DOI: http://dx.doi.org/10.33846/hn50105
http://heanoti.com/index.php/hn

RESEARCH ARTICLE
URL of this article: http://heanoti.com/index.php/hn/article/view/hn50105

Risk Factor of Hospital Malnutrition After Pediatric Nutrition Care Management

Miriawati[1(CA)], Roedi Irawan[2], Boerhan Hidayat[3], Nur Aisiyah Widjaya[4], Meta Herdiana Hanindita[5]
[1(CA)]Department of Pediatrics, Faculty of Medicine, Universitas Airlangga, Indonesia; miria_wati@yahoo.com (Corresponding author)
[2]Department of Pediatrics, Faculty of Medicine, Universitas Airlangga, Indonesia; roedi.dr.rsds@gmail.com
[3]Department of Pediatrics, Faculty of Medicine, Universitas Airlangga, Indonesia; drboerhanhidayat@yahoo.com
[4]Department of Pediatrics, Faculty of Medicine, Universitas Airlangga, Indonesia; nuril08@yahoo.com
[5]Department of Pediatrics, Faculty of Medicine, Universitas Airlangga, Indonesia; metahanindita@yahoo.com

ABSTRACT

Increased prevalence of Hospital Malnutrition (HM) caused by Pediatric Nutrition Care (PNC) has not been implemented and influenced by several risk factors. The aim was to determine the prevalence and risk factors for gender, age, initial nutritional status, admission diagnosis, and length of stay (LOS) of HM after PNC. A cross sectional study was conducted from May 1, 2017 to May 1, 2018 by reviewing the medical record of children who were treated in the pediatric ward Dr. Soetomo Surabaya. The sampling method is total sampling. Hospital malnutrition was defined as weight loss ≥ 2% for LOS <7 days, ≥5% for 7-30 days and ≥ 10% for 1-6 months. Logistic regression was performed, and significance value with p <0.05. There were 736 children who met the inclusion and exclusion criteria. The prevalence of HM after PNC occurred in 5.6% children, which were dominated by 51.2% girls, 73.2% aged 1 month to 5 years, 46.3% well nourished, 61% from respiratory division, and 51.2% with LOS 7 to 30 days. Significant risk factors only from respiratory division (p = 0.033; OR 3.822; CI 95% 1.111-13.146). We conclude that children with admission diagnosis of respiratory division have a risk of HM after PNC.

Keywords: prevalence; hospital malnutrition; pediatric nutrition care; risk factors; children

INTRODUCTION

Hospital malnutrition (HM) remains a widespread problem throughout the world, affecting 2.5–51% of pediatric patients which is related to several risk factors such as age, gender, initial nutritional status, admission diagnosis, length of stay (LOS), and socioeconomic factors.[1-2] According to the American Society of Parenteral and Enteral Nutrition (ASPEN), hospital-acquired malnutrition is a nutritional imbalance that occurs during hospital stay, regardless of whether the patients were malnourished or not on admission.[2] Almost 70% of patients with HM undetected and do not receive adequate treatment. This is due to the lack of attention to PNC, lack of knowledge or strategies for handling nutritional therapy. Hospital malnutrition results in an increase of mortality and morbidity, disease complications, delayed healing, and a higher risk of exposure to infection due to prolonged hospitalization, and higher hospitalization costs.[5] Long-term effects can affect a child's growth and development.[3] Early recognition and prevention of HM is very important to get good outcomes such as decreased hospitalization costs, obtaining a better quality of life, and reducing the psychological burden on parents. At present there is no consensus on how to make the diagnosis or the ideal screening tool to determine the risk of malnutrition in children during hospitalization. Assessment of nutritional status is carried out based on clinical, anthropometric, laboratory, and dietetic analysis. In the pediatric population, a number of screening tools have been validated and recommended for use such as the Screening Tool for the Assessment of Malnutrition in Paediatrics (STAMP), Screening Tool for Risk Of Impaired Nutritional Status and Growth (STRONG kids), Pediatric Nutritional Risk Score (PNRS), Subjective Global Nutritional Assessment (SGNA), Paediatric Yorkhill Malnutrition Score (PYMS) and Nutrition Risk Score (NRS)[4-5]. Pediatric nutritional care for inpatients can prevent HM.[6] The aim of our study is to determine the prevalence and risk factor of HM in children after PNC management.

