Survival Analysis of Patients with Severe Acute Malnutrition Admitted at the In-patient Therapeutic Care of the Bicol Regional Training and Teaching Hospital

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ABSTRACT

Background. Severe acute malnutrition (SAM) in children under five years remains a major global health concern. It carries a burden to the overall health of a child, contributes to mortality, and adds financial strain to the family and the hospital. The Philippine Integrated Management of Acute Malnutrition was established to address acute malnutrition in Filipino children.

Objective. This study aimed to determine the factors affecting survival of patients admitted at Bicol Regional Training and Teaching Hospital (BRTTH) In-patient Therapeutic Care (ITC).

Methods. This is a retrospective cohort study design utilizing survival analysis. Accrual period was from January 1, 2018 to December 31, 2018. Follow-up ended on March 31, 2019. There were 154 admissions and excluded 17 missing charts. Survival analysis was done utilizing STATA 14.

Results. The prevalence of SAM requiring ITC admission was 3.0 percent. Majority belonged to 6-59 months of age (63%), with equal predilection for both sexes (1:1) and 71% came from the home province, Albay. Most of patients' caretakers had middle educational attainment. Sixty-eight percent (68%) were new patients, 16% readmitted, 15% transferred from the Out-patient Therapeutic Care (OTC) and <1% relapsed. The top three most common complications and co-morbidities include: pneumonia, low electrolytes, and fever. Sixty-three percent (63%) of patients at the ITC had a desirable treatment outcome, of which, 8% were cured and 55% transferred to OTC. Undesirable outcomes accounted for 37% of the cases which included non-cured, defaulter, and died at 12%, 8%, and 17%, respectively. The risk of dying was higher in SAM patients with parents having middle and low educational attainment as compared to those with high educational attainment (2-5 folds to 100-200 folds). SAM patients presenting with hypovolemic shock were likely to die by 1.5-19 times (1.5-19x) as compared to those without. SAM patients with malignancy were more likely to die 4-44 folds as compared to patients without malignancy.

Conclusion and Recommendations. Educational attainment of parents, malignancy, and hypovolemic shock were significant predictors of mortality. We recommend prompt intervention by educating families, strengthen policies targeting socio-economic determinants, capacitate medical staff, refine current clinical practice guidelines and treatment pathways to reduce the number of children who die from severe acute malnutrition.

Keywords: severe acute malnutrition, community management of acute malnutrition, in-patient therapeutic care, survival analysis

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INTRODUCTION

Severe acute malnutrition (SAM) steals a child's opportunity to develop normally and increases his risk of dying. Worldwide, SAM accounts for about 400,000 child deaths annually.[1] Furthermore, children with SAM have a mortality risk of 11.6 times higher than well-nourished children.[2] This global condition necessitates sustained and effective nutrition interventions. An evidence-based model which could avoid deaths in these children, the Community-based Management of Acute Malnutrition (CMAM) provides global standards in the management of SAM patients without medical complications with ready-to-use therapeutic foods coupled with the facility-based approach for those SAM children with medical complications.[3] Several studies in other countries done showed that CMAM was effective in averting child deaths and achieving good survival rates.[4-6]

The prevalence of under-five wasting in the Philippines dropped from 7.9% in 2013 to 7.1% in 2015.[7] However, the rate was still lagging from the Global nutrition target of <5% by 2025. It was then that the Philippine Integrated Management of Acute Malnutrition (PIMAM) program was launched in 2015 to address acute malnutrition in children under five years. The PIMAM program has four components: (1) Community Mobilization; (2) Out-patient Therapeutic Care (OTC); (3) In-patient Therapeutic Care (ITC); and (4) Targeted Supplementary Feeding Program (TSFP). The program has set protocols for the management of SAM in the community and in the hospital setting. In 2018, the prevalence of acute malnutrition in the Philippines decreased to 5.6%.[8]

