

## Factors Influencing Outcomes of Children Hospitalized with Acute Severe Malnutrition

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### Abstract

**Background:** Nutrition is still a global health issue, and improving nutrition is among the targets of the Sustainable Developmental Goals (SDGs). One of Indonesia's SDGs indicators is to reduce prevalence of malnutrition in children. Indonesia, as a developing country, implements a comprehensive malnutrition treatment program for children, including various aspects related to management of children with acute malnutrition. The purpose of this study was to identify factors associated with the outcome of children hospitalized with acute severe malnutrition.

**Methods:** This cross sectional study enrolled 195 children with severe acute malnutrition, admitted to hospital from November 2016 to August 2017. Statistical Analysis was conducted using multivariable logistic regression to identify factors associated with the outcome. Adjusted Ratio with Confident Interval 95% and the value of P <0 .05 was considered significant.

**Result:** A total of 195 children were diagnosed having acute severe malnutrition. A history of complete immunization status (p value <0.001) was proved to be directly proportional to the recovery rate of patients with acute severe malnutrition. Provision of other types of antibiotic (p value 0.001) showed to increase recovery rates of patients with acute severe malnutrition. Several comorbid diseases reduced recovery rates such as pneumonia (Crude OR 0.619) tuberculosis (Crude OR 0.606) and HIV (p value 0.08).

**Conclusions:** This study shows that although the provided treatments are appropriate with the standard treatment for severe malnutrition, they still encounter high levels of morbidity. Further large-scale studies should be conducted to develop better interventions and management of acute severe malnutrition, in order to achieve better outcome.

**Keywords:** Children, related factors, outcome, severe acute malnutrition

### Introduction

Adequate nutrition is a fundamental human right and is a prerequisite for good health. 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. Severe acute malnutrition (SAM) causes approximately 1–2 million deaths each year, with 20 million living in a state of severe acute malnutrition.<sup>1,2</sup> Malnutrition is associated with > 50% mortality in developing countries due to underlying infectious diseases.<sup>3</sup> Several diseases that often accompanies children with malnutrition and increase mortality are: diarrhea 60.7%, pneumonia 52%, measles 44.8% and malaria

57.3%.<sup>3,4</sup>

Approximately 2% of children in developing countries suffer from SAM, especially in South Asian countries and Sub-Saharan Africa. Acute severe malnutrition is a common comorbid of children admitted to the hospital.<sup>5-7</sup> This underlying condition may cause death up to 25 to 30% of children in many poor countries.<sup>6</sup> Previous studies suggest that approximately 12 million children under the age of five die every year in developing countries, in which 60% was associated with malnutrition.<sup>8</sup> Despite good progression in child health, severe acute malnutrition remains the leading cause of death in children under the age of five.<sup>7</sup> SAM high mortality rate had remained a problem for the past few years. Several countries with

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high SAM prevalence have developed specific national policies in order to formulate the strategies to solve malnutrition problem comprehensively.<sup>9</sup>

Currently, there are limited information on treatment outcome and clinical characteristics associated with mortality aiming to improve inpatient care of SAM.<sup>10</sup> Therefore, this study aims to assess outcome status and factors influencing outcome in children with SAM admitted to the Department of Child Health Hasan Sadikin Hospital.<sup>4</sup>

## Methods

This study was conducted in Bandung City, ±150 km from Indonesia's capital, Jakarta, and is the largest city in West Java province with an estimated population of 2,500,000 inhabitants. This study was conducted at Dr. Hasan Sadikin Hospital, which is a provincial reference hospital that has a pediatric in-training study program.

Data was obtained from patient's medical records with prior approval from the Health Research Ethics Committee and Medical Record Installation of Dr. Hasan Sadikin General Hospital. The inclusion criteria were based on WHO Child Growth Standard curve <-3 Z-score or if the patient had bilateral pitting edema or arm circumference <-3 Z-score. Criteria for improvements were based on the SPHERE international criteria, in which children returning from hospital present no symptoms of disease and are able to maintain or increase bodyweight (measured within 2 weighing times).<sup>4</sup>

This cross sectional study enrolled 195 children with acute severe malnutrition treated at the Department of Child Health, Dr. Hasan Sadikin General Hospital, since November 2016 to August 2017. Analysis using multivariable logistic regression was used to identify the factors associated with outcomes. Adjusted Ratio with 95% CI and P-values less than 0.05 was considered significant. All data obtained were processed and analyzed using SPSS software version 16.

## Results

The result of this study showed no association between gender, age, place of residence and exclusive breastfeeding with patient outcome ( $p > 0.05$ ). Interestingly, a significant positive correlation was observed between immunization and patient recovery. A total of

96 out of 152 recovered subjects had complete records and 33 out of 43 patients who did not recovered had complete records. Complete immunization status in the recovery group was 44.8%, which was higher than the non-recovered group (12.1%) (Table 1).