METHODS

This study was a cross sectional study in pediatric ward Dr. Soetomo hospital Surabaya. The sample was 906 subjects from medical records, but only 736 subjects met inclusion and exclusion criteria. The sampling method was total sampling. This study included subjects aged 1 month to 18 years who are hospitalized from May 1, 2017 to May 1, 2018

with hospital stay >48 hours. Exclusion criteria were admission to pediatric intensive care unit, conditions leading to anasarca (severe liver, renal, or cardiac failure), died during hospitalization, and incomplete medical document data. Data collected included demographics (gender, age), nutritional status at admission, admission diagnosis, and LOS.

Assessment of nutritional status at admission was performed using anthropometric parameters. Body weight is measured by digital scales (baby scale) with an accuracy to 0.01 kg for under 1 year old, for over 1 year old or already able to walk with an accuracy of 0.1 kg by digital trampling scales. Data on length (for children under 1 year) were obtained using a Seca infantometer, accurate to 0.1 cm. Children over 1 year had their height measured in the orthostatic position using a Seca stadiometer, accurate to 0.5 cm.

Nutritional status was determined according to the World Health Organizatio (WHO) 2006 weight-for-length/height Z score (WLZ/WHZ) curve based on age and sex for children under 5 years. Determination of ideal body weight based on the 2000 Center for Diseases Control (CDC) curve for children over 5 years. Ideal body weight is obtained from height-age, which is to draw a horizontal line from the actual length that cut the 50th percentile. Nutritional status is obtained by calculating the percentage of actual weight to ideal body weight. Calculation of body mass index (BMI) by weight divided by height squared (kg/m^2) for overweight or obese children. The 2006 WHO BMI curve is for children under 2 years, while the 2000 CDC BMI curve for over 2 years. Patients with a BMI above the 85^{th} percentile but less than 95 are considered overweight and those with a BMI above 95^{th} percentile are considered obese.[6] Mid-upper arm circumference (MUAC) was measured in patient with organomegaly ot tumors that use a medline tape meter with an accuracy of 0.1 cm. Body weight were obtained at admission and discharge.[7] Hospital malnutrition was characterized by ≥ 2% weight loss in ≤ 7 days or ≥ 5% in 8 to 30 days or ≥ 10% in 1 to 6 months of hospitalization.[8] Ethical approval for the study was obtained from the Airlangga University Ethics Committee (*Ref*: 0185/KEPK/IV/2018). Statistical analysis used bivariate and multivariate analysis with logistic regression, and a significance value of $P < 0.05$.

RESULTS

Table 1. Characteristics of subjects

Characteristics	Total n (%)	HM n (%)	Not HM n (%)
Gender			
-Boys	427 (58)	20 (48.8)	407 (58.6)
-Girls	309 (42)	21 (51.2)	288 (41.4)
Age			
-1 month-5 year	437 (59.4)	30 (73.2)	407 (58.6)
-5 year-18 year	299 (40.6)	11 (26.8)	288 (41.4)
Initial nutritional status			
-Well nourished	322 (43.8)	19 (46.3)	303 (43.6)
-Moderately malnourished	233 (31.7)	9 (21.9)	224 (32.2)
-Severely malnourished	122 (16.6)	8 (19.5)	114 (16.4)
-Overweight and obesity	59 (8.0)	5 (12.3)	54 (7.8)
Admission diagnosis			
-Infection	64 (8.7)	3 (7.4)	61 (8.8)
-Hematooncological	176 (23.9)	4 (9.8)	172 (24.7)
-Cardiovascular	22 (3.0)	1 (2.4)	21 (3.0)
-Neurological	115 (15.6)	2 (4.9)	113 (16.3)
-Respiratory	158 (21.5)	25 (61.0)	133(19.1)
-Nephrology	55 (7.5)	1 (2.4)	54 (7.8)
-Gastroenterology	146 (19.8)	5 (12.2)	141 (20.3)
Length of stay			
-< 7 days	401 (54.5)	18 (43.9)	383 (55.1)
-7-30 days	310 (42.1)	21 (51.2)	289 (41.6)
-1-6 months	25 (3.4)	2 (4.9)	23 (3.3)
HM after PNC			
-Weight loss ≥ 2%, LOS < 7 days		21 (2.9)	-
-Weight loss ≥ 5%, LOS 7-30 days		18 (2.4)	-
-Weight loss ≥ 10%, LOS >1-6 months		2 (0.3)	-
Total subjects after PNC	736 (100)	41 (5.6)	695 (94.4)

