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Prevalence and Associated Factors of Malnutrition in Patients with Intracranial Infections at Sanglah Hospital Denpasar

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Abstract

Malnutrition is a major health problem in developing countries, it can occur acutely, chronically or combination of both. Malnutrition aggravates the condition of infectious diseases, including intracranial infections. Hereby we aimed to determine the prevalence and factors associated with malnutrition in pediatric patients with intracranial infections in Sanglah Central General Hospital. This cross-sectional analytic study was conducted in patients with final diagnosis intracranial infection whom were treated from January 2019 to March 2021. The study was conducted in pediatric patients aged 1 month-18 years old and patient would be excluded if had any of these conditions: 1) incomplete medical records, 2) discharge by his/her own request, 3) hydrocephalus for which VP shunt had not been performed, 4) diagnosis of tumor or mass that could affect body weight measurement. Secondary data such as weight/height for children <5 years and BMI/age for children >5 years were measured in growth curve by using the WHO Anthro application. Total samples were 83 children with predominance age group was 0-5 years old. Malnutrition was found in 48.1% patients. Chronic malnutrition was more common than acute malnutrition (32.5% vs. 31.3%). Age below 5 years has relationship with the incidence of acute malnutrition in pediatric patients with intracranial infection ($p: 0.008$, 95% CI: 0.076-0.675). The incidence of malnutrition in children with intracranial infections in Sanglah Hospital during January 2019 to March 2021 was 48.1%, and age < 5 years had significant relation to the incidence of malnutrition in children with intracranial infections.

Keywords: Malnutrition; Pediatric; Intracranial infection; Acute

1. Introduction

Malnutrition is a broad term that describes nutritional status. The World Health Organization (WHO) defines malnutrition as an imbalance between intake and nutritional needs to ensure optimal growth, therefore malnutrition can be either deficiency or excess of nutrients. Acute malnutrition is condition of acute nutritional deficiency that causes a child appears thin or very thin [1].

Malnutrition is still a major health problem in developing countries and causes more than 50% of under-five deaths in the world. According to data from The United Nations Children's Fund (UNICEF) in 2018, 149 million (22%) children under five in the world were short stature, 49 million (7.3%) were underweight and 40 million (5.9%) were undernourished [2]. In Indonesia, the problem of malnutrition is the highest in the world, Basic Health Research (Riskesmas) showed in 2018 as many as 30.8% of Indonesian children under five were short stature, 10.2% were thin and 8% were overweight[3].

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Acute infectious diseases such as intracranial infections are risky for acute malnutrition induced by hypermetabolism due to stress and decline food intake that causes loss of energy supply. The risk of death and illness will increase in conditions of acute malnutrition. In conditions of severe acute malnutrition the mortality rate is estimated 11.6 times higher than in well-nourished children [4-6]. Acutely malnourished patients are also known have longer length of stay than well-nourished patients [7-8].

Recent study in Hasan Sadikin Hospital found that 68.7% patients with neurological diseases were malnourished [9]. In addition another study showed that children with bacterial meningitis showed decrease of food intake due to changes of consciousness [10].

The length of stay of patients with intracranial infections is estimated about 7-45 days based on the underlying cause of infection. Longer duration of hospitalization can lead to additional morbidity such as nosocomial infections and malnutrition in hospital. Therefore, if the nutritional status of patients with intracranial infections is not considered properly during hospital admission, it will lead to inadequate nutrition during treatment, thereby will increase mortality rate. These conditions prompted researchers to conduct research on the prevalence and factors associated with malnutrition in pediatric patients with intracranial infections in Sanglah Hospital.

2. Material and methods

This cross-sectional analytic study was conducted from January 2019 to March 2021 by using medical records. The inclusion criteria were pediatric patients with final diagnosis intracranial infection aged 1 month-18 years old who were admitted in pediatric wards of Sanglah Hospital since January 2019 to March 2021 and the exclusion criteria were: 1) patients with incomplete medical records, 2) patients who were discharged at their own request, 3) patients with hydrocephalus who had not performed VP shunt, and 4) patients with diagnosis tumor or mass that could affect body weight measurement.

