JIMMA UNIVERSITY

INSTITUTE OF HEALTH, FACULTY OF PUBLIC HEALTH, DEPARTMENT OF POPULATION AND FAMILY HEALTH, HUMAN NUTRITION UNIT

TIME TO CURE AND PREDICTORS OF RECOVERY AMONG CHILDREN AGED 6-59 MONTHS WITH SEVERE ACUTE MALNUTRITION ADMITTED TO JIMMA UNIVERSITY MEDICAL CENTER, JIMMA, ETHIOPIA

BY:

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THESIS SUBMITTED TO THE DEPARTMENT OF POPULATION AND FAMILY HEALTH, INSTITUTE OF HEALTH, FACULTY OF PUBLIC HEALTH, JIMMA UNIVERSITY, IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF SCIENCE (MSc) IN HUMAN NUTRITION

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ABSTRACT

Background: Treatment at stabilization center is an important intervention to avert the huge burden of mortality for children with complicated severe acute malnutrition (SAM). Despite the improvement in hospital coverage, and the development of standardized WHO treatment guideline, recent reviews indicated a wide range in recovery rate (34-88%) due to several context-specific factors. This study assessed the contextual predictors of recovery.

Objective: This study aimed to estimate time to recovery and to determine predictors of time to recovery among children aged 6-59 month with severe acute malnutrition.

Method: An institution based retrospective cohort study design was used among 375 children aged 6-59 months admitted in Jimma university medical center, from September 2014 to September 2016, Jimma. All eligible children were enrolled and assessed using pretested questionnaire. Kaplan Meir estimate and survival curve was used to compare the time to recovery using log-rank test among different characteristics. Cox Proportional Hazard Model was used to identify significant predictors of time to recovery. A p value less than 0.05 was declared statistically significant.

Results: The rate of recovery was 4.06 per 100 person days. Median time of recovery for cohort of SAM children's was 19 days (95%CI: 17.95-20.05). Independent predictors of time to recovery were: Play stimulation (AHR=1.93, 95%CI: 1.23-3.03), vaccination status (AHR=2.26, 95% CI: 1.12-4.57), TB (AHR= 0.48, 95% CI: 0.27-0.87), malaria (AHR=0.34,95%CI:0.13-0.88), use of amoxicillin (AHR=1.54, 95%CI: 0.008-2.34), deworming (AHR=1.8, 95%CI: 1.18-2.73) and shock (AHR=0.18, 95%CI: 0.05-0.59).

Conclusion and recommendation: The findings of this study showed that average length of stay on treatment and median time for recovery are within the sphere standard. So appropriate provision of routine medication, psychosocial stimulation and management of medical co-morbidity as per the national SAM management protocol is needed to promote fast recovery.

Key words: Retrospective cohort**,** predictors, recovery, severe acute malnutrition, Jimma

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ACRONYMS/ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
AHR	Adjusted Hazard Ratio
CI	Confidence Interval
F 75	Formula Milk Seventy Five
F 100	Formula Milk Hundred
HIV	Human Immune Deficiency Virus
JUMC	Jimma University Medical Center
MRN	Medical Registration Number
MUAC	Mid Upper Arm Circumference
NRU	Nutritional Rehabilitation Unit
OR	Odds Ratio

RUTF Ready to Use Therapeutic Food

SAM Severe Acute Malnutrition

SPSS Statistical Package for Social Sciences

TFC Therapeutic Feeding Center

TFU Therapeutic Feeding Unit

TB Tuberculosis

UNAIDS United Nations on HIV/AIDS

UNICEF United Nations International Children's Emergency Fund

WFH/A Weight for Height/Age

WHO World Health Organization

1. Introduction

1.1 Background

Malnutrition is a major health problem affecting children and adults in Ethiopia. In less developed countries like Ethiopia, it is a contributing factor to more than 50 percent of all child deaths (1).

In acute malnutrition, the amount of one or more macronutrients available to body tissues is inadequate to sustain optimal function. Macronutrient deficiency may result from inadequate diet, poor absorption of ingested nutrients, or the presence of a chronic inflammatory condition that increases requirements for nutrients while promoting a nutrient wasting, catabolic state (2).

Acute childhood malnutrition leads to greater risk of death or disability from common pediatric illnesses such as pneumonia and diarrheal disease, and it shapes long term health by compromising physical and intellectual development (3).

Acute malnutrition is classified into severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) according to the degree of wasting and the presence of edema. It is severe acute malnutrition if the wasting is severe (weight for height < 70% NCHS median or a low MUAC i.e. <110 mm) or if there is edema. Acute malnutrition is defined as moderate acute malnutrition if the wasting is less severe (weight for height between 70% and 80% NCHS median); edematous cases are always classified as severe. In many health facilities mortality rate from severe malnutrition is over 20%; at present, which is unacceptable (4).

Children with SAM are predisposed to serious infections like diarrhea, pneumonia, skin infection, gut bacterial overgrowth, and others. Adherence to the protocol in managing children with SAM results in improved recovery. The treatment is integrates both nutritional deficiency and medical co-morbidities (5).The treatment for SAM is given in three phases: phase I, transition phase and phase II; using F-75 for physiologic restoration and ready to use therapeutic food (RUTF) or F-100 to enhance weight gain. Infants younger than six months are fed with diluted F-100 and other medication through tube with breast milk (6).

Effectiveness of the treatment is evaluated by recovery rate, death rate, average length of stay and weight gain. Thus acceptable level of mortality, recovery rate and default rate should be below 10 %, above 75 % and below 15 %, respectively (7). However these parameters are still not achieved in many developing countries (8).

1.2 Statement of the problem

Acute malnutrition remains a major public health concern because it is associated with more than half of the eight million deaths among children under five worldwide (9).Globally acute malnutrition affects nearly 52 million under five children in 2014. More than 90 % of burden is in Africa and Asia. The mortality is also high due to limited access to effective and timely treatment. Severe form of acute malnutrition (SAM) is associated with one million under five deaths each year. Globally, it is estimated that 25-35 million under five children are severely malnourished, with its prevalence ranging from 5 to 30 %. In 2015, more than two thirds of all acutely malnourished children under 5 lived in Asia and more than one quarter lived in Africa. In Africa, 14.1 million children under five are wasted, of which 4.3 million are severely wasted. Sub-Saharan Africa (SSA) carry about 13.2 million children next to south Asia (27.8 million) of acute malnutrition burden (5). In sub-Saharan Africa alone, there are 137 million children under the age of five, of which 12.3 million were wasted (10).

In Ethiopia, the level of stunting, underweight and wasting was 38.4, 23.6 and 9.9 percent respectively. Among 9.9 percent of wasted children, 2.9 percent are severely wasted. In Oromia Region prevalence of stunting, underweight and wasting was 36.5, 22.5 and 10.6 (11). A study done in Jimma Zone on nutritional status of children showed that 14.4% were underweight, while 33.9% were stunted and 19.2% were wasted (12).

For children with SAM, the risk of death is approximately 10-fold higher compared to well nourished children (13).Because of the high risk of death, most severely malnourished children are managed in health facilities including hospitals (14). In an effort to improve the quality of hospital care for severely malnourished children and reduce case fatality rates, standardized guidelines have been developed by WHO (9) and Ethiopia (4) for SAM patients. When these guidelines are followed, it has been possible to reduce case fatality rate considerably (15). Treatment in stabilization center for complicated SAM children is an important target intervention to avert huge burden of mortality. More than 15 % of SAM children need admission to therapeutic feeding unit. Thus patients need evidence based nutritional and medical management, to minimize death due to mismanagement despite hospitalization and development of standardized guidelines, recent reviews indicated that the recovery rates for inpatient treatment of severe acute malnutrition using the WHO protocol ranged from 33.6% to 88.4%

(16-18). A study done in Jimma University Medical Center nutritional rehabilitation unit on severe acute malnutrition showed a recovery rate of 77.8% (19).