HM : Hospital Malnutrition; LOS : Length of stay; PNC : Pediatric Nutrition Care

There were 906 subjects from medical records, but 90 died, 40 with LOS < 48 hours and 40 with incomplete data so only 736 subjects met the inclusion and exclusion criteria. Most of subjects were boys (58%), aged 1 month to 5 years (59.4%) with 43.8% well nourished at admission. Admission diagnosis was dominated by 23.9% hematooncological disease, 21.5% for respiratory, and 19.8% by gastroenterology. The LOS was dominated by

less than 7 days (54.5%). Most of HM was girls (51.2%), 1 month to 5 years old (73.2%), 46.3% well nourished, from respiratory (61%), gastroenterology (12.2%), and hematooncological (9.8%) divisions, with 51,2% LOS of 7 to 30 days. The highest was obtained 2.9% for weight loss ≥ 2% for LOS <7 days, followed by 2.4% for weight loss ≥ 5% for LOS of 7-30 days, and the lowest was 0.3% of weight loss ≥ 10% for LOS of 1-6 months (Table1).

Boys (p=0.220), age 1 months to 5 years (p=0.068), admission diagnosis of respiratory (p=0.033), and LOS of 7 to 30 days (p=0.187) were risk factors in the bivariate analysis. Multivariate analysis revealed that only subjects from the respiratory division were risk factors of HM after PNC (p = 0.033; OR 3.822; 95% CI 1.111-13.146) (Table 2).

Table 2. The risk factors of hospital malnutrition after pediatric nutrition care

Characteristics	Bivariate			Multivariate		
	OR	95% CI	p*	OR	95% CI	p*
Gender						
-Boys	0.674	0.359-1.266	0.220	1.545	0.805-2.964	0.191
-Girls	-	-	-	-	-	-
Age						
-1 month-5 year	1.930	0.952-3.914	0.068	1.205	0.553-2.626	0.639
-5 year-18 year	-	-	-	-	-	-
Initial nutritional status						
-Well nourished	-	-	-	-	-	-
-Moderately malnourished	0.641	0.285-1.443	0.282	-	-	-
-Severely malnourished	1.119	0.477-2,628	0.796	-	-	-
-Overweight and obesity	1.477	0.529-4,123	0.457	-	-	-
Admission diagnosis						
-Infection	-	- -	-	-	-	-
-Hematooncological	0.473	0.103-2.173	0.336	-	-	-
-Cardiovascular	0.968	0.095-9.822	0.978	-	-	-
-Neurological	0.360	0.059-2.212	0.270	-	-	-
-Respiratory	3.822	1.111-13.146	0.033	3.822	1.111-13.146	0.033
-Nephrology	0.377	0.038-3.728	0.404	-	-	-
-Gastroenterology	0.721	0.167-3.113	0.661	-	-	-
Length of stay						
-< 7 days	-	-	-	-	-	-
-7-30 days	1.546	0.809-2.955	0.187	1.609	0.814-3.179	0.171
-1-6 months	1.850	0.405-8.462	0.428	-	-	-

HM: Hospital Malnutrition; IC: Confidence Interval; LOS: Length of stay; PNC: Pediatric Nutrition Care; OR: Odds Ratio, *logistic regression test

DISCUSSION

This study found that HM was dominated by girls (51.2%). A similar study in Bandung reported that HM was dominated by 80% of girls. Another study reported that HM was more in boys (54%).[9] Patients with weight loss below or above 2% with respectively 61.2% and 59.7% for boys, but there was no significant relationship between the two.[10] There is no literature that explains the factors underlying the dominance of gender.[11]

Age is an important risk factor for malnutrition as the risk of losing weight increases with decreasing age. Our results revealed that HM was more frequent in the 1 month to 5 year age group (73.2%). Children under 5 year require higher calorie intake per kilogram of body weight than older children and adolescents, so they are at greater risk of HM. Other studies also have demonstrated that children less than 60 months of age are at higher risk of developing hospital acquired malnutrition.[12] Children < 12 months were less affected, because they are dependent mostly on breast milk which is readily available and has a good caloric content to meet nutritional needs. The older age groups, above 12 months are at higher risk of malnutrition as they are dependent on their guardians and hospital staff to provide adequate nutrient requirements. Therefore, clinicians should be aware of the risk of malnutrition in all hospitalised children.[13] Older children and adolescents tend to be more tolerant of prolonged inadequate nutrition up to 7 days. However, clinicians should be aware of prolonged fasting and should apply adequate enteral or parenteral nutrition. In the adolescent group, age was a risk factor of weight loss during hospitalization. It could be influenced by many factors such as differences in diseases or treatments, types of meals and emotional stresses.[10]

