens the prognosis of severely ill children and it will lead to a higher mortality, a longer length of stay, and a higher health cost.**

***Objective*: The main outcome was to investigate the prevalence of hospital malnutrition on admission, discharge, and in-hospital in PICU Sanglah Hospital, Bali during 2015. The secondary outcome was to investigate the association of cost and hospital malnutrition.**

***Methods*: A retrospective study was conducted in PICU Sanglah Hospital, Bali, from January to December 2015.**

***Patients and participants*: Children aged 1 month to 12 years with complete medical records. We assessed the prevalence of hospital malnutrition using WHO Anthro software or WHO AnthroPlus software.**

***Results*: From January to December 2015, there were 477 patients admitted to the PICU and 456 were enrolled in this study. Malnutrition was observed in 72 patients (15.8%) during PICU admission, 56 (17.2%) during discharged, and only 13 (2.9%) suffered from malnutrition during hospitalization. Multivariate analysis showed that malignancy was the only factor associated with in-hospital malnutrition. Malnutrition during admission and discharge were not associated with an increase in the length of hospital stay. But, in-hospital malnutrition was associated with longer length of stay (3.2 vs 14.0 days, p<0.001), and was associated with additional cost of Rp 5,500,000.**

***Conclusion*: Malnutrition was observed in 72 patients during PICU admission, 56 during discharged and only 13 during hospitalization. Hospital malnutrition was associated with additional cost of Rp 5,500,000.**

Key words: Hospital malnutrition, children, intensive care unit.

Introduction

Malnutrition is a broad term that can be used to describe any imbalance in nutrition, even during hospitalization. Malnutrition affects approximately 50% of hospitalized children and 25-70% of critically ill children. Children are very susceptible to nutrition problem, especially when they are ill. In comparison with an adult, a child has lower percentage of muscle mass and fat. Consequently, a child has fewer calorie reservation and higher resting energy expenditure. Therefore, children have poorer tolerance to fasting than adults, more prone to protein depletion and become malnourished. This condition is worsened by growth and development, which require high energy expenditures. (1,2)

Malnutrition in the ill children is associated with altered metabolism and increased or decreased metabolism, and catabolism, and reduced nutrient delivery. In critically ill children, the first body response to the disease is to rapidly decrease metabolic rate, accompanied by a decrease in oxygen consumption, thus reduces energy production. The second phase is a disturbance in hormonal regulation marked by hypercatabolism, negative nitrogen balance, lose weight and muscle mass, and alteration in carbohydrate metabolism. Malnutrition prior admission worsens the prognosis in severely ill children and it will lead to a higher mortality, a longer length of stay, and a higher health cost. (1,3)

From Pediatric Department, Faculty of Medicine, Udayana University, Sanglah Hospital, Bali, Indonesia (Daisy Suriadji, Dyah Kanya Wati, I Gusti Lanang Sidiartha, Ida Bagus Suparyatha, I Nyoman Budi Hartawan).

Address for correspondence:
Dr. Dyah Kanya Wati, MD
Pediatric Consultant, Critical Care Medicine
Udayana University, Sanglah Hospital
Pulau Nias Street, Denpasar 80114, Indonesia
Tel: +62-361-246211
Fax: +62-361-244038
Email: dyahpediatric@yahoo.com

Improvement in the evaluation and monitoring of the nutritional status in the critically ill children will reduce the prevalence of malnutrition in children admitted to the intensive care unit. The main outcome of this study was to investigate the prevalence of hospital malnutrition on admission, discharge, and in-hospital in PICU Sanglah Hospital, Bali during 2015. The secondary outcome was to investigate the association of cost and hospital malnutrition.

Methods

A retrospective study was conducted in PICU, Sanglah Hospital, Bali during January to December 2015. We used consecutive sampling methods. The inclusion criteria were children under 12-year-old, and had a complete medical record in PICU. We collected the patients' anthropometry data from their admissions and on their discharges. The exclusion criteria were patients with edema, ascites, hydrocephalus, organomegaly, and history of low birth weight. We only used the first data for patients who were hospitalized more than once. The sample size was calculated by using a single proportion formula with α 0.05 and 5% precision. A precedent study conducted in our hospital showed the proportion of the in-hospital malnutrition was 17.5%. (4,5) It led to a minimum estimated sample size of 354 subjects. Our study has obtained permission from Ethic Committee of Sanglah Hospital Bali, and the study was conducted according to the principles of the Declaration of Helsinki and the ICH Harmonized Tripartite Guideline for Good Clinical Practice (1996).