Despite improvement in recovery from SAM, still the cure rate is unacceptably low in developing countries including Ethiopia (17, 20). Jimma University Medical Center is a large stabilization center in Jimma, which would have capacity to show the overall survival status among admitted SAM children in Jimma catchment area.

So far there are studies conducted to assess the recovery among admitted SAM children and their predictors (21-23). However the majority of these studies were limited to children below six months, had smaller sample size and unable to clearly show the effects of some factors like season and psychosocial stimulation. As the factors vary according to context, this study will assess predictors of recovery in this particular setting which will have positive feedback for the concerned bodies.

2. Literature review

2.1 Recovery patterns and Survival time of SAM Children

Recovery rate among admitted SAM varies in different situation. From study done on 2740 children aged 6–59 months admitted to 199 Nutrition Rehabilitation Centers in India, their mean length of stay was 14.2 days. On discharge, 1179 (65%) of the children had recovered (weight gain >15% of initial weight) (24). Another study conducted in India on 129 children, 65.1% cure rate reported (25).

On a study done in Ghana on 348 children aged 6–59 months with SAM admitted to the TFC, 33.6% recovery rate (having MUAC ≥125) was recorded and number of days spent in the facility was 7days with the minimum and maximum being 1 and 47 days, respectively (16).

Similar study done in Uganda on 220 children with severe malnutrition reported low recovery rate of 107 (49%) achieving a target weight of 85% weight for height (20). Similarly, a hospital based study conducted in Ghana shows that children aged 24–59 months had 5.8 times higher likelihood of recovery from SAM as compared to children aged 6–11 months (16).

Recovery among admitted SAM varies in different settings and situations. In Ethiopia recovery among admitted SAM children varied according to settings. Recovery rate Varied from as low as 33.6% and to as high as 88.4 % (16-18). Another study done on 855 malnourished children in Wolliso showed a recovery rate of 83.16% (23). The recovery rate among two hospitals, namely Mekele and Ayder Referral Hospital in North Ethiopia was 69.4 % and 69.8 % respectively (22). Another study conducted in Woldia hospital reported a recovery of 85% (26). Similar study on 13,843 children with SAM admitted to therapeutic feeding centers in southern region of Ethiopia reported 11,191 (87%) cured (15).

Survival time of children varied with different admission characteristics. Study done in Sekota Hospital showed that median survival time of children was 10 days with range of 1 to 32 days. Children with anemia had a significantly lower survival time (for death) than without anemia. Similarly, those with and without tuberculosis and treated with antibiotics have significantly higher mean survival time than their counterparts (17). While similar study conducted in Mekelle, Northern Ethiopia showed a median survival time of 15 days. In the same study, the probability of survival after 56 days was 78 % among admitted SAM children (22). Similar study in southern Ethiopia reported the median nutritional recovery time of the entire

cohort of 26 days. The median nutritional recovery time was significantly different for SAM children who had diarrhea 26 days and their counterparts, 25 days, dehydration 29 days and their counter parts, 26 days, anemia 27 day and without anemia, 26 days and children who developed complications in TFCs after admission 33 days and their counterparts, 25 days (21) .

2.2 Predictors of recovery among admitted SAM children

Recovery from complicated SAM in stabilization center is related to different factors including background characteristics, type of malnutrition, presence of co morbidity and other factors (21, 23) .

Socio-demographic factors

Age group of children was the determinant factors for the time to cure from SAM. Children aged between 12–23 months had prolonged cure time as compared to older age groups (23).Similar study also reported the cure rate increased with age (15). On a study done on 345 children in Ghana , children aged 24–59 months had 5.8 times higher probability of recovery from SAM as compared to children aged 6–11 months(16). A study conducted in Felegehiwot Referral Hospital on 401 children reported that children who are fully vaccinated (AOR: 4.12; 95%CI: 1.64–10.35) and partially vaccinated (AOR: 7.16; 95%CI: 1.97–25.25) have better recovery rate than those who are not vaccinated for age (27). However the above studies did not include variables like season of admission and residence.

Anthropometry and type of SAM

Age ,weight for height Z score (WHZ), edema and MUAC determine likelihood of recovery while in treatment program (24). Based on study done on two therapeutic feeding centers in southern Ethiopia on sample of 420 SAM children between 2013 and 2014, predictors of nutritional recovery rate were type of malnutrition, weight, MUAC, no loss edema on day four after starting treatment and inpatient complications. SAM children who were diagnosed as edematous malnourished were 1.8 times more likely to recover than severely wasted. For every one kg increase in weight, nutritional recovery rate increased by 48.2 %. Similarly, nutritional recovery rate increased by 36.2 % for every one centimeter increase in MUAC. Children with SAM who did not acquire complications at TFCs were about 2.2 times more likely to recover than those who acquired complications after admission; while patients who lost edema within four days of treatment were about 2.3 times more likely to recover than those who failed to lose

edema (21). However, this study did not address important nutritional therapy factors like vitamin A.

Chane and his colleagues found that edematous children were less likely (or the probability of recovery was reduced by 73% among edematous children as compared to wasted children) to be cured than wasted children (26).

Co-morbidity

HIV, TB and pneumonia were found to be factors that lower the probability of recovery. A study done in Bahirdar showed that children with severe acute malnutrition who are co-morbid with HIV/AIDS (AOR: 0.12; 95%CI: 0.03–0.41) and tuberculosis (AOR = 0.13; 95%CI: 0.04–0.35) were less likely recover (27). On study done in Zambia among 9540 children recovery was low in children who were HIV infected, 80% more likely to die than those who were HIV free. While those with septicemia were approximately 2.8 times more likely to die compared to those without co-morbidities, those with diarrhea were 60% more at risk of dying compared to those who had no commodities. Pneumonia also increased the risk of dying by 30% compared to children without any co-morbidity. However this study was done in high HIV prevalence setting (28). But another study done in Burkina Faso reported that mortality rate did not differ significantly between severely malnourished children with anemia at admission (12.4%) and severely malnourished children without anemia at admission (22.2%), p-value=0.12 (29). A study done in Kenya also reported any diarrhea during admission resulted in a significantly higher mortality (19%) than those uncomplicated by diarrhea (9%) (30). Severely malnourished children with HIV/AIDS co-morbidity were less likely to be cured as compared to those without co-morbidity (26).

Nutritional Therapy Related Factors

Study done on Sekota Hospital also showed that there was significant difference in the hazard of death among children who had been treated with medication than those children not managed. Children not supplemented folic acid during their hospitalization, more than two time hazard of death when compared to supplemented children. The hazard rate of death among children not supplemented for Vitamin A were 53% times higher than supplemented children (17). However, this study included children 0-6 months who need different approach and management than 6-59

months. Chane and his colleagues found that odds of recovery than children who were given Plumpy'-nut were 3.7 times more odds of recovered children who were not taking Plumpy'-nut (26).

Treatment Related Factors

Blood transfusion, routine medication, play stimulation and intavenous infusion were associated with odds of recovery. A randomized clinical trial in sub-Sahara Africa reported that severely malnourished children who took amoxicillin have a statistically significant higher recovery rate than those who did not (31). A study done in southern Ethiopia found that severely malnourished children who received play stimulation have improved rate and speed of recovery than those did not received (32). Also another study conducted in Bangladesh showed that children with SAM have improved weight for age score as compared to their counterparts (33). Bachou and his colleagues showed that the odds of death in the transfused group were 4.8 times more as compared to the non-transfused. The odds ratio for death in the infusion group was 3.1 times higher as compared to those not infused (20). However, this study used small sample size i.e. 220. Another study reported that children who had complication that need special antibiotics, but not managed were about 3 times as likely to die as compared to the same cases managed by special antibiotics (17). As discussed above recovery is still far from the standard and some factors associated with cure were found and some were controversial. Using the aforementioned facts as background knowledge this study will identify the situation of time to cure of SAM and its predictors in this particular context. Thus it will add value for possible predictors of cure and indicate intervention to improve recovery in the hospital.

