

The Association Between Nutritional Status on Admission and Hospital-Acquired Malnutrition in Pediatric Patients at Sanglah General Hospital

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Abstract: *Introduction:* Hospital-acquired malnutrition is one aspect of childhood malnutrition that healthcare professionals might not recognize. The prevalence of hospital-acquired malnutrition globally and in developing countries is still high varies between 6.1%-40.9%. Various factors contributed to the frequency of hospital-acquired malnutrition, including the nutritional status at the onset of the disease. *Material and Methods:* The prospective cohort study was conducted on the patients in Pediatric Ward at Sanglah General Hospital, Denpasar Bali period July 2020 and January 2021. We Include children aged one month to 18 years old. Samples were taken by consecutive sampling. Hospital-acquired malnutrition was marked by more than 2% loss of weight from the measurement during admission. Univariate analysis was performed using the chi-square test. Nutritional status presented as Prevalence Ratio (PR) and 95% Confidence Interval (95% CI). The result is considered as significant if $p < 0.05$. *Results:* 208 subjects were included and analyzed in this study. Malnutrition incidence was 15.4%. The risk factors significantly associated with hospital-acquired malnutrition were an underlying disease, length of stay, admission nutritional status. Malnutrition, length of stay and underlying condition were the independent risk factors for hospital-acquired malnutrition with PR 7.528 (95% CI, 2.528-21.033; $p=0.001$), PR 9.061 (95% CI, 2.925-28.066; $p=0.001$) and PR 2.638 (95% CI, 1.0325-6.724; $p=0.042$). *Conclusion:* The incidence of hospital acquired malnutrition in Sanglah Hospital was 15.4%. Children with malnutrition, prolonged hospitalization length, and underlying disease are associated with hospital-acquired malnutrition.

Keywords: Hospital, Malnutrition, Children, Nutritional Status

1. Introduction

Hospital-acquired malnutrition is one aspect of childhood malnutrition that healthcare professionals might not recognize [1]. Pediatric inpatients were at a higher risk for malnutrition during a hospital stay due to decreased food intake, hypermetabolism, malabsorption, and nutrition loss. Malnutrition increases complication incidence, length of stay, and hospital cost [2].

Hospital-acquired malnutrition occurs during hospital stay characterized by loss of more than 2% body weight during treatment that lasts seven days or fewer, or 5% in treatment 8 to 30 days, or 10% in treatment more than 30 days. Some criteria are used for hospital-acquired malnutrition, including

any weight loss, weight loss greater than 2%, or decreased Body Mass Index (BMI) greater than 0.25 SD [3-6].

The prevalence of hospital-acquired malnutrition globally and in developing countries is still relatively high. The prevalence of malnutrition in the world varies between 6.1 to 40.9% [7]. In developing countries, hospital-acquired malnutrition ranges from 6.9 to 53%. The hospital-acquired malnutrition incidence has begun to be studied in several hospitals. Study in Wahidin Sudirohusodo Hospital, the incidence of malnutrition was 8.9%. Hospital-acquired malnutrition occurs more in males (56%) than females (44%) [8].

The incidence of malnutrition in Sanglah Hospital Denpasar is about 18%. In Sanglah Hospital, Denpasar, more children experienced hospital-acquired malnutrition in

females (19.1%) than in males (15.4%) [2].

Various factors can contribute to the high numbers of hospital malnutrition. Age, medical history, history during the gestational phase, social status, and nutritional status at disease onset are inherent factors. The other factors are hospital care related, including fasting requirement, acceptability to the diet provided, the efficacy of the diet, the disease types, and severity [9]. This study aims to know the association between nutritional status on admission and hospital-acquired malnutrition in children.

2. Materials and Method

This prospective cohort study was performed at the Pediatric Ward of Sanglah General Hospital, Denpasar Bali. The samples were selected using consecutive sampling. Children were chosen as samples if their ages were one month to 18 years old and hospitalized between July 2020 and January 2021. The patient treated in the intensive care unit, patients with edema, nephrotic syndrome, malignancy, undergoing an operation, overweight and obesity, and patients hospitalized for less than 24 hours were excluded.