The age was determined by the time since birth until the time of admission (in months). The sex was determined based on phenotype appearance and divided to male and female. A low birth weight was defined as birth weight less than 2500 grams.

The anthropometric data were collected by pediatric residents who were on duty in the Nutrition and Metabolic Diseases Subdivision. Weight was measured using baby weight scale for children under 2-year-old and a standing scale for children older than 2. Children were weighed in kilograms with light underclothes or naked and infants were without diapers. The weight was evaluated twice: once on admission and once on discharge. The length was measured in centimeters using a horizontal wooden stadiometer for children under 2-year-old, in a recumbent position. The height was measured in centimeters using a plastic ruler fixed on a wall for children above 2-year-old by standing up close to the wall bare feet. The length was measured by lying in children who were unable to stand. The length or height was measured once on admission with an assumption that it will not changed significantly on discharge.

The weight, height, and age were analyzed based on the World Health Organization (WHO) guidelines. The results were weight-for-age, weight-for-height or stature, body mass index (BMI)-for-age, and weight-for-stature for z-score. Nutritional status was classified according to WHO criteria: underweight when weight-for-stature z-scores less than -2 SD, stunted when stature-for-age z-scores less than -2 SD, and wasted when weight-for-stature z-scores under -2 SD. (3,6)

The diagnosis used in our analysis was the diagnosis made on discharge. A patient was categorized into an emergency or a planned admission case, having a surgery or a medical underlying disease. Moreover, the diagnosis was classified into single and multiple diagnoses. We examined whether there was dysphagia, congenital abnormality, malignancy, or HIV infection. The in-hospital malnutrition was a defined using Walker and Hendricks criteria: decreased of weight >2% within a week, >5% within a month, >7% within 3 months, or >10% within 6 months during hospitalization. This cut-off point was adopted in the absence of specific criteria from the literature on this topic. The length of stay (LOS) was the number of days counted from the day of admission until the day of discharge.

The descriptive data are frequency of sex, age, diagnosis, LOS, malnutrition at the time of admission and discharge, and prevalence of in-hospital malnutrition. A bivariate analysis was performed using chi-square and independent t-test to assess the patient length of stay when in-hospital malnutrition was present or absent.

A logistic regression test was used to obtain the odd ratio (OR) and confident interval 95% (CI 95%). A p value less than 0.05 was considered as statistical significance. The statistical analysis was processed using SPSS 19.0 for Windows.

Results

A total of 477 cases were eligible. Twenty-one were excluded because 4 had incomplete data, 6 had organomegaly, 5 had hydrocephalus, 3 had edema or ascites, and 3 had low birth weight. Thus, the study enrolled the remaining 456 cases. The actual numbers of children were 426. However, 30 of them were admitted to the hospital and PICU twice. In consequence, we analyze them as new cases, resulting in a total of 456. Out of 456, there were 202 (44.3%) males and 254 (55.7%) females,

giving a male-female ratio of 1:1.3. The subject characteristics are shown in **Table 1.**

The subjects were followed from the daily medical record, from their admission to PICU until their discharge from PICU. During the treatment in PICU, 121 died. The prevalence of malnutrition on admission was 15.8% (72/456) and 17.2% (56/326) on discharge. The prevalence of in-hospital malnutrition in PICU was 2.9% (13/456).

We observed that a longer LOS was an important risk factor for in-hospital malnutrition. The data of in-hospital malnutrition (**Table 2**) revealed that there were associations between in-hospital malnutrition with multiple diagnoses, malnutrition on admission and discharge, dysphagia, congenital anomaly, malignancy, and HIV infection. The LOS was longer in children with in-hospital malnutrition (**Table 3**). A multivariate analysis showed that malignancy was the only factor associated with in-hospital malnutrition (**Table 4**).

Discussion

Nutrition is an essential aspect of the clinical management of children admitted to a hospital. But, nutritional support in the critically ill children has not been well investigated. It remains a controversial issue in pediatric critical care. Critical illness often alters cellular energy metabolism, even the exact mechanisms are poorly understood. The metabolic rates in children with critical illness are often under the predicted basal metabolic rate in the first week. And, anabolism does not occur. Overfeeding is challenging more than underfeeding in the first week of illness because the excess protein does not prevent a catabolism but increase the catabolism of body protein. (7)

In-hospital malnutrition has been a worldwide reality and challenge. Its prevalence has been reported to be in the range of 6.1% to 51.6%. (7,8) Malnutrition has a negative impact on the patients' outcome by increasing morbidity, mortality, length of hospital stay, and costs. Despite improvements in intensive care technology, feeding possibilities, and increased awareness of the significance of adequate nutritional support, the prevalence of acute malnutrition remains high in a pediatric intensive care unit. (9,10)