Albay was one of the first provinces in the Philippines to implement the PIMAM program to address its high prevalence of acute malnutrition in children less than 5 years recorded at 10.5% in 2015.[7] The Bicol Regional Training and Teaching Hospital (BRTTH) then launched its PIMAM program in 2017 where an ITC and an OTC were established. At the ITC, patients are discharged with different treatment outcomes. The goal of ITC management is either for patients to be discharged cured of their wasting or treated of their medical complications and transferred to the OTC. However, some are non-cured while others are discharged against medical advice (defaulter). Despite adherence to SAM treatment protocols, some of the admitted patients die. Although SAM already increases the mortality risk of a child, associated factors will further escalate it many folds making ITC management more challenging. Several studies recognized related factors with mortality among SAM patients in the ITC. In the appraised literature, age less than 24 months[1], occurrence of hypothermia[1,9,10], fever[1], hypoglycemia[1], hyponatremia and hypokalemia[11], hypocalcemia[12], severe anemia[11], severe dehydration[11], shock[1], diarrhea[11], bronchopneumonia[10], septicemia[1,10], meningitis[1], HIV/AIDS[9,11], digestive illnesses, and skin lesions[11] were the factors suggestively related with mortality.

Because several factors may be linked with SAM and the risk of dying from it, conducting this study is imperative to determine the factors associated with the survival of SAM patients admitted at the BRTTH. As one of the first to implement the PIMAM ITC, this study will provide baseline data on factors affecting survival of admitted SAM patients under the PIMAM program in the Bicol region. This will help improve clinical decisions, augment the effectiveness of the program, and provide recommendations to stakeholders, PIMAM program managers and policymakers on which associated factor or determinant should be focused on to reduce the number of children who die from severe acute malnutrition. The general objective of the study was to determine factors affecting survival of SAM patients admitted at the BRTTH ITC from January 1, 2018 to December 31, 2018. Specifically, to describe the desirable and undesirable outcomes and to determine factors related to survival among patients at the ITC. Survival analysis will be done using Kaplan-Meier graphs and Cox proportional hazard regression analysis.

METHODS

Study Design

This is a hospital-based retrospective cohort study design utilizing survival analysis.

Study Setting

The study was conducted at BRTTH where an In-patient Therapeutic Care (ITC) is available. This is where SAM patients who failed the appetite test and/or with medical complications and/or with Grade 3 bilateral pitting edema are managed.

Subjects

The study population was composed of pediatric patients with SAM admitted at the ITC of BRTTH from January 1, 2018, to December 31, 2018. The sample size was computed based on the study of Roy et al. in 2011[10] using STATA Version 14 with the following assumptions: power or 80%, the significance of 0.05, the hazard ratio of 2.14 and standard deviation of 0.5. The total estimated number of events and sample size would be 110.

Data Collection Procedure

The study was granted ethical approval by the BRTTH Institutional Review Board. The charts of all pediatric patients with SAM admitted at the ITC from January 1, 2018 to December 31, 2018 were reviewed observing the Data Privacy Act of 2012. Missing charts were excluded. Patients who stayed at the ITC beyond December 2018 but who were admitted within the study period were included in the study. For these patients, an observation was done until March 31, 2019. The list of charts reviewed was based on all patients recorded in the ITC Registration logbook. The ITC

Pediatric history form and the ITC form and monitoring sheet were reviewed in detail. The admitting and discharge diagnoses including the complication or pre-morbid diseases, length of stay in the ITC, and treatment outcomes were noted. The monthly reporting form of UNICEF and DOH were also reviewed for comparison of data. All data gathered were documented in the Data Extraction Form. All data encoded were checked utilizing Kappa statistics with a near-perfect agreement. Data was gathered for a period of one (1) month (April 1-30, 2019) after IRB approval.

Statistical Analyses

Descriptive statistics was done utilizing frequency distribution and percentages. Multivariate analyses were done using Cox proportional hazard regression. STATA 14 software was used. Non-informative censoring approach was utilized in this study. Multiple imputation was done among those with missing "educational attainment" in the charts. Only 91 charts have the complete data for "educational attainment" among the total 137 charts included in the study. The reason for the missing data was incomplete documentation.

RESULTS

Demographics and Clinical Profile

Table 1 shows that the majority of patients belong to 6-59 months of age (63%), with an equal predilection to both sexes (1:1) and most came from Albay (71%). Most of the patients' caretakers (mothers and fathers) had middle educational attainment and an income of <Php 5,000 per month.