Conceptual frame work

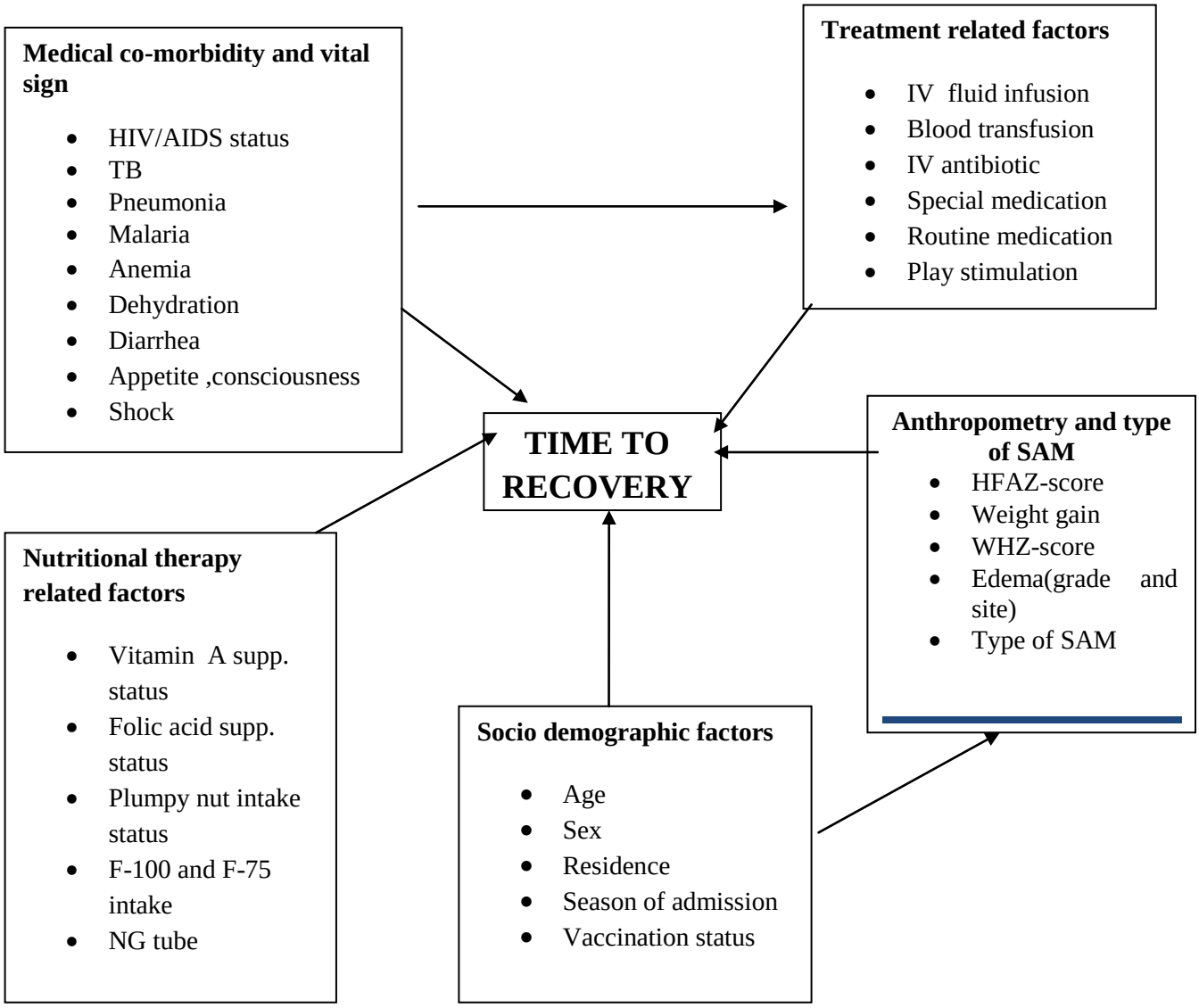

Figure: 1 Conceptual framework developed after reviewing relevant literature for predictors of time to recovery.

3. Significance of the study

- ✓ The finding of this study will build and upgrade the body of knowledge in management of SAM. Because this study is going to evaluate the effects of variables like season of admission and play stimulation on recovery of severe acute malnutrition patients, this study will upgrade the existing knowledge about the predictors of recovery from SAM.
- ✓ This study would generate valuable evidence regarding existing condition, the effectiveness of the treatment in terms of recovery, mortality and other parameters to Jimma University Medical Center in particular. This in turn will enhance targeted interventions against the identified predictors of recovery, to promote recovery and short hospital stay. It will also be valuable input to local nongovernmental organizations (NGO) which work on nutrition. It might create enabling environment for the local NGO and Jimma University Medical Center to take action in enhancing recovery among admitted SAM patients.

4. Objectives of the study

4.1. General objective

- ✓ To estimate the time to recovery and identify its predictors among children aged 6-59 month with severe acute malnutrition admitted in Jimma University Medical Center.

4.2. Specific objectives

- ✓ To estimate the time to recovery for children with severe acute malnutrition aged 6-59 months who were admitted in Jimma University Medical Center, between September 2014 and September 2016, Jimma, Ethiopia.

- ✓ To identify predictors of time to recovery among children with severe acute malnutrition aged 6-59 months who were admitted in Jimma University Medical Center, between September 2014 and September 2016, Jimma, Ethiopia.

5. Methods

5.1 Study area and period

This study was conducted in Jimma University Medical Center (JUMC), one of the teaching and tertiary medical centers in Ethiopia located in Oromia Region, Jimma Zone; at Jimma Town. Jimma Town is located at about 346 km, south west of Addis Ababa. JUMC provides services for approximately 9000 inpatient and 80,000 outpatient attendants in a year coming to the hospital from the catchment population of about 15 million people within the catchments area covering a 250km radius. Severely malnourished children are directly admitted to nutritional rehabilitation unit (sub-section of pediatrics ward) and treated by Interns (Medical and Health Officer), nurses, residents and/or pediatricians.

The study was conducted from March 1 to 20/2017.

5.2 Study design

Institution based retrospective cohort study was conducted.

5.3 Population

5.3.1. Source population

All cases of SAM aged 6-59 months who received treatment at Jimma University Medical Center nutritional rehabilitation unit (NRU) between September 2014 and September 2016.

5.3.2. Study population

All eligible cases of children aged 6-59 months from the source population based on the eligibility criteria.

5.4. Eligibility Criteria

5.4.1. Inclusion criteria

- ✓ All cases of children with SAM treated in Jimma University Medical Center nutritional rehabilitation unit (NRU) between September 2014 and September 2016.

5.4.2. Exclusion criteria

- ✓ Those SAM cases whose card has incomplete data on outcome variable.
- ✓ Those SAM cases who were readmitted within the study period.

- ✓ Those SAM cases with documented other causes of edema.

5.5. Sample size

For objective one: The sample size was calculated based on the assumption that type I error 5 %, power of 80 %, median survival time among severely wasted 29 days and median survival time among edematous malnutrition 22 days (21). The sample size was calculated by the formula which depends on two separate median survival times (34).