Sampling was performed with total consecutive sampling technique. According to literature the incidence of malnutrition in pediatric patients with previous neurological diseases was 68.7%, precision was set 5% and significance level was set <0.05 , we calculated the minimum required sample were 83 samples. Secondary data such as body weight, body height, age, length of stay, comorbid diseases, outcome were taken from medical records. Several data such as body weight, body height, age was taken from medical record while patient was first admitted. Meanwhile length of stay, comorbid diseases and outcomes were taken while patient was discharged. Data on weight/height for children <5 years and BMI/age for children >5 years were measured in growth curve by using WHO Anthro application.

Intracranial infection is an infection that affect meninges or brain, caused by bacteria, viruses, parasites or fungi that can manifest as bacterial meningitis; post neurosurgery meningitis; tuberculous meningitis; aseptic meningitis; encephalitis; or pyogenic process such as abscess according to the result of the examination by Doctor in Charge of Patient (DCP). Acute malnutrition was assessed by indicators such as body weight (BW) against body height (BH) for children aged <2 years, or weight for height (W/H) for children aged 2-5 years, or body mass index (BMI) against age (A) for children aged 5-18 years old based on WHO curve and expressed as nominal scale, namely acute malnutrition (<-2 SD) and not acute malnutrition (≥ -2 SD).

Chronic malnutrition was assessed by indicators of BH against A on WHO curve and expressed in nominal scale, namely chronic malnutrition (<-2 SD) and not chronic malnutrition (≥ -2 SD). Mixed malnutrition was defined when there is acute malnutrition and chronic malnutrition in one individual. Malnutrition can appear acute and/or chronic. The length of treatment is determined based on the length of stay since the patient was admitted to hospital until he was allowed to leave the hospital by the DCP and grouped into < 7 days and > 7 days. The complexity of disease is the number of diagnosis of patient in accordance with DCP decision which was recorded in medical record.

3. Results

Eight-eight subjects had intracranial infection during study period however only 83 subjects were recruited as samples. Four subjects were excluded due to incomplete medical record which body height wasn't recorded and another one due to discharge his by own will. This study was dominated by age group 0-5 years old, 64 subjects (77.1%). The most frequent intracranial infection was encephalitis (33.7%) followed by bacterial meningitis (30.1%). Moreover length of stay was dominated by ≥ 7 days (63.9%). Characteristic of sample were shown in table 1.

Table 1 Characteristic of subjects with intracranial infection in Sanglah general hospital

Characteristics	Total (n=83)
Intracranial infection (n, %)	
Meningitis bacterialis	25 (30.1)
Meningitis post neurosurgery	15 (18.1)
Meningitis aseptic	13 (15.7)
Encephalitis	28 (33.7)
Meningitis tuberculosis	2 (2.4)
Age	
≤ 5 years old	64 (77.1)
> 5 years old	19 (22.9)
Gender	
Male	34 (41)
Female	49 (59)
Length of stay	
< 7 days	17 (20.5)
≥ 7 days	66 (79.5)
Complexity of disease	
Multiple diagnosis	52 (62.7)
Single diagnosis	31 (37.3)
Mortality	
Death	19 (22.9)
Survived	64 (77.1)

As many as 40(48.1%) subjects with intracranial infection had malnutrition. Acute malnutrition was suffered by 26(31.3%) subjects, chronic malnutrition was suffered by 27 (32.5%) and 13 subjects suffered mixed malnutrition. In addition 8(30.7%) subjects from acute malnutrition suffered severe acute malnutrition, which was dominated by bacterial meningitis (50%). Distribution of malnutrition was shown in table 2.

Table 2 Distribution of malnutrition in pediatric patient with intracranial infection

Malnutrition	Total
Malnutrition (n, %)	40 (48.1)
Acute malnutrition	26 (31.3)
Chronic malnutrition	27 (32.5)
Mixed malnutrition	13 (15.7)

Multivariate analysis was performed to find the associated factors of malnutrition in patient with intracranial infection. Age group ≤ 5 years old showed significant relation with acute malnutrition and acted as protective factor for acute

malnutrition in pediatric patient with intracranial infection ($p=0.008$, PR 95%, CI: 0.076-0.675). Multivariate analysis can be seen in table 3 and 4.

