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Comorbid Diseases Is a Predictor Length of Stay in Children with Severe Acute Malnutrition

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Abstract: Severe acute malnutrition (SAM) is one of the leading causes of morbidity and mortality in children in developing countries. Patient with SAM mostly hospitalized with comorbidity that reduce the time of recovery and longer the length of stay (LOS). The aim of this study is to determine the association between comorbid with longer LOS among children with SAM. This was a retrospective cohort study from 2017-2018 on children with SAM conducted in the pediatric care ward of Sanglah Denpasar General Hospital. Inclusion criteria was children aged 1 months to 18 years diagnosed with SAM and had complete data at the start of admission. Exclusion criteria was patient discharged against medical advice. 134 children with SAM were included and analyzed with appropriate statistical analysis. The median of LOS was 18 days, comorbid at admission found were infection (31.3%), non-infection (56.0%), both infection and non-infection (12.7%). HIV found as the most comorbid in SAM patient (21.3%) followed by malignancy (17.3%), congenital heart disease (14%), and pneumonia (12.7%). Multivariate analysis found that comorbid was a risk factor for longer LOS in hospitalized SAM patients. Comorbid increases the LOS by 3.23 times (95% CI 1.563-6.709) p value 0.002. Bivariate analysis found that infection as comorbid increase the LOS by 1.72 times (95% CI 1.171-2.524) p value 0.011. Conclusion that comorbid at admission was associated with longer LOS in hospitalized patient with SAM.

Keywords: Severe Acute Malnutrition, Comorbid, Length of Stay, Children

1. Introduction

Malnutrition is still one of the most common causes of morbidity and mortality among children worldwide, especially in the regions of sub-Saharan Africa and Asia. Malnutrition is associated with >50% mortality in developing countries contributing to morbidity, mortality and increased risk of diseases [1]. The risk of death is also nine times higher among children with severe acute malnutrition (SAM) [2]. The death of 7.6 million children < 5 years of age, approximately 4.4% are attributable to severe wasting. In 2013 prevalence of severe acute malnutrition in Indonesia was 5.7% [2, 3].

Prognosis for SAM treatment continues to be a challenge and better outcomes for inpatient interventions which still remains low due to co-morbidity, poor adherence to treatment guideline, mismanagement of cases and other socio-demographic factors [4].

Children with SAM have a greater risk of dying from common infections, increases the frequency and severity of such infections and contributes to delayed recovery. In addition, the interaction between severe acute malnutrition and infections can create a potentially lethal cycle of worsening illness and deteriorating nutritional status [5].

In a severely malnourished child who has diarrhea, mortality is high ranging from 67.3% to 71% and the cause of death is commonly due to dehydration and electrolytes imbalances. Death is also associated with septicemia, pneumonia, malaria, and hypothermia [6, 7].

The purpose of this study was to determine comorbid diseases as a predictor length of stay in children with severe acute malnutrition. The expected benefits of this study are the results can be an input for colleagues of pediatricians and general practitioners and also can be the basis of further research.

2. Material and Method

This study use retrospective cohort design study with span of 2017-2018 on SAM children in the pediatric care ward of Sanglah General Hospital, Denpasar. Subject of this study was all patients diagnosed with severe acute malnourished who were admitted to the pediatric ward of Sanglah Hospital among the study period. Inclusion criteria were children aged 1 months to 18 years diagnosed with SAM and patients had complete data at the start of admission. Exclusion criteria was patient who discharged against medical advice. Subject is determined by taking the subject in sequence until the number of subjects is met.

Nutrition state of SAM is defined by a very low weight for height (below -3z scores of the median WHO growth standards), or mid-upper-arm circumference (MUAC) < 11.5 mm (for children under 5 years old) and < 70% median MUAC (for children above 5 years old), or the presence of bilateral pitting oedem, or both. Comorbid can be defined as other disease other than SAM that present when patient hospitalized. Comorbid is divided into three categories which are infection, non-infection, and both infection and non-infection. Length of stay (LOS) can be defined as duration of patient with SAM from admission until discharged. LOS divided into two categories which are ≤ 18 days and >18 days. (based on median of total patient's LOS in this study which is 18 days). Patients who met the previously mentioned inclusion and exclusion criteria were included in the study. Comorbid of all the patient with SAM were recorded then followed to know length of stay of each patient.

Data obtained from the sample, then collected and processed into SPSS, descriptive analysis used to describe the characteristics of research subjects based on outcome so that it can be assessed comparability between the two groups. The analysis to assess the association between variable as predictors to mortality in SAM and mortality was done by making a 2x2 cross-tabulation (dummy table). The statistical test used is chi-square test with the significance limit of 0.05. All the variable were included in multivariate analysis. The analysis used is logistic regression, statistically significant with 95% confident interval (CI) and P values < 0.05.

3. Result

The study collected as many as 134 subject with severely malnourished included in this study since 2017 – 2018. We collect 42 subject (31.3%) with infection disease as comorbid, 75 subject (56.0%) with non-infection disease, and 16 (12.7%) with both infection and non-infection disease as the comorbid. Majority of subject were male and most the patient older than 24 months old, with median of age was 36 months (1.0-204.0). Median of LOS in this study was 18 days (1.0-93.0). Subject with LOS less than 18 days was 69 subject (51.5%), and 65 subject (48.5%) with LOS more than 18 days. Characteristic of the sample were summarized in table 1.