The required patients in each group were calculated as follow.

$$n = \left(Z_{\alpha}+Z_{\beta}\right)^{2}\left[\Phi(\mu_{\mathrm{E}}) + \Phi(\mu_{\mathrm{C}})\right]/\left(\mu_{\mathrm{E}}^{-1}-\mu_{\mathrm{C}}^{-1}\right)^{2}$$

where

$$\Phi(\mu_i) = \frac{T}{\mu_i^3}/\left[\frac{T}{\mu_i}-1+\exp(-T/\mu_i)\right], i = \mathrm{C}, \mathrm{E}$$

C = median survival time for the first group, T = total time study subjects were recruited to the study (730 days i.e. 2 years), α = level of significance (0.05), Zα/2 = 1.96 at 95 % confidence level, Power = 80 %, *n* = minimum sample size required was 310 and after adding 10 % for non retrieved records, the total sample size becomes 341.

For the second objective: The sample size was calculated for predictors using STATA version 13.0

Factor considered	Statistics	Sample size	Reference
Type of malnutrition	AHR:1.78 Power: 80% SD:0.5 CL:95%	105	(21)
Presence of Co-infection	AHR:2.22 Power: 80% SD:0.5 CL:95%	55	(21)

Weight	AHR:1.482 Power: 80% SD:0.5 CL:95%	226	(21)

By taking the maximum sample size among the above listed, the final sample size is **341**

5.6 Sampling Procedure

First unique SAM number was retrieved from patient registry. There after using the corresponding unique SAM number from SAM registry, a total of 452 records between 6-59 months were identified. Out of these, 48 have incomplete data on outcome variable or other pertinent variable and 17 were records of SAM children who are readmitted in the study period and 12 records were lost. The remaining 375 cases were found to be eligible and data were collected from all 375 records. (Figure 2)

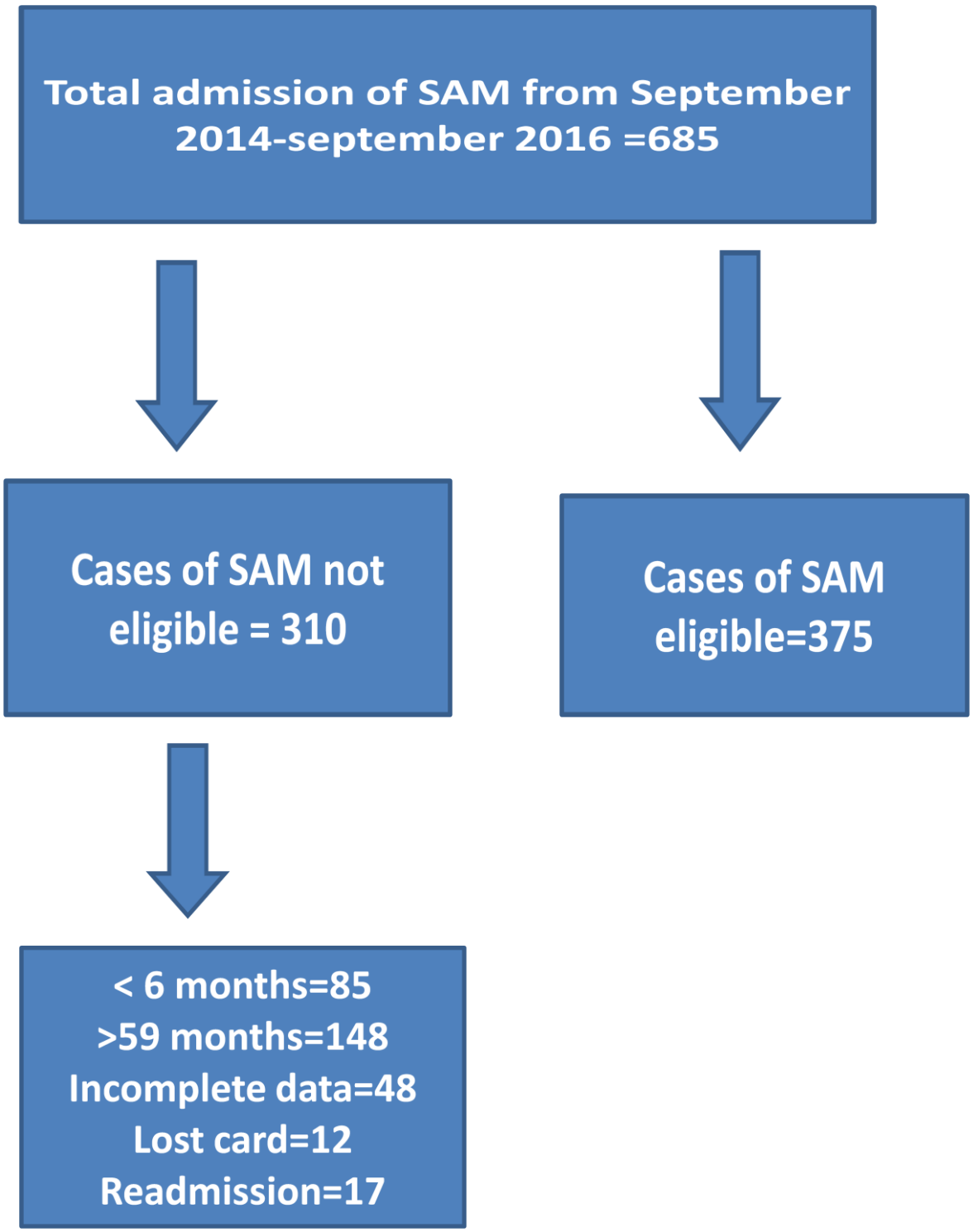

Figure: 2 schematic presentation of sampling procedure

5.7 Data collection Method

Data were collected using pretested data abstraction format. Structured and pretested data collection tool (format) was used to collect the data from medical records. Data were abstracted from SAM registries and cards of children retrieved from card room using medical record number. Six graduated diploma nurses were recruited to collect the data from the patient medical record and SAM treatment registry. Before actual data collection, the data collection tool was pretested and necessary amendments were made. One supervisor with principal investigator followed the data collection closely. Length of stay and average weight gain were calculated from the available secondary information from card. Anthropometric data of patient and other data were taken from medical card and SAM registry.

5.8. Variables of the study

5.8.1 Dependent Variable

- ✓ Time to recovery

5.8.2 Independent Variable

- ✓ **Socio-demographic characteristics**: Age, sex of the child, place of residence, season of admission and vaccination status
- ✓ **Anthropometry and type of SAM**: Anthropometry at admission (weight, height, MUAC for 6–59 months), weight gain, admission diagnosis (Marasmus, kwashiorkor, and marasmic-kwashiorkor) and edema.
- ✓ **Medical co-morbidity and vital signs**: Pneumonia, HIV sero-status, diarrhea, Hemoglobin level, malaria, TB, Dehydration, consciousness and shock.
- ✓ **Medication and treatment**: IV fluid intake, IV antibiotic treatment, blood transfusion, routine medication (amoxicillin, ampicillin, gentamicin…) and special medication.
- ✓ **Nutritional therapy related factors**: NG tube use, plumpy nut, F-100 and F-75 intake, play stimulation.

5.9 Operational and standard definition

Recovered (Cured): when the child reaches > = 85 % of median WFH or WFH Z score > = - 2 on more than one occasion or no edema for 10 days.

Censored: those SAM children who were defaulted, transferred, dead and non-responded were considered as censored observations.

Defaulters: is defined as those who are absent for 2 consecutive weighing (2 days).

Death: referred to the patient that died while he/she is in the program..

Weight gain: referred to increase in weight of the patient after being admitted in the in-patient program.

Length of stay: the number of days the child stayed in hospital from admission until the child develop event of interest (recovery) or censored.

Transfer out: referred to those who were transferred to outpatient management from inpatient management phases.

Special medication: referred to medications given to those SAM patients additional to routine medications.

Anemia: is defined as hemoglobin level below 11 g/dl while severe anemia as plasma hemoglobin level less than or equals to 4g/dl or hematocrit less than or equals to 12 % at admission.