Table 3 Multivariate analysis of associated factors with acute malnutrition in patient with intracranial infection

	Acute Malnutrition (n = 26)	Not acute malnutrition (n = 57)	aPR	P-value	PR (95% CI)
Age (n, %)					
≤ 5 years old	15 (23.4)	49 (76.6)	0.227	0.008*	0.076-0.678
> 5 years old	11 (57.9)	8 (42.1)			
Gender					
Male	10 (29.4)	24 (70.6)	0.926	0.886	0.323-2.652
Female	16 (32.7)	33 (67.3)			
Length of stay					
≥ 7 days	21 (31.8)	45 (68.2)	1.056	0.934	0.286-3.902
< 7 days	5 (29.4)	12 (70.6)			
Complexity of disease					
Multiple diagnosis	19 (36.5)	33 (63.5)	1.851	0.280	0.606-5.653
Single diagnosis	7 (22.6)	24 (77.4)			
Mortality					
Death	7 (36.8)	12 (63.2)	1.106	0.871	0.328-3.733
Survive	19 (29.7)	45 (70.3)			

*significant ($p<0.05$)

Table 4 Multivariate analysis of associated factors of chronic malnutrition in patient with intracranial infection

	Chronic malnutrition (n = 27)	Not chronic malnutrition (n = 56)	aPR	P-value	PR (95% CI)
Age (n,%)					
≤ 5 years old	19 (29.7)	45 (70.3)	0.610	0.375	0.205-1.818
> 5 years old	8 (42.1)	11 (57.9)			
Gender					
Male	11 (32.4)	23 (67.6)	1.010	0.984	0.370-2.756
Female	16 (32.7)	33 (67.3)			
Length of stay					
≥7 days	23 (34.8)	43 (65.2)	1.596	0.489	0.424-6.005
<7 days	4 (23.5)	13 (76.5)			
Complexity of disease					
Multiple diagnosis	21 (40.4)	31 (59.6)	2.437	0.110	0.818-7.262
Single diagnosis	6 (19.4)	25 (80.6)			
Mortality					
Death	8 (42.1)	11 (57.9)	1.434	0.535	0.459-4.477
Survived	19 (29.7)	45 (70.3)			

*significant ($p<0.05$)

4. Discussion

This study found the incidence of malnutrition was 48.1%, occurred in 40 subjects with intracranial infection. This is the first study examined the incidence of malnutrition in children with intracranial infection.

Intracranial infections and various other types of infections often related with the incidence of malnutrition. In infected children, activation of inflammatory cascade will decrease appetite, protein and fat tissue. In general, almost all infections can cause protein loss accompanied by amino acid diversion into acute phase response proteins and immune response proteins, in addition, the presence of pathogens reduce overall energy due to the use of energy sources for pathogen survival [11].

Intracranial infection also potentially cause long-term neurological abnormalities or neurological disability that can lead to difficulty in eating, as well as increased nutrient expenditure through the vomiting response and increased energy requirements for adequate healing process. This increases the risk of acute malnutrition in pediatric patients whom suffers intracranial infections [11, 12].

In this study, there were 31.3% of pediatric patients with intracranial infections whom also experienced acute malnutrition with the largest proportion were bacterial meningitis and encephalitis compared to other diagnosis of intracranial infections. In bacterial meningitis, encephalitis and other intracranial infections, the neuromotor disability occur in difficulty of chewing food and changes of consciousness thus patient cannot swallow food properly. This condition will reduce children's caloric intake and causing acute malnutrition[13]. This study is similar to previous study in Pakistan which showed that one of the symptoms found in children with meningitis was difficulty of feeding 23% and 35% which caused acute malnutrition [10].

The prevalence of children aged <5 years who have acute malnutrition was 23.4%. This number is higher than the population of children under five in Bali province at the 2018 who experienced acute malnutrition, which was 4.4% (95% CI; 3.2-5.9)[3]. This is understandable because the determinant factor and population size in this study were smaller. However this study was more specific, all of the subjects experienced condition of acute infection and experienced decreased of nutritional intake and increased metabolism.

Chronic malnutrition causes short stature in the form of stunting, which is chronic nutritional problem resulting from long term lack of nutrition intake and develop into growth retardation. Basic Health Research (Riskesdas) in 2018 stated, the prevalence of children aged 0-59 months old with short stature was 16.3% in Bali (95% GI; 13.9-18.8)[3]. The prevalence of chronic malnutrition in this study was higher than the general population. This could be due to the small number of samples and sampling was performed only on those whom suffering intracranial infections therefore are not suitable for the general population.