There are several studies about in-hospital malnutrition in children. The incidence of in-hospital malnutrition in Wahidin Sudirohusodo Hospital, Makasar, Indonesia was about 8.9%. (11) The incidence of in-hospital malnutrition in Sanglah Hospital decreased from 30.1% in 2007 to 17% in 2009. (4,5) Our study found the incidence of in-hospital malnutrition in children admitted to PICU was 2.9%. The incidence of in-hospital malnutrition at Sanglah Hospital in 2007 was 30.1% in children under 5-year-old and in 2009 was 17% in all children admitted to our hospital. (4,5) If the PICU in-hospital malnutrition is compared to the total in-hospital malnutrition, the PICU in-hospital malnutrition was very low. It might be because most children in PICU had acute illnesses. It seems that chronic illness more related with in-hospital malnutrition. Our study is similar to other studies which found malnutrition during admission was not related to in-hospital malnutrition, but prolonged hospitalization was associated with in-hospital malnutrition. (12) Nutritional screening, proper nutritional care, and underlying disease treatment become greatly considered to prevent in-hospital nutrition in children.

Acute in-hospital malnutrition has been widely documented in the literature with its prevalence 20-50%. The results vary depend on the patient population, variable definition, and the criteria used to diagnose. (3) Even though every clinician agrees with its importance, there are problems in defining in-hospital malnutrition. In fact, there is not a readily available data can be used as a basis of the cut-off point for the weight loss percentage, which the term ought to be applied. (13,14) Kac took the parameter for in-hospital malnutrition as decreased of z-score of weight for age ≥0.5 SD. (15) Sidiartha used cut off point 0.5 z-score weight for stature. (4) Rocha and Sidiartha applied the criteria for in-hospital malnutrition as a decrease of body weight ≥2% in a week, ≥5% in a month, or ≥10% in 6 months during hospitalization. (5,12) Different results were achieved because of the differences in the range of patient's age, the criteria of in-hospital malnutrition, and also the different pattern of underlying disease in PICU.

LOS was a factor associated with weight loss during hospitalization. (15,16) Our results also showed that in-hospital malnutrition in our PICU was associated with a longer hospital stay, and it led to high-cost hospitalization. In our hospital, longer LOS is associated with additional cost of Rp 5,500,000. In-hospital malnutrition is also associated with the underlying disease and clinical condition. Our study showed that malignancy was associated with in-hospital malnutrition.

In-hospital malnutrition was affected by many factors. Sermet-Gaudelus and colleagues at Necker-Enfants Malades Hospital in Paris showed that most predictive factors of weight loss in children during a hospital stay were poor food intake, pain, and severity of the disease. The combination of these factors was the best predictor whether a pa-

tient was at risk of nutritional depletion. (17) In contrast, exposure to hospital infections and emotional disorders caused by separation from the family environment may reduce appetite, and were reflected in the decreased dietary intake.

The limitation of this study was that we only performed a retrospective examination of the daily nutritional and anthropometry from the medical record. The anthropometry examination was performed only on the admission to and on the discharge from PICU. Prospective studies, with more sensitive tools to assess acute severe illness in children, are needed.

Conclusion

Various definitions were used to describe in-hospital malnutrition. Studies around in-hospital malnutrition are rarely found due to different categories used. The prevalence of in-hospital malnutrition in a pediatric intensive care unit remains substantial. Malnutrition was observed in 72 patients on PICU admission, 56 on discharge and only 13 during hospitalization. Hospital malnutrition was associated with additional cost of Rp 5,500,000.

Table 1. Subject characteristics

Characteristics	Total=456	
	n	Percentage (%)
Sex - Male - Female	 202 254	 44.3 55.7
Hospital admission type - Emergency - Non-emergency	 411 45	 90.0 10.0
Department - Medical - Surgery	 347 109	 76.1 23.1
Malnutrition on admission	72	15.8
Malnutrition on discharge	56	12.2

Table 2. Bivariate analysis of in-hospital malnutrition and its association with the variables

Variables		In-hospital malnutrition				
		Yes		No		p
		n	%	n	%	
Multiple diagnosis	Present Absent	13 0	100 0	54 389	12.2 87.8	<0.001
Malnutrition - On admission	 Present Absent	 12 1	 92.3 7.7	 60 383	 13.5 86.5	<0.001
- On discharge	Present Absent	12 1	92.3 7.7	13 430	2.9 97.1	<0.001
Dysphagia	Present Absent	10 3	76.9 23.1	40 403	9.1 90.9	<0.001
Congenital anomaly	Present Absent	5 8	38.5 61.5	25 418	5.6 94.4	<0.001
Malignancy	Present Absent	0 13	0 100	13 430	2.9 97.1	0.04
HIV infection	Present Absent	5 8	38.5 61.5	23 420	5.2 94.8	<0.001