Rate of weight gain (g/kg/day) was calculated as (4):

$$\frac{(\text{Weight (kg)at discharge} - \text{weight(kg)at admission}) * 1000}{(\text{admission weight(kg)} * \text{length of stay in days})}$$

Recovery rate: Recovery rate = No of patients discharged for recovery/ total No of admitted
Death rate: Death rate = No of patients died in the program/ total No of admitted

Defaulter rate: Defaulter rate = No of true defaulter/total No of admitted

Average length of stay: Average length of stay = sum of length of stay/No of admitted

Variables/characteristics at admission: a variable taken as admission variable if recorded or diagnosed with in the first 48 hours of admission.

Play stimulation: a play session held by a trained nurse at specially decorated play stimulation room with different toys and playing aids based on the age of the child for at least for 30-45min/day. A child will be taken as he got play stimulation if he attended a minimum of 3 play session; otherwise a child is considered as not received play stimulation.

5.10 Data Quality Control

To assure data quality the data collection tool was pretested on 20 patient cards treated in Jimma university medical center. After pretest necessary amendment of tool was done for the final data collection. Then the data collection tool was corrected and data collectors were made aware of changes made. Intensive two day training was given for six data collector diploma nurses on how to extract the data from patient registry. The daily collected data were checked by supervisor and principal investigator for completeness and consistencies.

Data form in Epidata was managed in such a way it will not allow illegal values through specifying range of legal values and it was coded carefully to increase accuracy and quality of data collected.

Variables like anemia were cross checked by taking recorded measures of hemoglobin from the chart against physician's diagnosis to improve data quality. For the case of play stimulation list of children indexed by their medical record number who received play stimulation therapy was taken from play stimulation clinics record in the NRU.

5.11 Data processing and analysis

Data were coded and entered to EpiData software Version 3.02. Then the data were exported to SPSS version 24 for cleaning, checking and analysis of the data. The age, weight, height and edema were further exported to ENA-SMART software to calculate WFH% and HAZ score from admission and discharge height and weight measurements. Descriptive statistics using frequency, percent and measure of central tendency was done. Survival curve was used to display the survival (time to cure) among different characteristics. The outcome variable was dichotomized to cured and censored for survival analysis. Kaplan Meir test was done to compare median survival time among different groups. Factors related to time to recovery were analyzed using multivariable Cox proportional hazard model. Crude and adjusted hazard ratio with 95 % confidence interval was used. Proportional hazard assumption of Cox proportional hazard was checked by plotting log-minus-log survival plot against time for different variables.

To control confounding effect of variables, multivariable Cox proportional hazard regression was used. Variables with p value less than 0.25 in bivariate analysis were selected and included in multivariable analysis. Associations with P value less than 0.05 declared as statistically significant association.

5.12 Ethical Consideration

Ethical clearance was obtained from Jimma University, institute of health Institutional Review Board and supporting letter was written to administrative body of Jimma university medical center. They were informed about the importance of this study to improve management of severe acute malnutrition in particular context. Information collected was kept confidential and will never be disclosed to others without informed consent of hospital. Medical record number was recorded rather than the child name. Written informed consent was taken from the hospital manager for accessing the medical records of SAM patients.

5.13 Dissemination plan

The result and finding of this study will be communicated and presented to concerned bodies. First it will be presented in open public Master's thesis defense program in June, 2017. Also the result will be communicated to Jimma University Medical Center management and pediatrics staffs. Finally efforts will be made to publish the findings.

6. RESULTS

6.1 Description of Characteristics of the study participants

Socio demographic and care related characteristics

A cohort of 375 SAM children were followed retrospectively for median time of 17 days with Inter quartile range of 10 days. From this 191 (50.9 %) were female while the rest are males. The mean age (in months) of study subjects was 26.8 months with standard deviation of 14.6 months with more than half (53 %) being between one and three years. Two hundred fifty five (68%) were from rural areas. Nearly one third 107(28.5%) of the children were admitted on winter (June to august) season. Nearly two-third of children 238(63.5%) were fully vaccinated for their age (table 1).

Table 1: Socio Demographic and care related characteristics of SAM children admitted in JUMC, nutritional rehabilitation unit from sept.2014 to sept.2016.

Characteristics	Number	Percent (%)
Age (in months) n=375		
6-11	55	14.7
12-23	110	29.3
24-35	89	23.7
36-47	61	16.3
48-59	60	16
Sex of the respondent(n=375)		
Female	191	50.1
Male	184	49.9
Residence (n=375)		
Urban	120	32
Rural	255	68
Season of admission(n=375)		
Winter	107	28.5
Summer	85	22.7
Spring	89	23.7
Autumn	94	25.1
Vaccination status for age (n=375)		
Fully vaccinated	238	63.5
Partially vaccinated	50	13.3
Not vaccinated	36	9.6
Not documented	51	13.6

Exclusive breast feeding (n=322)		
Yes	196	52.5
No	126	33.6

Anthropometry and complication related characteristics

More than half 247(65.9%) of the children have edematous SAM and 224 (59.7%) passed appetite test. Over two third (66.6%) of the children were stunted while nearly half (48.3%) had WFH % median below 70% (table 2).

Table 2: Baseline anthropometry related characteristics of SAM children admitted in JUMC, nutritional rehabilitation unit from sept.2014 to sept.2016.

Variable	Number	Percent
Nutritional edema		
Yes	247	65.9
No	128	34.1
Appetite test		
Failed	151	40.3
Passed	224	59.7
WFH %		
< 70	181	48.3
70 – 80	23	6.1
> 80	171	45.6
Stunting		
Stunted(HAZ<-2 SD)	219	66.6
Not Stunted (HAZ >-2SD)	110	33.4

Three hundred fifty six (94.9%) had at least one type of complication at admission. As shown in (Table 3) diarrhea and anemia were the commonest co morbidities among admitted SAM children. About 268 (71.4 %), 159 (42.4 %) had diarrhea and anemia as a major co morbidity followed by pneumonia (29.6%), dehydration (14.7%), tuberculosis (14.4%), malaria (5.6%) and HIV (3.5%), respectively. Twenty five (6.7%) had septic or hypo-volumic shock at admission. And about 304(81.1%) were conscious at admission.

Table 3: Medical complication and clinical features of SAM children admitted in JUMC, nutritional rehabilitation unit from sept.2014 to sept.2016.

Variable	Category	Number	Percent
Complication at admission	Yes	356	94.9
	No	19	5.1
Diarrhea	Yes	268	71.5
	No	88	23.5
Tuberculosis	Yes	54	14.4
	No	302	85.6
HIV(n=190)	Yes	15	3.5
	No	175	91.9
Pneumonia	Yes	111	29.6
	No	245	65.3
Anemia	Yes	159	42.4
	No	197	52.5
Malaria	Yes	21	5.6
	No	335	89.3
Dehydration	Yes	55	14.7
	No	301	80.3
Shock	Yes	25	6.7
	No	350	93.3
Consciousness	Yes	304	81.1
	No	71	18.9

Medication and nutritional therapy related characteristics

With regard to routine medication and nutritional therapy 299(79.4%) had taken folic acid and 270(72%) took amoxicillin. While 158(42.1%), 126(33.6%), 129(34.4%) and 161(42.9) took vitamin A, iron, deworming and special medication respectively. Two hundred ninety six (78.9%) had taken IV antibiotic and 68.1 (18.1%) has taken IV fluid therapy. Few 30(8%) had blood transfusion and 130(34.4%) used NG tube. Almost all 364(97.1%) has got formula 75

nutritional therapy while 293(78.1%), 237(63.2%) received formula 100 and plumphy nut therapy respectively. Seventy four (19.7%) children also received play stimulation.

Table 4: medication and nutritional therapy related characteristics of SAM children admitted in JUMC, nutritional rehabilitation unit from sept.2014 to sept.2016.