Table 2 shows the clinical profile of SAM patients**.** Sixty-eight percent (68%) of admitted patients were new patients, 16% were readmitted, 15% were transferred from OTC, and only <1% relapsed. The prevalence of SAM requiring ITC admission from January 1, 2018 to December 31, 2018 was 3.0%. The top three most common complications and/or co-morbidities include pneumonia, low electrolytes, and fever.

Table 1. Demographic Profile, (N=137)

Demographic Profile	Frequency	Percentage
Age		
>59 months	35	26
6-59 months	87	63
<6 months	15	11
Sex		
Female	66	49
Male	70	51
Residence		
Albay	98	71
Camarines Sur	5	4
Masbate	12	9
Sorsogon	22	16
Paternal educational attainment		
High	8	6
Middle	61	44
Low	22	16
Missing data	46	34
Maternal educational attainment		
High	9	7
Middle	64	47
Low	19	14
Missing data	45	32
***Family Income** (in Php)*		
≥Php 5000/month	27	20
<Php 5000/month	62	45
Missing data	48	35

Treatment Outcomes

Figure 1 shows the total number of patients included in the study and the treatment outcomes depicted in raw values. The five treatment outcomes were grouped into desirable and undesirable.

Table 3 shows the association of the clinical profile of SAM patients admitted at the ITC and the general treatment outcome – whether desirable or undesirable.

Factors Affecting Survival

Table 4 shows the 60-days overall survival estimates of all SAM patients admitted at the ITC. Figure 2 shows the

Table 2. Clinical Profile of SAM Patients, (N=137)

Profile	Frequency	Percentage
Admission type		
New	93	68
Readmission	23	16
Relapse	1	<1
Transfer from OTC	20	15
Patient type		
New	110	80
Readmission	27	20
Pneumonia	100	73
Low electrolytes	90	66
Fever	75	55
Dehydration	49	36
Acute Diarrhea	48	35
Intestinal parasitism	40	29
Sepsis	27	20
Severe anemia	28	20
Hypoglycemia	22	16
Bilateral pitting edema, Grade 3	21	15
Tuberculosis	17	12
Cerebral palsy	13	12
Heart disease	16	12
GI obstruction	15	11
Malignancy	7	5
CNS infection	6	4
Colostomy	5	4
Hypothermia	4	3
Hypovolemic shock	4	3
Skin infection	2	1

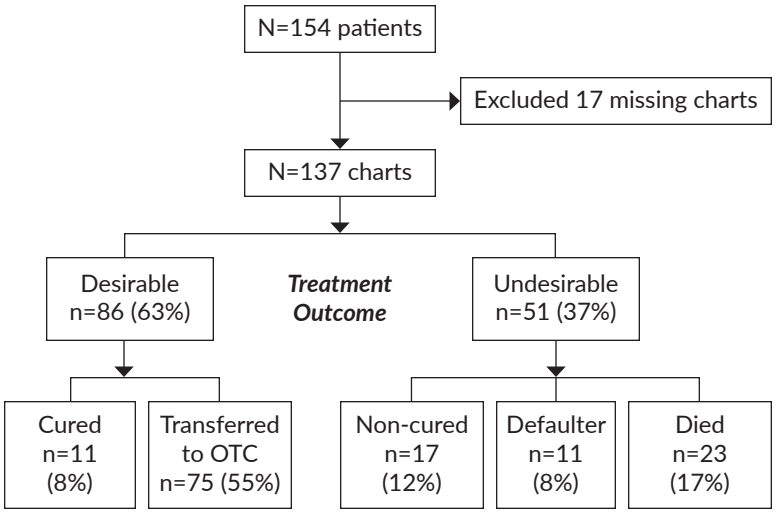

Figure 1. Study participants and their treatment outcome.

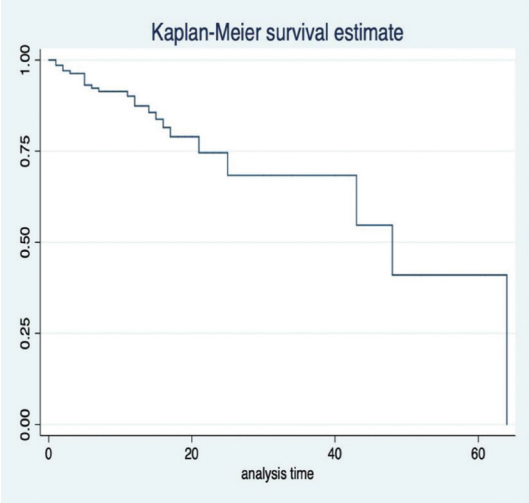

Figure 2. Sixty-days KM overall survival estimates.