Table 3. Independent sample t-test for in-hospital malnutrition and mean of length of stay

Group	n	Mean (SD)	Mean difference (95% CI)	p
In-hospital malnutrition - Yes - No	 13 443	 14.000 (1.225) 3.231 (0.663)	 10.869 (10.491-11.247)	<0.001

Table 4. Multivariate analysis of in-hospital malnutrition factors

Factors	Coefficient	p	OR	95% CI
Multiple diagnoses	-1.810	0.086	0.164	0.021-1.291
Dysphagia	0.007	0.993	1.007	0.240-4.221
Congenital anomaly	0.009	0.354	1.009	0.990-1.027
Malignancy	0.013	0.011	1.013	1.003-1.023
HIV infection	0.005	0.412	1.005	0.992-1.019

References

1. Prieto MB, Cid JL. Malnutrition in the critically ill child: the importance of enteral nutrition. Int J Environ Res Public Health 2011;8:4353-66.
2. Barker LA, Gout BS, Crowe TC. Hospital malnutrition: prevalence, identification, and impact on patients and the healthcare system. Int J Environ Res Public Health 2011;8:514-27.
3. Nasar SS, Susanto JC, Lestari ED, Djais J, Prawitasari T. Malnutrisi di Rumah Sakit. In: Sjarif DR, Lestari ED, Mexitalia M, Nasar SS. Editors. Buku Ajar Nutrisi Pediatrik dan Penyakit Metabolik. 1st ed. Jakarta: BP IDAI; 2011. p. 165-76.
4. Sidiartha IGL. Insidens malnutrisi rawat inap pada anak balita di Rumah Sakit Umum Pusat Sanglah Denpasar. Sari Pediatri 2008;9:381-5.
5. Sidiartha IGL. Insidens malnutrisi rumah sakit pada anak di Rumah Sakit Umum Pusat Sanglah Denpasar. Medicina 2012;43:15-8.
6. World Health Organization. Training course on child growth assessment, WHO; lecture given 2008.
7. Joffe A, Anton N, Lequier L, Vandermeer B, Tjosvold L, Larsen B, et al. Nutritional support for critically ill children. Cochrane Database Syst Rev 2016;(5):CD005144.
8. Mokkink LB, van der Lee JH, Grootenhuis MA, Offringa M, Heymans HS, Dutch National Consensus Committee Chronic Diseases and Health Conditions in Childhood. Defining chronic diseases and health conditions in childhood (0-18 years of age): National concensus in the Netherlands. Eur J Pediatr 2008;167:1441-7.
9. Joosten KF, Hulst JM. Malnutrition in pediatric hospital patients: current issues. Nutrition 2011;27:133-7.
10. Correia MI, Campos AC, ELAN Cooperative Study. Prevalence of hospital malnutrition in Latin America: the multicenter ELAN study. Nutrition 2003;19:823-5.
11. Juliaty A. Malnutrisi rumah sakit pada bangsal anak Rumah Sakit Dr. Wahidin Sudirohusodo Makassar. Sari Pediatri 2013;15:65-8.
12. Rocha GA, Rocha EJ, Martins CV. The effects of hospitalization on the nutritional status of children. J Pediatr (Rio J) 2006;82:70-4.
13. Marginean O, Pitea AM, Voidazan S, Marginean C. Prevalence and assessment of malnutrition risk among hospitalzed children in Romania. J Health Popul Nutr 2014;32:97-102.
14. Wonoputri N, Djais JT, Rosalina I. Validity of nutrtitional screening tools for hospitalized children. J Nutr Metab 2014;2014:143649.
15. Kac G, Camacho-Dias P, Silva-Coutinho D, Silveira-Lopes R, Marins VV, Pinheiro AB. Length of stay is associated with incidence of in-hospital malnutrition in a group of low-income Brazilian children. Salud Publica Mex 2000;42:407-12.
16. UNICEF. The state of the world's children. New York, USA: Brodock Press; 2009.
17. Sermet-Gaudelus I, Poisson-Salomon AS, Colomb V, Brusset MC, Mosser F, Berrier F, et al. Simple pediatric nutritional risk score to identify children at risk of malnutrition. Am J Clin Nutr 2000;72:64-70.