Characteristics	Number	Percent (%)
Vitamin A		
Yes	158	42.1
No	217	57.9
Folic acid		
Yes	299	79.7
No	76	20.3
Amoxicillin		
Yes	270	72
No	105	28
Iron		
Yes	126	33.6
No	249	66.4
Deworming		
Yes	129	34.4
No	246	65.6
Special medication		
Yes	161	42.9
No	214	57.1
Blood transfusion		
Yes	30	8
No	345	92
IV fluid		
Yes	68	18.1
No	307	81.9
IV antibiotic		
Yes	296	78.9
No	79	21.1
NG tube		
Yes	130	34.4
No	245	65.6
Plumpy nut		
Yes	237	63.2
No	138	36.8
F-100		
Yes	293	78.1
No	82	21.9

F-75		
Yes	364	97.1
No	11	2.9
Play stimulation		
Yes	74	19.7
No	301	80.3

6.2 Survival pattern and time to recovery

Regarding the treatment outcomes of cohort of children with SAM 274(73.1%, 95% CI: 68.5-77.4) recovered while 46(12.35, 95% CI: 9.06-15.6), 10(2.7%, 95% CI: 1.05-4.35) and 45(12%, 95% CI: 8.71-15.28) were died, transferred out and defaulted respectively (figure 3). The overall follow up time for 375 SAM children was 6748 days with cumulative incidence of recovery 0.0406 recovery per person day (40.6 recovery /1000 person days) among admitted children

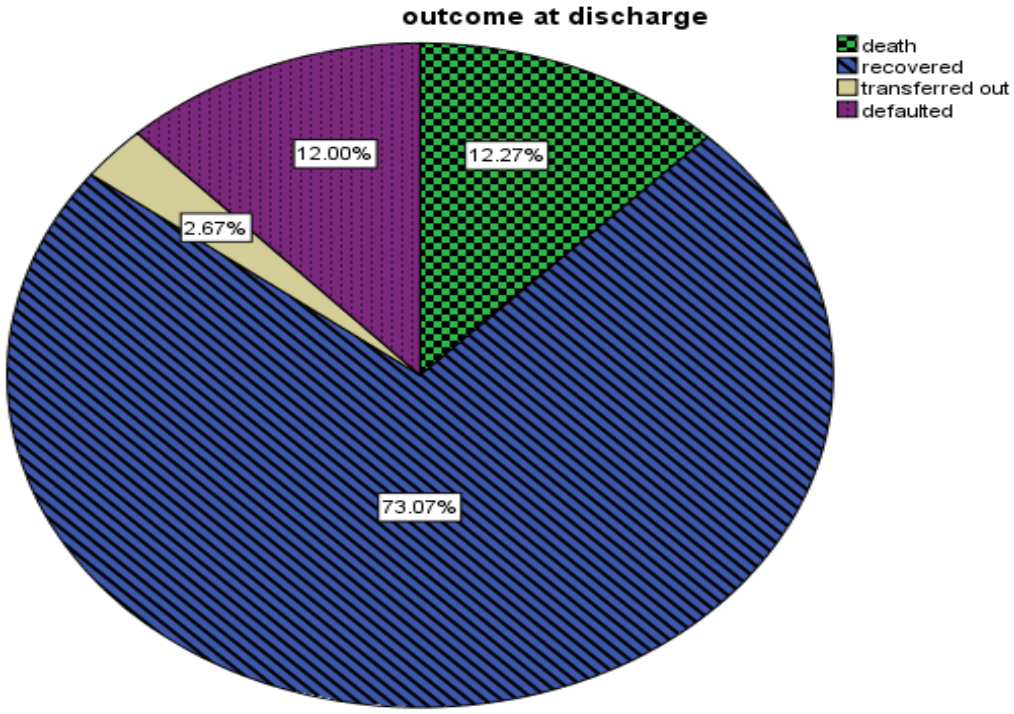

Figure 3: Treatment outcome of admitted SAM children in Jimma university medical center between September 2014 and September 2016, Jimma.

Table 5 and figure 4 illustrated median time of recovery from SAM among children with SAM managed at NRU. The figure revealed that overall median length of stay for the entire cohorts of children with SAM was 17 days ± 9 days standard deviation. The mean length of stay for the entire cohort is 18 days with minimum of 1day and maximum of 56 days. Actuarial Life Table analysis showed that cumulative probability of nutritional recovery was 99, 78, 30, 8, and 1 % at 5, 10, 15 20, 30 and 50 days respectively.

Table 5: Actuarial Life table analysis showing survival of SAM children admitted in JUMC from 2014 to 2016, Jimma, southwest Ethiopia.

Interval Start Time	Number Entering Interval	Number censored	Number Exposed to Risk	Number recovered	Proportion not recovered	Proportion Surviving	Cumulative Proportion recovered
0	375	12	369	1	.00	1.00	1.00
5	362	36	344	3	.01	.99	.99
10	323	23	311.5	66	.21	.79	.78
15	234	17	225.5	89	.39	.61	.47
20	128	5	125.5	47	.37	.63	.30
25	76	2	75	37	.49	.51	.15
30	37	1	36.5	18	.49	.51	.08
35	18	1	17.5	7	.40	.60	.05
40	10	2	9	4	.44	.56	.03
45	4	1	3.5	1	.29	.71	.02
50	2	0	2	1	.50	.50	.01
55	1	1	.5	0	.00	1.00	.01

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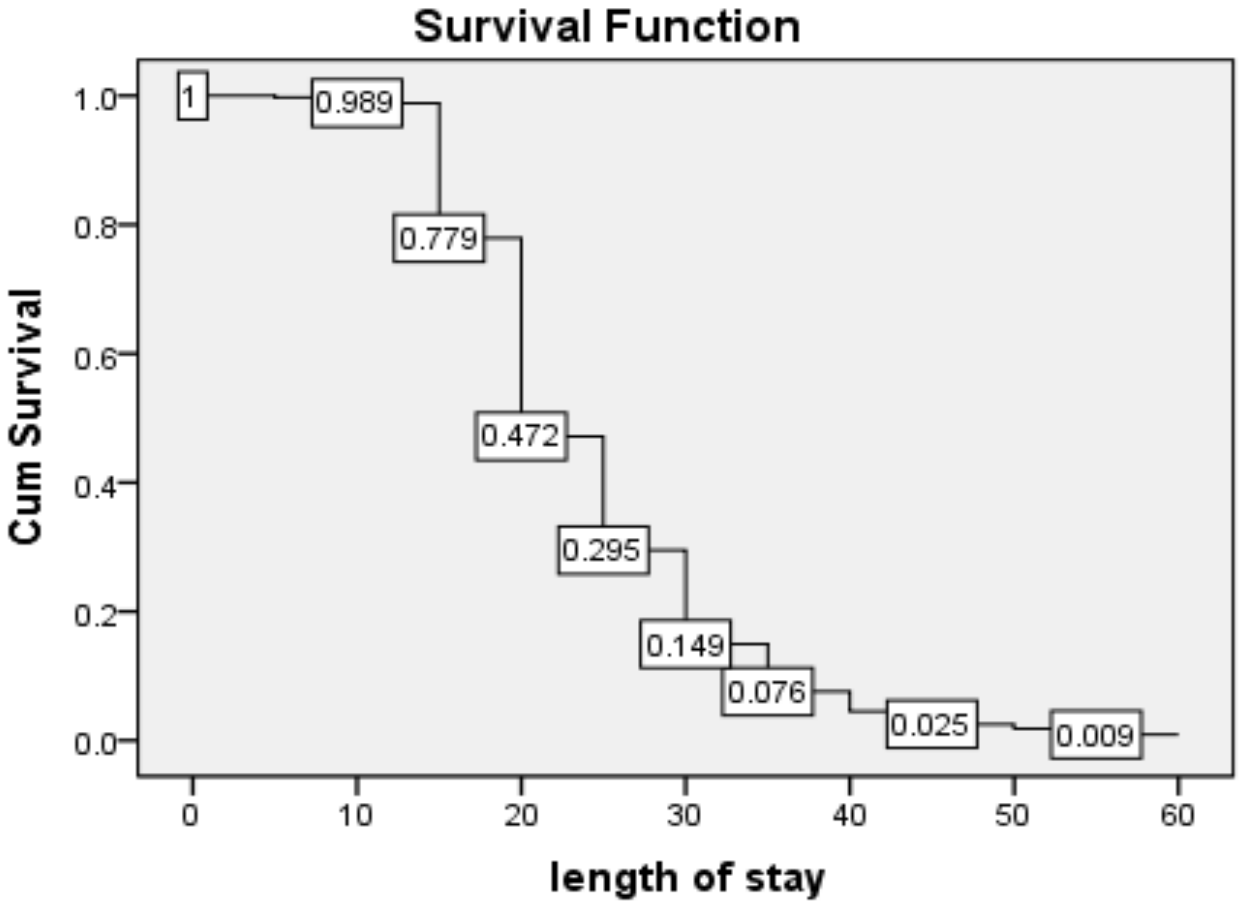