Table 3. Clinical Profile and Frequency of Desirable and Undesirable Outcomes of SAM Patients

Clinical Profile	Outcome			
	Desirable		Undesirable	
	f	%	f	%
Admission type				
New	58	62	35	38
Readmission	11	48	12	52
Relapse	1	100	0	0
Transfer from OTC	17	85	2	15
Patient type				
New	72	65	38	35
Readmission	15	56	12	44
Pneumonia	64	64	36	36
Low electrolytes	54	60	36	40
Fever	47	62	28	38
Dehydration	32	65	17	35
Acute Diarrhea	30	62	18	38
Intestinal parasitism	28	70	12	30
Sepsis	15	56	12	44
Severe anemia	16	58	12	42
Hypoglycemia	14	64	8	36
Bilateral pitting edema, Grade 3	13	62	8	38
Cerebral palsy	7	54	6	46
Heart disease	7	44	9	56
GI obstruction	6	40	9	60
Tuberculosis	14	82	3	18
Malignancy	1	14	6	86
CNS infection	2	33	4	67
Colostomy	4	80	1	20
Hypothermia	2	50	2	50
Hypovolemic shock	0	0	4	100
Skin infection	2	100	0	0

Kaplan-Meier survival curve. The survival of patients during the first twenty days was at and above 79%, plateaued at 68% during the next 30-40 days and went down to 41% when patients stayed for more than 50 days in the ward. The median survival of SAM patients was 45-46 days, which means that half of the patients (if they were still admitted at the ITC ward) will survive until the 45th-46th day of admission.

Table 5 shows the association of demographic factors and survival. Only the paternal and maternal educational attainment had a significant association with survival. Low paternal educational attainment was significantly associated with mortality twenty- one times (21x) as compared to those with high paternal educational attainment. Also, low maternal educational attainment was significantly associated with mortality fifty-one times (51x) as compared to those with high maternal educational attainment.

Table 6 shows the clinical factors affecting survival. The presence of hypovolemic shock was significantly associated with mortality four folds (4x) as compared to those without hypovolemic shock. Also, the presence of malignancy was significantly associated with mortality twelve times (12x) as compared to those without malignancy.

Table 7 shows a multivariate multiple imputation analysis of all the significant factors affecting survival from all the univariate analyses. Only malignancy and hypovolemic shock

Table 4. 60-days OS Estimates of SAM Patients

Time in days	Survivor function	Standard error	95% CI
10 days	0.91	0.02	0.85-0.95
20 days	0.79	0.05	0.67-0.87
30 days	0.68	0.08	0.49-0.82
40 days	0.68	0.08	0.49-0.82
50 days	0.41	0.16	0.13-0.68
60 days	0.41	0.16	0.13-0.68

Table 5. Demographic Factors Affecting Survival

Factors	Hazard Ratio	Standard Error	p-value (<0.05)	95% CI
Age at diagnosis *(>59 months old= 0)*				
6-59 months old	3.12	2.35	0.13	0.71-13.67
<6 months old	3.97	3.63	0.13	0.66-23.92
Sex *(Female=0)*				
Male	1.37	0.60	0.46	0.58-3.2
Family income *(>5,000=0)*				
<5,000	1.21	0.85	0.78	0.31-4.8
Paternal Educational Attainment *(High =0)*				
Middle	5.5	32.0	<0.001*	1.73-17.2
Low	21.2	-	-	-
Maternal Educational Attainment *(High =0)*				
Middle	16.8	9.9	<0.001*	5.1-54
Low	51.0	-	-	-
Exclusive Breastfeeding *(Yes=0)*				
No	1.04	0.49	0.94	0.41-2.63
Fully Immunized *(Yes=0)*				
No	0.99	0.43	0.99	0.38-2.58

**Significance*

were significantly associated with survival. Patients with malignancy are fourteen times (14x) more likely to die than patients without malignancy. The presence of hypovolemic shock increases the chance of dying by five times (5x) as compared to those admitted without hypovolemic shock.