Table 1. Characteristic of Subjects with SAM.

Characteristic	N=134
Sex	
Male, N (%)	81 (60.4)
Female, N (%)	53 (39.6)
Age	
≤24 months, N (%)	62 (46.3)
>24 months, N (%)	72 (53.7)
Anemia, N (%)	86 (64.2)
No anemia N (%)	48 (35.8)
Type of SAM	
Kwashiorkor, N (%)	7 (5.2)
Marasmus, N (%)	127 (94.8)
Condition	
1, N (%)	6 (4.5)
2, N (%)	1 (0.7)
3, N (%)	26 (19.4)
4, N (%)	1 (0.7)
5, N (%)	100 (74.6)
Comorbid	
Infection, N (%)	42 (31.3%)
Non infection, N (%)	75 (56.0%)
Both, N (%)	17 (12.7%)
LOS	
≤18 days, N (%)	69 (51.5%)
>18 days, N (%)	65 (48.5%)
Outcome	
Death, N (%)	57 (42.5%)
Survive, N (%)	77 (57.5%)

Bivariate analysis was conducted using chi square test indicated that age, type of SAM, and anemia did not show significant correlation with the length of patient's LOS. However the result showed that infection as comorbid had significant correlation caused longer LOS in patient with SAM. Predictor for LOS were summarized in table 2.

Table 2. Predictors for LOS in Patient with SAM.

	≤ 18 days (n=69)	> 18 days (n=65)	RR	CI95%	p
Comorbid					
Infection	16	26			
Non infection	48	27	1.720	1.171-2.524	0.011
Both	5	12	0.877	0.595-1.293	0.765
Age (month)					
≤24 months	34	28	0.879	0.616-1.253	0.493
>24 months	35	37			
Type of SAM					
Marasmus	66	61	0.841	0.432-1.637	0.712
Kwashiorkor	3	4			
HB					
Anemia	39	47	1.457	0.964-2.202	0.072

This study showed 32 patients (21.3%) with HIV as the most infection comorbid found in the patient, following by 19 patients (12.7%) with pneumonia and 10 patients (6.7%) with tuberculosis. Patient with non-infection comorbid were mostly malignancy with 26 patients (17.3%), following by 21 patients (14.6%) with congenital heart disease and 14 patients (9.3%) with gastrohepatology defect. This study also showed that between infection comorbid have no significant effect for the LOS of the patient (p =0.974), on the other hand between non infection disease also showed no significant correlation (p = 0.319). Sub-analysis of the

comorbid were summarized in table 3.

Table 3. Subanalysis of Patient's Comorbid hospitalized with SAM.

	≤18 hari	>18hari	P
Infection			0.974
HIV, N (%)	18 (56.2)	14 (43.8)	
Pneumonia, N (%)	12 (63.2)	7 (36.8)	
Tuberculosis, N (%)	8 (80.0)	2 (20.0)	
Others, N (%)	5 (62.5)	3 (37.5)	
Non infection			0.319
Malignancy, N (%)	12 (46.2)	14 (53.8)	
Congenital heart disease, N (%)	12 (57.1)	9 (42.9)	
Gastrohepatology disease N (%)	9 (64.3)	5 (35.7)	
Others, N (%)	7 (35.0)	13 (65.0)	

Multivariate analysis showed that in this study only comorbid that have a significant correlation in the longer LOS of the patient. Multivariat analysis summarized in table 4.

Table 4. Multivariate Analysis Factors Associated in LOS of SAM.

Variable	Exp (B)	CI 95%	*p*
Comorbid	3.238	1.563-6.709	0.002
Age	0.969	0.468-2.006	0.932
Type of SAM	0.704	0.146-3.383	0.661
Anemia	2.021	0.944-4.323	0.070

4. Discussion

Malnutrition one of a major causes of childhood morbidity and mortality. This condition is still a great challenge in developing nations, in 2011 about for 3.1 million or 45% of all child deaths causes by this condition [8]. Patient with SAM mostly hospitalized with comorbidity that reduce the time to recovery and longer the LOS.

The median LOS of patient with SAM in this study is 18 days, lower than our institution suggested which is 6 weeks (42 days), but more than that reported in other studies. We also found that most of the patient was hospitalized less than 18 days. The range of LOS with minimum 1 days to maximum 93 days, this can be happen due to 42.5% of the patient was death during admission.