Data included patient's age, gender, diagnosis, underlying disease, weight-for-height nutritional status (for 1-60-month-old) or BMI-for-age (for 5-18 year old) were collected at the same time when the patient was admitted and body weight when the patient was discharged.

Length of Stay (LOS) is calculated from the day of admission until discharge or on the seventh day of treatment. This variable was analyzed categorically and divided into the following distribution: <5 days and 5-7 days of hospitalization. The nutritional status was categorized as severe malnutrition, moderate malnutrition, and well-nourished. Gender is determined based on phenotype appearance, and data was analyzed categorically (male and female).

Diagnosis of patients was classified into chronic diseases and acute diseases. The definition of chronic diseases is based on the following criteria: the disease is diagnosed scientifically using reproducible and valid methods or instruments, according to professional standards; the disease lasts longer or is expected to last more than three months; the disease is not curable, or in case of mental health conditions, it is highly resistant to treatment. The data on chronic diseases was presented on a nominal scale [21].

We conduct body length measurements for 0 to 2 years old pediatric patients and standing height measurements for patients older than two years old. We performed standardized measurements of body weight during admission and at discharge or on the seventh day of treatment. The children must be on bare feet and wear minimum clothing to be weighed using a calibrated digital weighing scale. To determine the nutritional status during admission, we use the World Health Organization (WHO) standardized chart of weight-for-height or BMI-for-age. Severe categorized as <-3 Standard Deviation (SD) Z-score, moderate falls between -3SD and <-2SD Z-score, and well nourish between \pm 2SD Z-score.

We define hospital-acquired malnutrition as the loss of more than 2% of weight during admission at the end of hospitalization. This variable was analyzed categorically. This formula used for calculating relative weight is as follows:

$$\% \text{ Weight loss} = \frac{\text{weight discharged} - \text{weight admission}}{\text{weight admission}} \times 100\%$$

Sample size using two proportion sample formula with disease proportion was 30% level of significance 0.05, 90% power respectively. According to this calculation, the sample size was 205 [2].

The data were analyzed using SPSS for windows. The data were distributed symmetrically. Descriptive data is shown as a median and percentage in the table and narration. Univariate analysis between independent and dependent variables was conducted using the chi-square test. The multivariate analysis was done using a logistic regression test. The nutritional status was expressed as PR with 95% CI. The result is deemed as significant if $p < 0.05$. The ethics committee of The Faculty of Medicine at Udayana University has approved this research with the ethical clearance number 2325/UNUN.14.2.2.VII.14/LT/2020.

3. Result

Between July 2020 and January 2021, 210 subjects fulfilled the inclusion criteria. Two subjects were excluded because they moved to the intensive care unit. A total of 208 subjects were analyzed, male 101 (48.6%), female 107 (51.4%) with a median age was three years five months, and 102 (49%) with chronic disease. Forty-nine patients (23.6%) were hospitalized because of cardiology symptoms, 18.8% with respiratory tract infection, 18.3% with neurological symptoms, and 14.9% with GI tract symptoms.

One hundred and fourteen (54.8%) of the subject were well-nourished, 32.7% were moderate malnutrition, and 12.5% were severe malnutrition. The median length of stay in all subject were five days, 49.5% <5 days and 50.5% 5-7 days. The demographic characteristic showed in Table 1.

Table 1. Subjects Characteristic.