Table 8 shows the summary of significant variables associated with survival combining the complete case and imputation analyses.

Holding all other variables constant, the risk of dying was higher in SAM patients whose parents had middle and low educational attainment as compared to SAM patients' parents with high educational attainment (2-5 folds to 100-200 folds). SAM patients presenting with hypovolemic shock were likely to die by 1.5-19x as compared to admitted patients without hypovolemic shock. SAM patients with malignancy were more likely to die 4-44 folds as compared to patients without malignancy.

In summary, findings of the study showed that the prevalence of SAM requiring ITC admission was 3% percent. Majority belonged to 6-59 months of age (63%), with equal predilection for both sexes (1:1) and 71% came from Albay. Most of patients' caretakers had middle educational attainment. Sixty-eight percent (68%) were new patients, 16% readmitted, 15% transferred from OTC and <1% relapsed. The top three most common complications and co-morbidities included: pneumonia, low electrolytes, and fever. Majority of SAM patients at the ITC had desirable outcomes at 63%, of which, 8% were cured and 55% transferred to OTC. The non-desirable outcomes comprised 37% as non-cured, defaulter and died at 12%, 8%, and 17%, respectively. The factors found to be significantly associated with survival were paternal and maternal educational attainment, presence of malignancy, and hypovolemic shock.

DISCUSSION

Severe acute malnutrition as a risk factor to child mortality is well established. Community-based Management of Acute Malnutrition programs provide evidence-based interventions for the treatment of SAM. Adherence to the clinical practice guidelines on the in-patient management of children with SAM is expected to lessen deaths in these children. However, socio-demographic and clinical factors have been shown to affect survival. Several studies have been done on identifying factors affecting the mortality of patients enrolled in CMAM programs worldwide.[1,9-12] This study provides baseline data in the Bicol region on the sociodemographic and clinical profile, description of desirable and undesirable outcomes, and factors affecting survival of pediatric patients with SAM enrolled in the BRTTH PIMAM program.

Majority (63%) of SAM patients admitted at the BRTTH ITC belong in the 6 to 59-month age group. There was an equal predilection for both sexes (1:1). Seventy-one percent (71%) of the patients reside in the province of Albay where BRTTH is located. Being a referral hospital and the only one with an In-patient Therapeutic Care in the Bicol Region during the study period, BRTTH also received patients from neighboring provinces of Sorsogon, Masbate, and Camarines Sur. Both paternal and maternal educational attainment were mostly in the middle level (elementary and high school graduate) although a good proportion – 16% for paternal and 14% for maternal had low level (pre-school graduate and elementary undergraduate) educational attainment. Comparably, it was found in a study by Vollmer et al. in 2017 that higher educational level attainment for both mother and father was associated with lower childhood undernutrition including wasting.[13] Furthermore, a study in India in 2000 showed that maternal education had the