The data that related malnutrition on admission to the risk of weight loss during hospital stay are controversial. Our study revealed that most of the well-nourished subjects were HM (46.3%). Children with malnutrition on admission had lost more BMI on discharge than those with better nutritional on admission. On the other hand, hospital stay had a negative impact on the nutritional status of children with mild malnutrition on

admission but not of children with moderate malnutrition on admission.[1] Normal weight and mildly malnourished patients do not draw the attention of the health care team to a possible need of nutritional support, while patients with moderate malnutrition receive special care. The incidence of HM is most common in children with poor nutritional status.(9) The fact that children in a well nourished deteriorate while in the hospital indicates that special attention is needed to the nutritional conditions of inpatients.(1)

Our study revelad most of the subjects with HM were from the respiratory division (61%) followed by gastroenterology (12.2%), and hematooncological (9.8%). A China study reported that hospitalization of children evaluated using STRONGkids were exposed to nutritional high risk, especially with underlying cardiac disease (19,2%), respiratory disease (17,6%), oncologic disease (10,6%), and gastrointestinal disease (9,5%).(14) Pneumonia has the highest incidence of HM due to prolonged fasting, failure to identify increased nutritional requirements due to infection, and nutritional therapy is not routinely carried out in health care facilities.(15) The greatest weight loss was observed in children with gastroenteritis (81.2%), gastritis (64.3%) and pneumonia (55.6%). Diarrhea and vomiting cause significant nutritional loss by poor retention and altered gastrointestinal mucosal integrity, leading to malabsorption of nutrients. Children with pneumonia have varying degrees of respiratory distress which increases energy requirements resulting in imbalance of calorie needs.(13)

This study resulted in a predominantly HM of 7 to 30 days LOS (51.2%). Hospital malnutrition is higher in children who are hospitalized for more than 7 days (53%).(9) Hospital stay for more than 5 days revealed the highest percentage of weight loss (78%) compared for less than 5 days (56%).(13) The longer of hospital stay, the higher the incidence of weight loss in 62.39% children who were hospitalized for 10-67 days.(15) The incidence of HM was lower in the LOS of more than 7 days compared to less than 7 days because the largest number of subjects were children with LOS less than or equal to 7 days, besides that patients who were hospitalized longer would receive nutritional support interventions more and more intensive so that it is better able to prevent the incidence of HM.(11)

Proportion of HM after PNC in our study was 5.6% lower than previous studies because PNC was carried out in inpatients. The PNC includes assessment of nutritional problems, nutritional requirements, routes of delivery, formula selection, monitoring and evaluating or reviewing responses.(6) Adequate nutritional support during hospitalization contributes to reducing the prevalence of malnutrition and improving clinical prognosis.(16) Over a ten-year period in European countries and the United States reported 6.1 to 14% of children experiencing HM.(17) Whereas in Indonesia the prevalence of HM is 24.3% to 40.9%.(18) Based on the reduction in Z-score weight for height using hospital admission and discharge data, the results revealed that 22.9% of children experienced HM, but 60.6% of children revealed a decrease in Z-score BMI.(13) Hospital malnutrition occurred in 51.6% based on weight loss at admission and discharge from hospital. The impact of hospitalization on the nutritional status of children under five only takes into account weight loss without a cut off point so that the HM rate is higher.(15) Therefore, the difference in prevalence of HM in each study was due to differences in the criteria for defining HM, the study contexts, hospital type (secondary versus tertiary), country status (developed versus developing), age groups, and patient status.(1)

Our study revealed that gender, age, initial nutritional status, and LOS were not risk factors of HM in children, however subjects from the respiratory division were risk factor (p = 0.033; OR 3.822; 95% CI 1.111-13.146). Patients from the respiratory division are mostly hospitalized for shortness of breath due to infection, in which energy requirements or muscle protein catabolism are increased, while nutrient intake is low. The nutritional requirements in the first week of hospital stay may not be met, because the patient has decreased appetite. Another problem is patient require fasting or food intolerances. In addition, patient from respiratory division usually with another multiple disease or accompanied by congenital abnormalities that will aggravate the patient's illness. Disease from the infection subdivision with risk factors 1.1 times greater than the non-infectious subdivision.(9) The underlying disease is related to weight loss which is often increased by inflammation. Tissue disease or injury promotes an acute inflammatory response mediated by cytokines, especially interleukin 6 and tumor necrosis factor-alpha, which results in rapid lean body mass catabolism.(2) The inflammatory response during the acute disease phase is associated with high baseline energy expenditure and nitrogen excretion. Disease frequently induces anorexia and fever, in addition to vomiting and diarrhea, worsening the imbalance between nutrient requirements and intakes.(2) Inflammation promotes malnutrition and adverse outcomes through associated anorexia and decreased food intake as well as altered metabolism with elevation of resting energy expenditure and increased muscle catabolism. this will result in high weight loss.(19) Higher nutritional risk was associated with malnutrition, younger age and the presence of an underlying disease, and it contributed to a longer LOS, greater weight loss, higher incidence of infectious complications and greater hospital expenses.(14) Children aged less than 5 years have a significantly 2.7 times higher risk of experiencing HM.(12) After adjusting for gender, age category, and presence of stunting at admission; presence of wasting at admission (OR= 0.07, CI 95% 0.01 - 0.55) and length of stay from 17 to 69 days (OR= 4.68, CI 95% 2.00 - 10.95) were statistically associated with HM. Wasting at admission was a protective factor against the occurrence of HM. Children with malnourished at admission have little body mass reserves to be depleted, while those admitted in satisfactory nutritional condition have available body mass for catabolism.(1)