Characteristic	N= 208
Gender, Male n (%)	101 (48.6)
Age (month), Median (minimum-maximum)	41 (1-228)
Underlying disease, chronic, n (%)	102 (49.0)
Diagnosis, Cardiology, n (%)	49 (23.6)
Respiratory tract, n (%)	39 (18.8)
Neurology, n (%)	38 (18.3)
GI tract, n (%)	31 (14.9)
Immunology, n (%)	15 (7.2)
Others, n (%)	36 (17.3)
Nutritional status, well nourished, n (%)	114 (54.8)
Moderate malnutrition, n (%)	68 (32.7)
Severe malnutrition, n (%)	26 (12.5)
Hospital-acquired malnutrition, Yes, n (%)	32 (15.4)
Length of stay (days), median	5
< 5 days, n (%)	103 (49.5)
5-7 day, n (%)	105 (50.5)

There are thirteen (40.6%) males and 19 (59.4%) females with hospital-acquired malnutrition with a median age of 9.5 months. Children with hospital-acquired malnutrition in

moderate and severe malnutrition 84.4%. The percentage of children who had the chronic disease in the hospital-acquired malnutrition group was 71.9% (Table 2).

Table 2. Result of Bivariate Analysis of Selective Variables with Hospital-Acquired Malnutrition.

Parameter	Hospital-acquired malnutrition		p
	Yes n=32	No n=176	
Gender, Male n (%)	13 (40.6)	88 (50.0)	0.329
Female n (%)	19 (59.4)	88 (50.0)	
Age (month), Median (minimum-maximum)	9.5 (1-207)	49 (1-288)	0.169
≤60 month	22 (68.8)	98 (55.7)	
>60 month	10 (31.2)	78 (44.3)	
Underlying disease, chronic, n (%)	23 (71.9)	79 (44.9)	0.005*
Acute, n (%)	9 (28.1)	97 (55.1)	
Diagnosis, respiratory tract, n (%)	12 (37.5)	27 (15.3)	0.334
Neurology, n (%)	8 (25.0)	30 (17.0)	
GI tract, n (%)	3 (9.4)	28 (15.9)	
Cardiology, n (%)	6 (18.8)	43 (24.4)	
Others, n (%)	3 (9.4)	48 (27.3)	
Nutritional status, Well nourish, n (%)	5 (15.6)	109 (61.9)	0.001*
Malnutrition, n (%)	27 (84.4)	67 (38.1)	
Length of stay 5-7 days, n (%)	28 (87.5)	77 (56.3)	0.001*
< 5 day, n (%)	4 (12.5)	99 (43.8)	

The PR showed a significant association between hospital-acquired malnutrition and malnutrition with PR 6.521 (95% CI, 2.258-18.830), length of stay with PR 9.427 (95% CI, 3.021-29.415), and underlying disease with PR 2.638 (95% CI, 1.0325-6.724) Result of multivariate analysis of selective variables with hospital-acquired malnutrition are summarised in Table 3.

Table 3. Result of Multivariate Analysis of Selective Variables with Hospital-Acquired Malnutrition.

Variable	p	PR	CI
Underlying disease	0.042	2.638	1.035-6.724
Nutritional status	0.001	6.521	2.258-18.830
Length of stay	0.001	9.427	3.021-29.415

PR: prevalence ratio; 95% CI: 95% confidence interval.

4. Discussion

Malnutrition is a common problem in pediatric inpatients. The nutritional status of pediatric patients often deteriorates during the hospital stay. Children are vulnerable to malnutrition because they have a lower caloric reserve with higher nutritional requirements per unit of body weight because more nutrition is needed for growth [10].

In our study, children with hospital-acquired malnutrition during hospitalization was 15.4%. Among patients with hospital-acquired malnutrition, 54.8% of patients had a normal nutrition status upon admission compared to pre-existing moderate (32.7%) and severe (12.5%) malnutrition. Sukhosa *et al.* in Thailand report the prevalence of all malnutrition was 59.9% [1]. Rocha *et al.* in Brazil found that 51.6% of children aged less than five years had lost weight on discharge [11]. From the previous study in Sanglah hospital, the incidence of hospital-acquired malnutrition was 30.1% and four years later became 18%. The incidence of hospital-acquired malnutrition has

decreased because since 2008, most patients treated have been given nutritional management by the hospital nutrition therapy team consisting of pediatricians, pediatric residents, nutritionists, and nurses [2].