Table 6. Clinical Factors (Comorbidities) Affecting Survival

Factors	Hazard Ratio	Standard Error	p-value (<0.05)	95% CI
***Hypoglycemia* (Yes=1)**				
Without (no=0)	1.94	0.97	0.17	0.75-5.03
***Electrolytes** (Normal=0)*				
Low (yes=1)	2.31	1.74	0.26	0.53-10.10
***Fever** (Afebrile=0)*				
With fever (yes=1)	1.2	0.55	0.72	0.48-2.94
***Hypothermia** (yes=1)*				
Without hypothermia (no=0)	1.5	1.6	0.67	0.20-11.6
Dehydration				
Without dehydration	0.73	0.34	0.49	0.30-1.81
***Hypovolemic shock** (yes=1)*				
Without hypovolemic shock	3.80	2.23	0.02*	1.20-12.1
***AGE** (yes=1)*				
Without AGE (=0)	0.97	0.44	0.95	0.41-2.34
***Pneumonia** (yes=1)*				
Without pneumonia (=0)	1.53	0.85	0.44	0.51-4.59
***CNSI** (yes=1)*				
Without CNSI (=0)	0.68	0.70	0.71	0.1-5.13
***Sepsis** (yes=1)*				
Without sepsis (=0)	1.95	0.87	0.13	0.82-4.7
***Parasitism** (yes=1)*				
Without parasitism (=0)	0.91	0.47	0.86	0.33-2.51
***Severe anemia** (yes=1)*				
Without anemia (=0)	1.36	0.67	0.52	0.52-3.58
***GI obstruction** (yes=1)*				
Without obstruction (=0)	2.16	1.09	0.13	0.80-5.81
***Tuberculosis** (yes=1)*				
Without TB (=0)	0.26	0.27	0.20	0.04-1.97
***Skin infection** (yes=1)*				
Without skin infection (=0)	4.47	1.11	1.0	NE
***Heart disease** (yes=1)*				
Without heart disease (=0)	1.72	0.96	0.34	0.57-5.15
***Cerebral Palsy** (yes=1)*				
Without CP (=0)	1.33	0.84	0.64	0.39-4.59
***Malignancy** (yes=1)*				
Without malignancy (=0)	11.87	6.4	<0.001*	4.2-34
***Colostomy** (yes=1)*				
Without colostomy (=0)	0.51	0.54	0.52	0.06-4.04

**Significance*

strongest influence on the occurrence of malnutrition in children; such that mothers who had little or no education had children with lower nutritional status.[14] In developing countries like the Philippines, parental education usually dictates the nutritional status of their children.[15] More than half of the patients' families in this study were earning less than Php 5,000.00 a month which was defined by the World Bank to be below the poverty line.[16] Household poverty has also been shown to be linked with acute malnutrition in other studies.[15,17,18] Deficient financial resources will not allow enough food on the table thus, decreasing the nutritional intake of a child leading to severe acute malnutrition. However, poverty has not been shown to be associated with mortality among the admitted SAM patients at BRTTH. This is in contrast with a study done by Braudt et al. in the US where lower levels of household income were found to be associated with an increased risk of early death among the children.[19]

Most of the SAM patients were under the category new admission at 68%. However, 16% were readmitted and 15% were transfer from the OTC while already under SAM management. This proportion of readmitted and transfer from OTC children which was approximately one-third of the admitted SAM patients reflect the need for clinicians to consider other underlying factors which make a SAM child vulnerable to recurrent illnesses. These may also be the type of SAM patients who would take longer to recover. In a study done on hospitalized SAM patients with complications in

Table 7. Clinical (Comorbidities) and Socio-Demographic Factors Affecting Survival, N=137

Factors	Hazard Ratio	Standard Error	p-value <0.05)	95% CI
Paternal Educational Attainment *(High =0)*				
Middle	0.59	0.44	0.49	0.14-2.60
Low	2.01	2.16	0.52	0.24-16.54
Maternal Educational Attainment *(High =0)*				
Middle	0.74	0.55	0.68	0.17-3.21
Low	0.75	0.86	0.80	0.08-7.06
Malignancy *(No=0)*				
Yes	13.68	8.20	<0.001*	4.23-44.29
Hypovolemic shock *(No=0)*				
Yes	5.3	3.44	0.01*	1.51-18.92

**Significance*

Table 8. Summary of Significant Variables Affecting Survival

Factors	Complete Case Analysis		Multiple Imputation Analysis	
	p-value <0.05)	95% CI	p-value <0.05)	95% CI
Paternal Educational Attainment *(High =0)*				
Middle	<0.001*	2.7-101	0.49	0.14-2.60
Low	-	+	0.52	0.24-16.54
Maternal Educational Attainment *(High =0)*				
Middle	<0.001*	5.12-205	0.68	0.17-3.21
Low	-	+	0.80	0.08-7.06
Malignancy *(No=0)*				
Yes	0.006*	1.80-36	<0.001*	4.23-44.29
Hypovolemic shock *(No=0)*				
Yes	0.05	1.0-15.65	0.01*	1.51-18.92

**Significance*
+Confidence intervals are non-estimable

tertiary hospitals in Zambia and Zimbabwe between 2016 to 2018, the readmission rate was similar in this study at 15.4%.[20] The aforementioned study found that ongoing SAM at discharge, non-edematous SAM, and cerebral palsy were found to be risk factors for readmission and poor nutritional recovery.[20]