Figure 4: Depicted survival graph for length of stay (days) for entire cohort of children admitted with SAM in JUMC from 2014 to 2016, Jimma, Ethiopia.

Analysis comparing the median survival time using Kaplan-meir showed that there was significant difference in median nutritional recovery time between children with SAM for different age category ; 22 days (95% CI: 18.2-25.8), 20 days(95% CI: 18.3-21.7), 18 days (95% CI:16.5-19.5), 26 days (95% CI:21.8-30.2) and 17 days (95% CI:15.5-18.5) for age groups 6-11, 12-23, 24-35, 36-47 and 48-59, respectively. But, nutritional recovery time was not significantly different for residence, sex, season of admission ($P > 0.05$) (Table 6).

Table 6: Kaplan Meir comparison of median recovery time across socio demographic factors among SAM children admitted to Jimma university medical center, Jimma, southwest Ethiopia, 2017.

Variables		Median survival time	95% CI	p-value for log rank test
Age	6-11	22	18.2-25.8	< 0.00001*
	12-23	20	18.3-21.7	
	24-35	18	16.5-19.5	
	36-47	26	21.8-30.2	
	48-59	17	15.5-18.5	
Sex	Male	19	17.8-20.2	0.876
	Female	19	16.8-21.2	
Residence	Urban	19	17.1-20.9	0.644
	Rural	19	17.7-20.3	
Season of admission	Winter	18	16-20	0.129
	Summer	19	17.6-20.4	
	Spring	20	17.5-22.4	
	Autumn	21	18.2-23.8	

Regarding type of malnutrition there was significant difference in median nutritional recovery time between 18 days for marasmus (95% CI: 16.5-19.5), 18 days for kwashiorkor (95% CI: 16.9-19.1) and 23 days for marasmic-kwashiorkor (95% CI: 20-26). Similarly, there was a significant difference in median nutritional recovery time between SAM children who passed appetite test 19 days (95% CI: 18-20) and those who failed appetite test 20 days (95% CI: 18.1-21.9). However nutritional recovery time was not significantly different for WFH% category ($p > 0.05$).

Table 7: Kaplan Meir comparison of median recovery time across type of SAM and anthropometry among SAM children admitted to Jimma university medical center, Jimma, southwest Ethiopia.

Variables		Median survival time	95% CI	p-value for log rank test
Type of SAM diagnosis	Marasmus	18	16.5-19.5	0.027*
	kwashiorkor	18	16.9-19.1	
	Marasmic-kwashiorkor	23	20-26	
Appetite test	Failed	20	18.1-21.9	0.006*
	Passed	19	18-20	
WFH %	< 70%	20	18.4-21.6	0.495
	70%-80%	22	14-29	
	>80%	18	16.9-19.1	

In relation to medical complications and clinical features on admission, median nutritional recovery time was significantly different for SAM children who had tuberculosis (27 days (95 % CI: 23.7–30.2) and their counter-parts, 19 days (95 % CI: 17.9–20). Likewise, nutritional recovery time was significantly different for children who had HIV (31 days (95 % CI 22.9–39.1) and their counter-parts, 19 days (18-20). In addition, nutritional recovery time was significantly different between children with malaria 25 days (95 % CI: 21.4–28.6) and without malaria, 19 days (95 % CI: 17.9-20). However, nutritional recovery time was not significantly different for complication at admission, pneumonia, anemia, dehydration, URTI and diarrhea ($p>0.05$).

Table 8: Kaplan Meir comparison of median recovery time across medical complications and clinical features on admission among SAM children admitted to Jimma university medical center, Jimma, southwest Ethiopia.

Variables	Category	Median time	95% CI	P-value for log rank test
Complication at admission	Yes	19	18-20	0.057
	No	15	12.3-17.7	
Diarrhea	Yes	19	17.7-20.3	0.44
	No	19	17-20.9	
Tuberculosis	Yes	27	23.7-30.2	0.003*
	No	19	17.9-20	
HIV	Yes	31	22.9-39.1	0.007*
	No	19	18-20	
Pneumonia	Yes	19	16.2-21.8	0.389
	No	19	17.7-20.3	
Anemia	Yes	20	17.6-22.3	0.446
	No	19	18.1-19.9	
Malaria	Yes	25	21.4-28.6	0.016*
	No	19	17.9-20	
Dehydration	Yes	20	16.1-23.9	0.406
	No	19	17.8-20.2	

Regarding medication and nutritional therapy related characteristics, there significant difference in median survival time between children who took folic acid 18 days (95% CI: 16.8-19.2) and those did not 22 (95% CI: 19.3-24.7). Similarly recovery time was significant between those who has taken amoxicillin 18 (95% CI: 17.1-18.9) and their counterparts 22 (95% CI: 19.3-24.7). Also there was also significant difference in nutritional recovery time for variables like gentamicin, special medication, blood transfusion, IV antibiotic, IV fluid, NG tube, plumphy nut intake and formula 100 intake ($p<0.05$). However significant different median nutritional

recovery time was not seen for vitamin A, iron, deworming, formula 75 and play stimulation (p>0.05). (Table 9)

Table 9: Kaplan Meir comparison of median recovery time across medication and nutritional therapy related characteristics among SAM children admitted to Jimma university medical center, Jimma, southwest Ethiopia.

Variable	Category	Median time	95% CI	P-value for log rank test
Vitamin A	Yes	19	17.1-20.9	0.674
	No	19	17.7-20.3	
Folic acid	Yes	18	16.8-19.2	0.01*
	No	22	19.3-24.7	
Amoxicillin	Yes	18	17.1-18.9	0.038*
	No	22	19.2-24.7	
Iron	Yes	19	16.8-21.1	0.275
	No	19	18.2-19.8	
Gentamicin	Yes	20	18.4-21.5	0.008*
	No	17	15.8-18.2	
Deworming	Yes	18	16.7-19.3	0.091
	No	20	18.2-21.7	
Special medication	Yes	22	19.6-24.3	0.000*
	No	18	17-19	
Blood transfusion	Yes	28	9.7-46.3	0.000*
	No	19	18.2-19.8	
IV antibiotic	Yes	20	18.5-21.5	0.003*
	No	17	15.9-18	
IV fluid	Yes	23	17-29	0.000*
	No	18	17.1-18.9	
NG tube	Yes	20	18-22	0.002*
	No	18	17-19	
Plumpy nut	Yes	18	17-18.9	0.000*
	No	22	19.5-24.5	
F-100	Yes	19	17.9-20.1	0.007*
	No	22	17.8-26.1	
F -75	Yes	19	17.9-20	0.664
	No	17	13.4-20.6	
Play stimulation	Yes	18	16.7-19.3	0.115
	No	19	17.6-20.4	

Figure 5: Kaplan Meir survival curve of amoxicillin intake for children admitted with SAM in JUMC from 2014 to 2016, Jimma, Ethiopia.