Several contributing factors for hospital-acquired malnutrition are nutritional status at the onset of the disease, age, patients' past medical histories, and social status. Children have a higher chance of becoming malnourished because of extra energy requirements for growth while having fewer energy reserves. The primary disease that induces catabolism of protein, reduced energy intake, and increased energy requirement can increase the risk of malnutrition [9, 12]. There was no difference found between females and males who experienced hospital malnutrition in this study. It is similar to Sidiartha, and Juliarty study that sex and age did not have a significant difference in hospital-acquired malnutrition [8, 13].

Patients with moderate and severe malnutrition were the major independent risk factors of hospital-acquired malnutrition in our hospital. Our study found that the incidence of hospital-acquired malnutrition was higher in malnutrition. McCarthy *et al.* found that subjects with malnutrition on admission had lost more BMI on discharge than those with better nutritional status [4]. In several studies, children who were well-nourished or mildly malnourished, according to the WHO nutritional classification, were the most affected by hospitalization.

During the hospitalization of pediatric patients, the attention is mainly directed to the main medical problem, and little attention is directed to nutritional management. A study by Kazem *et al.* with 293 samples shows that the nutritional status of children mainly affects those who were either well-nourished or mildly malnourished during admission. A similar finding was also reported by Rocha *et al.* [11, 14].

We found that the most significant weight loss happened to malnutrition and chronic diseases in children. The study by

Campanozzi et al. shows children with malnutrition during admission lost more BMI on discharge than children with non malnourished children. The primary disease and admission cause are also related to weight loss during the hospital stay. The inflammation process increases weight loss. Injury or tissue stress promotes an acute cytokines-mediated inflammatory response, usually by interleukin six (IL6) and tumor necrosis factor (TNF)-alpha. The inflammation results in the rapid catabolism of lean body mass. Inflammation is associated with increased nitrogen excretion and baseline energy expenditure. The disease also induces fever, anorexia, vomiting, and diarrhea that can further worsen the imbalance of intake and nutritional requirements [9, 20].

The duration of hospital stay is associated with a higher rate of pediatric inpatients' weight loss in the previous study [14]. Malnutrition is a pathological condition as one of the risk factors that cause bad outcomes, especially in pediatric patients. Malnutrition weakens the immune systems, leading to an increased risk of postoperative complications, infection, and impaired wound healing. That leads to an increase in morbidity and mortality of the patients. Malnutrition slows the recovery, which prolongs the hospital stay and increases cost and other healthcare-related resources [15, 16]. A multi-centric study consisting of 2,567 pediatric patients from 14 centers in 12 countries in Europe with age ranging from one month to 18 years found that 217 (23%) of the 938 patients that stays longer than four days have lost their weight during hospitalization. There are some difficulties when comparing several studies regarding hospital malnutrition prevalence because of the different parameters and measuring methods used. Some studies also include the length of stay of longer than five days as a risk factor [17, 18].

Hwang et al. found that 24.8% of pediatric patients lose more than 2% of their weight in the first week of hospital stay compared to patients who stay < 4 days. Campanozzi et al. described that LOS > 5 days is a significant risk factor for hospital-acquired malnutrition [19, 20]. In our study, hospital-acquired malnutrition is higher in children with LOS for more than four days. The patients' weight loss rate in this study is similar to the study by Hulst et al. that showed that weight loss was present in 35% of pediatric patients with four days or longer hospital stay. Poor intake, disease severity, and pain sensation are thought to be the potential reasons for weight loss during hospitalization [5].

This study has several limitations. We used losing 2% of the before-hospitalization body weight as the marker of hospital-acquired malnutrition. The measurements of body weight, and height were conducted by different person for each patients that might affected the results by inter-observer variability.

5. Conclusion

Hospital-acquired malnutrition incidence in Sanglah Hospital was 15.4%. Children with malnutrition, prolonged hospitalization length, and underlying disease are associated with hospital-acquired malnutrition. Effective and immediate

detection and intervention for disease-associated malnutrition are needed. All healthcare providers, including doctors, hospital administration, and health authorities, should collaborate with the nutritional team to prevent the occurrence of hospital-acquired malnutrition.

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