Furthermore, in the non-recovered group, the most common comorbidities were pneumonia 44.2%, anemia 32.6%, and tuberculosis 20.9%. From 152 recovered subjects 28.9% were given other antibiotics, while from 43 non recovered subjects, only 4.2% were given other antibiotics. In the non-recovered group, 72.1% received folic acid supplementation and 58.1% received Fe which were significantly higher than the recovered group (52.6% folic acid ( $p = 0.023$ ) and 28.3% Fe supplementation ( $p < 0.001$ ), respectively (Table 1).

Moreover, the bivariate analysis indicated that sex, age and residency did not show significant correlation with patient's outcome. However, the result implied that female, age <2 years and urban residence tend to have a higher chance of recovery.

This study revealed that complete immunization status had a 2-fold tendency to recover among children with acute severe malnutrition. Comorbid such as tuberculosis, pneumonia, anemia and sepsis showed an OR <1, suggesting reduced chance of recovery, but the results were not significant. Provision of other antibiotics influenced recovery 8-fold and was statistically significant. Multivitamin, folate and Fe supplementation results had OR <1, meaning that it reduced the chances of recovery, especially Folate and Fe which was significant.

## Discussion

This study included 195 children treated in the pediatric ward of Dr. Hasan Sadikin Hospital Bandung. This study showed no significant differences in sex among all patients with acute severe malnutrition. The ratio of male and female is 115 to 80. Most of the patients were above 5 years old, comprising almost half of the study subjects. A number of research and management in the field of healthcare has continued to increase, aiming to improve recovery rate. Malnutrition in children leads to weakened immunity and plays a large role in the high mortality rates observed among children in sub-Saharan Africa and south Asia.<sup>11,12</sup> Acute severe malnutrition is a global problem especially in developing countries such as Indonesia.

**Table 1 Basic Characteristics of Subject**

	Total n=195	Recovered n=152	Not recovered n=43	p-value
Gender				
Male	115 (59.0)	89 (58.6)	26 (60.5)	0.822
Female	80 (41.0)	63 (41.4)	17 (39.5)	
Age				
< 2 years old	59 (30.3)	46 (30.3)	13 (30.2)	0.255
2–5 years old	54 (27.7)	46 (30.3)	8 (18,)	
>5 years old.	82 (42.1)	60 (39.4)	22 (51.2)	
Residence				
Rural	99 (50.8)	74 (48.7)	25 (58.1)	0.274
Urban	96 (49.2)	78 (51.3)	18 (41.9)	
Exclusive Breastfeeding	n=9	n=9		
Not breastfed	3 (33.3)	3 (33.3)		
6 months	4 (44.4)	4 (44.4)		
2 years	2 (22.2)	2 (22.2)		
Immunization Status	n=129	n=96	n=33	
Measles	63 (48.8)	37 (38.5)	26 (78.8)	<0.001*
Complete	47 (36.4)	43 (44.8)	4 (12.1)	
Incomplete	19 (14.7)	16 (16.7)	3 (9.1)	
Comorbid				
Diarrhea	18 (9.2)	16 (10.5)	2 (4.7)	0.372
TBC	30 (15.4)	21 (13.8)	9 (20.9)	0.254
HIV	2 (1.0)	0 (0.0)	2 (4.7)	0.048*
Pneumonia	69 (35.4)	50 (32.9)	19 (44.2)	0.172
Anemia	61 (31.3)	47 (30.9)	14 (32.6)	0.838
CHF	8 (4.1)	7 (4.6)	1 (2.3)	0.688
Sepsis	22 (11.3)	16 (10.5)	6 (14.0)	0.586
Head Circumference	n=64	n=49	n=15	
Normosefal	24 (37.5)	19 (38.8)	5 (33.3)	0.930
Mikrosefal	36 (56.3)	27 (55.1)	9 (60.0)	
Makrosefal	4 (6.3)	3 (6.1)	1 (6.7)	
Treatment				
Amoxicillin	10 (5.1)	10 (6.6)	0 (0.0)	0.121
Ampicillin-Gentamisin	99 (50.8)	72 (47.4)	27 (62.8)	0.074
Other Antibiotics	46 (23.6)	44 (28.9)	2 (4.7)	0.001*
Supplements				
Multivitamin	93 (47.7)	69 (45.4)	24 (55.8)	0.227
Folat	111 (56.9)	80 (52.6)	31 (72.1)	0.023*
Fe	68 (34.9)	43 (28.3)	25 (58.1)	<0.001*