In this study majority of the patient was more than 24 month age (53.7%). Adjusting other variables, children with SAM at age < 24 months were three times more likely to die than children aged >24 months. Younger children may be more vulnerable because of depressed immunity, increased risk of infection and insufficient feeding practices, they have greater risk of non-recovery [9]. Another study of 348 cases of pediatric patient with SAM, controlling for other factors, children aged 24–59 months had 5.8 times higher probability of recovery from SAM as compared to children aged 6–11 months (AOR = 5.8, 95% CI = 2.5, 10.6, and *p* < 0.001) [10]. In our study there was no significant correlation between age and LOS of the patient (p = 0.932). [10]

Most of the children admitted were marasmic (94.8%), other studies have found that marasmus is more prevalent than kwashiorkor [11]. The etiology of severe wasting (marasmus) is linked to the situation where the child consumes much less food than required for his or her energy needs and so energy is mobilized from both body fat and muscle [12]. Gluconeogenesis in the liver is enhanced, and there is loss of subcutaneous fat and wasting of muscles. Those children who were diagnosed with marasmus on admission stayed longer before recovery than their kwashiorkor counterparts LOS [13, 14]. This finding was not found in this study because it showed that type of SAM doesn't have significant association with longer LOS (*p* = 0.661).

We also found most of the patient was with anemia (64.2%), and don't have significant association with longer LOS *p*=0.070, RR 2,021 CI 95% (0.944-4.323). This finding was not similar found in other studies. A study in Ethiopia found that most of children with SAM who were not anemic had higher probability of cure than those children who were anemic, that's mean the patient need less day of hospitalized. This is due to the fact that there is an increase in the prevalence of infection and increased probability of heart failure in anemic children leading to prolonged time to cure [15, 16]. In this study the mean of hemoglobin level was 10.24 g/dL, and was not an indication for a blood transfusion. Most of the patient have stable cardiovascular hemodynamic with less tendency of heart failure.

The prognosis of SAM largely depends on the presence of other comorbidities at admission. The possible reason might be that these children depressed humeral and cell-mediated immunity are attributable reasons for the prevalence of infection [17]. The finding of our study showed that almost all hospitalized patient with SAM has one or more comorbid during admission. Comorbid has a significant correlation with longer LOS (*p*=0.002, RR 3.238 CI95% (1.563-6.709)). In bivariate analysis we found that infection as the comorbid have a significant effect for longer LOS compare with non-infection comorbid or combine of both comorbid. (*p*=0.011, RR 1.720 CI95% (1.171-2.524)).

Moreover, the probability of recovery rate of patients with comorbid decreases, that was also found in studies conducted at Jimma University, reported low recovery rate and increase chance of mortality among patients with comorbid [18]. The reason behind this might be due to longer admission period, severe decline of nutrition status, and higher demand for nutrition [19, 20].

SAM patient with co-morbidities requires a prolonged hospital stay, present with an increased nutritional crisis, and more nutrient requirement because of reduced appetite and nutrient absorption in comparison with their counterparts. A study in Ethiopia found Tuberculosis was present in 21.5% cases, this shows that tuberculosis as the most common chronic infection associated with severe malnutrition [6, 21].

One study found SAM children without TB disease were more likely to cure earlier than those with TB, they revealed less recovery and a more likely risk of death in children with co-morbidities such as TB disease [4, 25]. Another study also found that patients with HIV / AIDS and TB have lower recovery rates than patients without HIV / AIDS and TB. The percentage of people with HIV and TB in their study are 1% and 15.4% respectively [1, 22].

A study in Bandung found pneumonia occurred in 35% of SAM patients, pneumonia is the most frequent comorbid disease suffered by the subjects, other studies also reported acute gastroenteritis being the most common co-morbid condition followed by respiratory tract infection in their cohort of SAM. This study shows that there are varied presentations of diseases in SAM but the two most common co- morbidities i.e. diarrhea and pneumonia cases should be looked on priority basis at the time of hospitalization and managed appropriately and aggressively to bring down the high mortality associated with SAM [23, 24].

A study in Ghana also found low treatment response may be because of inappropriate management of children such as partial prescription of routine medication and due to medical comorbidity at admission such as presence of pneumonia and HIV association with diarrhea, but significant association were seen between high cure rate with absence of HIV (p=0.002) and pneumonia (p=0.001) [1, 25].

All the study has similar result with our study showed that comorbid have a significant roles in a longer LOS. We found that most of the comorbid in our patient is non infection disease (56.00%), but this study showed HIV (21.3%) is the most infection comorbid found in the patient, following by pneumonia (12.7%), and tuberculosis (6.7%). We also found that infection have a significant role to make longer LOS comparing to the other two comorbid. Each disease in infection comorbid showed no significant effect in LOS of the patient (p= 0.974), the same result showed with non-infection disease as the comorbid (p= 0.319).

Limitation of our study is we can not measured the severity of the diseases that might be one of the reason for longer LOS of the patient. This study conducted at single center, others factors associated with longer LOS in patients diagnosed with SAM were not analyzed in this study. Further study still needed to be done to overcome limitation in this study.

5. Conclusion

Comorbid diseases was associated with predictor length of stay in children with severe acute malnutrition. Infection as comorbid have a significant effect to prolonged LOS compare with non-infection or combine of the comorbid. Moreover, this study presents the high rate of co-morbidity that hinders nutritional recovery rate as predictor LOS of SAM patient. Therefore, early detection and prompt management of comorbidities is the key to decrease the mortality and improve overall outcome of SAM children.

Disclosure

All the authors do not have any possible conflicts of interest.

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