The top three medical complications seen in the SAM patients admitted at the ITC were pneumonia, decreased electrolytes, and fever. Pneumonia has always been the leading infectious cause of morbidity and mortality in children under five years. A weak immune system in children with severe acute malnutrition coupled with conditions common to these children like incomplete vaccination and living in crowded homes are risk factors for pneumonia. However, in this study, pneumonia was not found to be a predictor of mortality among the admitted SAM patients. This is in contrast with the findings of several studies where it is associated with an increased risk of dying from SAM.[10,17,21] Deranged electrolytes in SAM patients are attributed to the process of reductive adaptation wherein the Na+K+ ATPase system activity is reduced, and the glomerular filtration rate is slowed. These sodium and potassium derangement is aggravated by the presence of diarrhea in SAM patients. Decreased electrolytes, however, were not found to be associated with mortality in this study. In contrast with other studies, hyponatremia and hypokalemia were associated with mortality[11] and hypocalcemia was seen in 26% of SAM patients and was associated with increased risk of death in a study done in Bangladesh[12]. Although patients with severe acute malnutrition usually do not show the usual signs of infection, 55% our patients were recorded to have fever during their stay at the ITC.

The study showed that majority (63%) of patients had a desirable outcome wherein fifty-five percent (55%) were transferred to OTC and eight percent (8%) met the discharge criteria as cured. These values are lower compared to other studies in different African hospitals having an average cure rate of 74%.[9,22,23] SAM patients who had undesirable outcomes at BRTTH accounted for 37% of cases. The proportion of those who died recorded at 17% is higher compared to those in Uganda and Ethiopia at 11.9% and 5.5%, respectively.[9,23] This study showed a defaulter rate of 8% which was comparable with the study in Uganda, also at 8% and lower than those in Ethiopia at 12.3%.[9,23]

We analyzed the overall survival estimates of SAM patients admitted at BRTTH ITC. Patients who stayed at the ITC beyond 50 days had 41% chance of survival. We assume that this could be attributed to factors such as hospital acquired infections and occurrence of secondary metabolic problems. Hospital acquired infections have been noted on

admitted SAM patients in studies in Durban, South Africa[24] and in Norway[25]. In the study by Koch et al. in Norway, hospital acquired infections had a hazard ratio of 1.5 and 1.4 for mortality within 30 days and 1 year, respectively.[25] On the other hand, patients who stayed for 10 days and below had a good chance of survival at 91%. This is comparable with the study by Ashine et al. in Ethiopia wherein there was a high chance of survival for SAM patients below five years of age during the first days of their admission.[26] This is to emphasize that proper management and adherence to the treatment protocol are crucial for patients to recover fast and discharged early from the hospital. Furthermore, the median survival of admitted patients in this study was 45- 46 days which means that half of the patients who were still admitted at the ITC will survive until the 45th to 46th hospital day. This median survival was comparable to the mean survival time of 45 days in a study done at the Dilla University in Ethiopia in 2017.[1]

Overall, multivariate analyses using complete case analysis and multiple imputation showed that among the sociodemographic and clinical factors studied, only paternal and maternal education, malignancy, and hypovolemic shock were significantly affecting survival. Holding all other variables constant, the risk of dying was higher in SAM patients whose parents had middle and lower educational attainment as compared to SAM patients' parents with high educational attainment (2-5 folds to 100-200 folds). SAM patients presenting with hypovolemic shock were likely to die by 1.5-19 times as compared to admitted patients without hypovolemic shock. SAM patients with malignancy were more likely to die 4-44 folds as compared to patients without malignancy.