**Table 2 Bivariate Analysis of Logistic Regression Factors Affecting the Output**

	Crude OR (95% CI)	p-value
Gender		
Male	1	
Female	1.083 (0.542 – 2.161)	0.822
Age		
< 2 years old	1	
2–5 years old	1.297 (0.591 – 2.847)	0.516
>5 years old	2.108 (0.861 – 5.164)	0.103
Residence		
Rural	1	
Urban	1.464 (0.739 – 2.902)	0.275
Immunization Status		
Measles	1	
Complete	0.267 (0.070 – 1.010)	0.052
Incomplete	2.016 (0.406 – 10.016)	0.391
Comorbid		
Diarrhea	2.412 (0.532 – 10.972)	0.253
TBC	0.606 (0.254 – 1.441)	0.257
HIV	-	-
Pneumonia	0.619 (0.310 – 1.235)	0.174
Anemia	0.927 (0.449 – 1.914)	0.838
CHF	2.028 (0.243 – 16.947)	0.514
Sepsis	0.725 (0.265 – 1.984)	0.532
Treatment		
Amoxicillin	-	-
Ampicillin-Gentamisin	0.533 (0.266 – 1.069)	0.076
Other Antibiotics	8.352 (1.936 – 36.033)	0.004*
Supplements		
Multivitamin	0.658 (0.333 – 1.301)	0.229
Folat	0.430 (0.206 – 0.900)	0.025*
Fe	0.284 (0.141 – 0.573)	<0.001*

This study showed a recovery rate of 77.9%, slightly exceeding the minimum value of international standards to monitor recovery rates which is more than 75%.<sup>4,13</sup> These results are similar with results obtained by Jimma University, which show a result of 77.8%.<sup>4</sup> These results provide notice that the recovery rate of children with acute severe malnutrition is still low, therefore an intervention program is needed to improve welfare and health of the

child in the future.<sup>14</sup>

The differences in recovery outcomes may be influenced by socioeconomic status, quality of treatment, clean and healthy life behavior, access to supplementary food and health services, and finally the difference in malnutrition management guidelines in each area. The study in Africa conducted by Grebemichael et al.<sup>10</sup> shows similar results. The study reported that socio-demographic factors

such as age and residence are not associated with recovery rates, however immunization status is proportionally correlated with severe acute malnutrition in children.<sup>14</sup>

Furthermore, pneumonia occurred in 35% of SAM patients, pneumonia is the most frequent comorbid disease suffered by the subjects. The incidence of pneumonia is still high in Indonesia, data from a study conducted by Rudan et al. in Tan et al.<sup>15</sup> showed that 450.611 episodes of lower respiratory tract infection in children <5 years old are caused by *Streptococcus infection Pneumonia*. Rudan et al. in Tan et al.<sup>15</sup> also showed that in Surabaya and Denpasar are 283 cases/100,000 children and 347 cases/100,000 children.

The low recovery rate obtained in this study might be due to the lack of data and limited amount of subjects. In addition, low immunization coverage also contributes to the recovery rate of children with severe acute malnutrition. The study was conducted at a tertiary referral hospital, therefore many patients had a severe comorbid such as tuberculosis, congenital heart disease, hemato-oncology and HIV malignancies, all which have an effect on the recovery rate of hospitalized patients.

Similar outcomes was reported by a retrospective cohort study conducted in southern Africa, in which socio-demographic characteristics such as age, place of residence, and breastfeeding status are not statistically associated with recovery rates. However, immunization status and use of other antibiotics are statistically correlated.<sup>10</sup>

Moreover, the probability of recovery rate of patients with comorbid decreases, that was also found in studies conducted at Jimma University, which reported low recovery rate and increase chance of mortality among patients with comorbid.<sup>16</sup> The reason behind this might be due to longer admission period, severe decline of nutrition status, and higher demand for nutrition. However, intake, absorption, and utilization remains low.<sup>10,16</sup>

Other comorbid studies are patients with HIV / AIDS and TB who have a lower recovery rates than patients without HIV / AIDS and TB. The percentage of people with HIV and TB in this study are 1% and 15.4% respectively. This study has similar results as those done by Collins et al.<sup>17</sup>

The limitations of this study are the lack of comparison with other studies conducted in other health facilities within the same area; lack of information on the study subject because the study relied on medical record

records; and the lack of appropriate statistical method to use in a small sample.<sup>4</sup>

It can be concluded that there is an association of factors that alleviate and increase the morbidity and mortality of acute severe malnutrition in children. Based on this research, the patient's complete immunization status and measles immunization was found to correlate with better recovery rates, while the provision of multivitamin, folic acid and Fe supplements reduces the chance of recovery. The use of other choices of antibiotics is also a factor that may have more influence on the recovery rate than the provision of ampicillin and gentamicin and when not given antibiotics. Additionally, HIV infection, pneumonia and tuberculosis are comorbid factors that exacerbate acute severe malnutrition.

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