Patients admitted to the surgery department (OR 1.668, 95% CI 1.054-2.637, p = 0.029), long duration of fasting (OR, 1.496, 95% CI 1.102-2.031, p = 0.010), and body weight for age below -2 SD (OR 1.188, 95% CI, 1.029-1.371, p = 0.019) were risk factor of > 2% weight loss during hospitalization. Long duration of fasting was the risk factor especially in the infant group because they have insufficient reserves to withstand hunger and are susceptible to the effects of hunger, so parenteral nutrition must be provided during fasting.[10] Children with gastrointestinal disease (OR 3.75, 95% CI 1.22-11.5, p = 0.026) and had more than one underlying disease (OR 10.234, 95% CI 3.76-28.91, p= 0.001) are at high risk for developing HM when evaluated with STRONGkids.[12] Another reported that diarrhea did not cause weight loss because they had received nutritional intervention during hospitalization.[1] Children with pneumonia and diarrhea are significantly at risk for HM. In diarrhea there is a change in the integrity and permeability of the intestinal mucosa, leading to malabsorption. In addition, there is an increase in energy demand due to infection in diarrhea or pneumonia, and a lack of adequate PNC.[15] Several studies have reported that malignancy is a predictor of MRS. Malnutrition in malignancy can occur as a result of tumor growth that has the potential to interfere with the digestive system, the body's response to malignant cell development, the resulting therapeutic effects, and long repeated hospitalizations. Clinical manifestations in malignancy, such as weight loss, decreased food intake, and gastrointestinal system disorders as predictor factors for HM.[8]

Poor nutritional status is a risk factor for HM even though the treatment given is in accordance with the standard of treatment for severe malnutrition.[20] A hospital stay longer than five days is considered a risk factor for malnutrition. Diet introduction is often postponed, and fewer than 50% of children receive food on the first day of hospital stay. The nutritional requirements in the first week of hospital stay may not be met, especially in critical patients.[15] Another problem is unnecessary diet interruption due to procedures that require fasting or food intolerances. Also, less than 50% of the patients finish their meals.[1] Children hospitalized for 17-69 days showed an OR for HM of 4.68 (CI 95%: 2.00 - 10.95) as compared to children who stayed for 1-5 days. Possible explanations for increased incidence of HM with LOS involve greater exposure to hospital infections and emotional disorders caused by separation from the family environment, which may reduce appetite.[15] Children with LOS more than 1 week had 1.2 times the risk of HM. They are generally have a multiple diagnosis with chronic disease.[9]

The weakness of this study is that there are still many other risk factors that are not studied, such as parental characteristics, the socioeconomic condition of the parents and the type and volume of nutritional intake during the child's hospitalization which may also affect the prevalence of HM. In addition, the admission diagnosis is only based on division and not based on the diagnosis of the disease itself. Infectious diseases are not differentiated based on infection marker, while in another divisions, many patients also experience infectious diseases. This data limitation causes researchers to experience difficulty in interpreting the causes of the research results that need further study.

CONCLUSION

Children with admission diagnosis from the respiratory division are at risk of Hospital Malnutrition after Pediatric Nutrition Care. The results of this study are useful for providing information related to risk factors in children who are hospitalized. Improving the quality of health services of PNC and early screening for the risk of malnutrition is important to reduce the prevalence of HM. Essential nutritional interventions for prevention and to obtain a better quality of life. Active and harmonious team work collaboration is the key to successful nutritional support when the child is hospitalized. Considering that there are still many limitations in this study, further research is needed. Data collection should be done periodically to obtain more complete data and observations can be made regarding the risk factors that affect HM.

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