Lower parental educational attainment has been linked with acute malnutrition.[13,14] The study by Braudt et al. on family socioeconomic status and early life mortality risk showed that both the father and the mother's lower educational attainment were associated with significantly higher all-cause mortality rate among children in their family.[19] Moreover, a study done in 2001 in Ghana illustrates a strong relationship between maternal education and childhood mortality primarily from lack of use of antenatal and postnatal care, maternal and child nutrition, and child vaccination.[27] In a systematic review and meta-analysis done by Balaj et al., the authors reported that lower maternal and paternal educational attainment increases the risk of under-five mortality at all ages.[28] Our assumption that may need further research is that low parental educational attainment increases the risk of dying from SAM via several mechanisms. First, the SAM child with medical complication may not be brought to the hospital immediately or if at all, because of ignorance to the condition or to its severity. Second, poor child rearing or childcare practices due to inadequate knowledge may lead to the worsening condition of a SAM child. Lastly, inadequate understanding of home instructions and the process of SAM management may cause poor compliance to treatment and follow-up. The aforementioned study of Balaj et al. mentioned mechanistic pathways as to why low educational attainment leads to high mortality among children under five years of age which may substantiate our assumptions. Parental literacy, health-seeking behaviors, consanguinity, and quality of early care were the factors said to play a role.[28]

Malignancy in a child has been associated with severe acute malnutrition due to the hypermetabolic state of the child and the side-effects of cancer therapy. It has been reported that children with cancer would develop signs and symptoms of malnutrition at some point in the disease by up to 50-60% of cases, depending on the neoplasm and whether the study was conducted in developed or developing countries where nutritional alterations are seen with increased frequency.[29] In a study done in Nicaragua in 2017, pediatric patients with malignancy and acute malnutrition had increased treatment-related morbidity, more frequent therapy abandonment, and a low event-free survival.[30] Similarly, the presence of acute malnutrition in a cancer patient increased the median length of hospital stay to 19.3 ± 19.4 days as compared to only 13.3 ± 19.4 days among cancer patients without acute malnutrition.[31] A longer hospital stay would increase the risk of mortality as found in this study.

Hypovolemic shock in a patient with SAM is more challenging to the clinician than managing hypovolemic shock in nutritionally normal children. Children with SAM may look dehydrated than they do or may not present with the usual signs and symptoms of shock thereby making clinical assessment difficult. Furthermore, aggressive fluid management of a SAM child presenting with hypovolemic shock may push the child into fluid overload and even death. Therefore, the usual life-saving actions may be dangerous to the SAM child. Hypovolemic shock has also been found to be significantly associated with mortality in other similar studies.[1,32]

Limitations of the Study

There would be inherent flaws in a retrospective study utilizing only secondary data. First, missing data were anticipated before the inception of the study. This is why multiple imputation technique would be a method to mitigate this problem. Consequently, this limitation is not related to the PIMAM program (informative censoring), but factors related outside of the program (non-informative censoring). We performed both complete case analysis and multiple imputation technique to at least see the difference between these two. Second, data extraction is a subjective process, human errors such as errors in translation and encoding may be a problem. To mitigate this, we utilized Kappa statistics to validate data from two encoders. Lastly, the survival analysis was only done in one institution thereby limiting the representation of the whole picture of all SAM patients admitted in different ITCs in the Philippines.

CONCLUSION AND RECOMMENDATIONS

In order to improve decision-making and management at the ITC, the study was done to determine the factors affecting treatment outcomes and survival using a retrospective cohort study design. Among the sociodemographic and clinical factors studied, only paternal and maternal education, malignancy, and hypovolemic shock were significantly affecting survival.

The authors recommend the following: (1) that strong policies and programs regarding socio-economic determinants leading to acute malnutrition in children be targeted as part of nutrition-sensitive interventions; (2) highlight the importance of parental counseling and education for early recognition of severe acute malnutrition and its complications, improve health-seeking behavior, and better compliance to home instructions and medication thus improving treatment outcomes; (3) strengthen training of clinicians, nurses, and nutritionists on the management protocol of SAM patients to optimize clinical outcomes which is crucial during the first 10 days of the management; (4) encourage clinicians to develop or refine clinical practice guidelines on the management of SAM patients with medical complications and specific co-morbidities as the need arises; and (5) further research be done on this field delving into the other factors which might affect survival.

Statement of Authorship

APC contributed in the conceptualization of work, acquisition and analysis of data, drafting and revising of manuscript, final approval of the version to be published, and coordination with the funding source. VBA contributed in the conceptualization of work, acquisition and analysis of data, drafting and revising of manuscript, and final approval of the version to be published. MLCR contributed in the conceptualization of work, acquisition and analysis of data, and drafting and revising of manuscript.

Author Disclosure

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