This study found significant relationship between age < 5 years old and the incidence of acute malnutrition in pediatric patients with intracranial infections ($p = 0.008$, CI 95% PR: 0.076-0.675). This is different from the previous study which found children aged <5 years old had no risk of acute malnutrition ($p=0.068$) [14]. Another study in Bangladesh in children aged <6-59 months old, found the risk of acute malnutrition, one of which was illness more than 2 weeks (OR: 3.08, CI 95 %: 1.13-8.42) [15]. In this study, no analysis was carried out in the onset of the disease before the patient was brought to hospital. Intracranial disorders are generally an acute condition that has emergency symptoms, namely seizures, decreased of consciousness and behavioral disturbances such as refusal to eat or drink milk. The changes of condition in children < 5 years old can cause parents to take their children to the hospital more quickly. More researches are needed for further information regarding onset of disease with length of stay in pediatric patients with intracranial infection.

Previous study in Ethiopia on malnutrition, found that male gender prone for acute malnutrition (AOR = 1.83, CI 95%: 1.29–2.94) and chronic malnutrition (AOR = 1.98, CI 95%: 1.46–2.72). In this study, there was no significant relationship between gender and malnutrition in children with intracranial infections, this was because the proportion of boys who had acute and chronic malnutrition was 29.4% and 32.4% did not differ much from girls who were 32.7% for acute and chronic malnutrition.

Length of stay in hospital relate with prolong exposure to pathogens among children that cause nosocomial infections. This leads to higher release of pro-inflammatory cytokines and associated with higher energy use which affect immune system making it difficult to cure infectious diseases [8, 14].

A study on 2567 patients in 14 centers in 12 countries found that 7% of children were acutely malnourished during admission. Children who experiences acute malnutrition (undernutrition and malnutrition) are risky of having longer length of stay 1.3 (95%CI: 1.01-1.55) and 1.6 (95% CI: 1.27-2.10) with $p = 0.04$ and $p < 0.001$, In addition, children with acute malnutrition in the study also had increased incidence of diarrhea and vomiting compared to children who did not have malnutrition[17]. These results were different with our study, the length of stay for pediatric patients >7 days in malnourished patients was not significantly different from the length of stay for children who were treated with malnutrition. This condition due to the underlying disease requires longer antibiotic treatment than other systemic infections so that longer length of stay can also be experienced by patients who are not malnourished.

The presence of malnutrition reduce immunity and increase complexity of disease, in this study, the proportion of those complexity of disease with acute malnutrition was 36.5% and those with chronic malnutrition were 40.4%. It is estimated that the more complex the disease experienced by children, the higher the activity of inflammatory markers and the longer the period of hospitalization, both of which affect indirectly the nutritional status of children in acute process[7,11,12]. Studies conducted at Sarjito hospital showed that children who were admitted with more than 1 diagnosis tend to be more risky of having malnutrition compared to children who did not have additional diagnoses (RR=2.35; 95% CI: 1.23-4.48)[7]. It can be in the form of protein energy malnutrition, diarrhea, pneumonia and sepsis which causing energy deficiency in children during hospitalization and worsening nutritional status. Another study conducted in children with intracranial infections showed the complexity of the disease did not significantly increase the number of malnutrition and vice versa. This could be probably the anthropometric measurements had been assessed in earlier so that the condition of acute malnutrition didn't affect significantly.

Malnutrition exacerbate mortality in children with CNS infections who are undergoing hospitalization. Study showed that malnourished children, the level of consciousness was dominated by GCS <13, while in well-nourished children the level of consciousness tend to be higher. They also found that being malnourished during treatment increased the mortality risk up to 4 times compared to children who were not malnourish ($p < 0.005$; 95% CI 2.17-5.22)[18].

Another study found acute malnutrition and stunting have significant relation with higher mortality due to respiratory tract infections and diarrhea in children aged below 5 years old (HR: 11.63, CI 95%: 9.84-13.76 for severe acute malnutrition and HR 5.48, 95% 4.62-6.50 for severe stunting) [4].

In current study, 27.5% of malnourish patients died compared to 18.6% of non-malnourished patients, but there was no significant association with this occurrence. This could be due to different of underlying disease from previous studies. In this study severe infection has high probability of mortality in both malnourished and non-malnourished individuals.

5. Conclusion

It can be concluded that the incidence of malnutrition in children with intracranial infections at Sanglah Hospital since January 2019 to March 2021 was 48.1%. Age < 5 years has significant relationship with the incidence of malnutrition in children with intracranial infection.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest.

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