6.3 Predictors of time to recovery

Bivariate analysis

Bivariate analysis was performed for the following variables using bivariate Cox regression: socio-demographic characteristics, anthropometry, type of malnutrition, complication at admission, clinical features, type of medications and nutritional therapy given. Statistical significance was observed in categories of age, season of admission, exclusive breast feeding, vaccination status, type of SAM, edema, complication at admission, TB, HIV, malaria, shock, appetite, complication after admission, folic acid, amoxicillin, ampicillin, deworming,

gentamicin, special medication, blood transfusion, IV antibiotic, IV fluid, NG tube use, plumpy nut, F-100 and play stimulation (P< 0.25).(Table 10)

Table 10: Bivariate Cox proportional hazard Model for predictors of time to recovery from SAM among Children admitted in Jimma university medical center, Jimma, southwest Ethiopia.

Variable		Cured	Censored	Crude Hazard ratio With 95% CI	p
Socio demographic characteristics					
Sex	Male	140	51	0.98 (0.77-1.28)	0.88
	Female	134	50	1	
Age(months)	6-11	37	18	0.69 (0.45-1.05)	0.086*
	12-23	78	32	0.59 (0.42-0.85)	0.004*
	24-35	68	21	0.78 (0.54-1.13)	0.19*
	36-47	41	20	0.42 (0.28-0.65)	0.000*
	48-59	50	10	1	
Residence	Urban	89	31	0.94 (0.73-1.22)	0.659
	Rural	185	70	1	
Season	Winter	77	30	1.39 (1.01-1.9)	0.042*
	Summer	52	33	1.39 (0.97-1.98)	0.07*
	Spring	67	22	1.29 (0.89-1.72)	0.205*
	Autumn	78	16	1	
Exclusive breast feeding	Yes	147	50	0.81 (0.62-1.07)	0.133*
	No	84	42	1	
Vaccination	Fully vaccinated	183	55	1.39 (0.9-2.14)	0.13*
	Partially vaccinated	28	22	1.12 (0.65-1.93)	0.68
	Unknown	39	12	1.16 (0.69-1.93)	0.57
	Not vaccinated	24	12	1	
Type of malnutrition , complication and clinical features					
Type of SAM	Marasmus	94	34	1.59 (1.095-2.32)	0.015*
	Kwashiorkor	141	51	1.51 (1.06-2.16)	0.022*
	Marasmic-kwashiorkor	39	16	1	

Edema	Yes	180	67	0.856 (0.67-1.02)	0.224*
	No	94	34	1	
Complication at admission	Yes	257	99	0.64 (0.39-1.04)	0.071*
	No	17	2	1	
Diarrhea	Yes	191	77	1	0.433
	No	66	22	0.89 (0.67-1.18)	
TB	Yes	29	25	1	0.006*
	No	228	74	1.72 (1.17-2.5)	
HIV	Yes	5	10	1	0.018*
	No	254	89	3.96 (1.26-12.4)	
Pneumonia	Yes	76	35	1	0.411
	No	181	64	0.89 (0.68-1.17)	
Anemia	Yes	115	44	1	
	No	142	55	1.1 (0.86-1.4)	0.467
Malaria	Yes	14	7	1	
	No	243	92	1.86 (1.08-3.2)	0.024*
Dehydration	Yes	32	23	1	0.428
	No	225	76	1.16 (0.8-1.68)	
Shock	Yes	4	21	1	0.029*
	No	270	80	3.02 (1.12-8.12)	
Consciousness	Impaired	33	38	1	0.272
	Conscious	241	63	1.23 (0.85-1.77)	
Appetite test	Failed	96	55	1	0.008*
	Passed	178	46	1.4 (1.09-1.81)	
Co-morbidity after admission	Yes	41	25	1	0.052*
	No	233	76	1.39 (0.99-1.94)	
Medication and nutritional therapy related characteristics					
Vitamin A	Yes	118	40	1.05 (0.83-1.34)	0.688
	No	156	61	1	
Folic acid	Yes	221	78	1.45 (1.07-1.97)	0.015*
	No	53	23	1	
Amoxicillin	Yes	207	63	1.32 (1-1.74)	

	No	67	38	1	0.049*
Ampicillin	Yes	173	81	0.84 (0.66-1.07)	0.164*
	No	101	20	1	
Iron	Yes	109	17	1.14 (0.89-1.45)	0.298
	No	165	84	1	
Deworming	Yes	110	19	1.22 (0.96-1.55)	0.107*
	No	164	82	1	
Gentamicin	Yes	201	80	0.7 (0.54-0.92)	0.012*
	No	73	21	1	
Special medication	Yes	104	57	0.58(0.45-0.74)	0.0000*
	No	170	44	1	
Blood transfusion	Yes	6	24	1	0.001*
	No	268	77	4 (1.77-9.07)	
IV antibiotic	Yes	209	87	0.67 (0.5-0.89)	0.005*
	No	65	14	1	
IV fluid	Yes	24	44	0.45 (0.29-0.69)	0.000*
	No	250	57	1	
Plumpy nut intake	Yes	208	29	1.74 (1.3-2.3)	0.000*
	No	66	72	1	
NG tube	Yes	74	56	0.67 (0.5-0.88)	0.004*
	No	200	45	1	
F-100	Yes	251	42	1.75 (1.14-2.68)	0.011*
	No	23	59	1	
F-75	Yes	268	96	0.84 (0.37-1.9)	0.678
	No	6	5	1	
Play stimulation	Yes	72	2	1.27	0.083*
	No	202	99	1	

Multivariable analysis:

Multivariable Cox regression analysis was performed for variables identified in the bivariate Cox regression as significant ($p<0.25$) by adjusting for confounders through step wise backward multivariable Cox regression method.

Vaccination status (fully vaccinated), play stimulation, TB, malaria, amoxicillin, deworming and shock were found to be independent predictors of nutritional recovery time. The likelihood of early recovery in fully vaccinated children was 2.26 (AHR=2.26, 95% CI: 1.12-4.57) times those of not vaccinated. Similarly, children who received play stimulation therapy were 1.93(AHR=1.93, 95%CI: 1.23-3.03) times likely to recover fast. Likewise, SAM children with TB were 52% (AHR= 0.48, 95% CI:0.27-0.87) more likely to have a delayed recovery time as compared to children without TB and children who have malaria 65.9%(AHR=0.34,95%CI:0.13-0.88) more probability of delayed recovery than their counterparts without malaria. In addition children who took amoxicillin were at 1.54(AHR=1.54, 95%CI: 0.008-2.34) times increased likelihood of fast recovery than their counterparts. Children with SAM who took deworming were 1.8(AHR=1.8, 95%CI: 1.18-2.73) times more likely to have early recovery than children without deworming. The likelihood of delayed recovery is 82 % (AHR=0.18, 95%CI: 0.05-0.59) more in those who developed shock relative to those who did not develop shock (Table 11).

Table 11: Multivariate Cox proportional Hazard Regression model for predictors of time to recovery from SAM among Children admitted in Jimma university medical center, Jimma, southwest Ethiopia.

Variable		Cases	Adjusted hazard ratio with 95% CI	p
Play stimulation	Yes	74	1.93(1.23-3.03)	0.004*
	No	301	1	
Vaccination status	Fully vaccinated	183	2.26(1.12-4.57)	0.023*
	Partially vaccinated	28	0.73(0.3-1.75)	0.481
	Unknown	39	1.06(0.44-2.58)	0.892
	Not vaccinated	24	1	
Malaria	Yes	21	0.341(0.13-0.88)	0.026*
	No	335	1	
Shock	Yes	25	0.18(0.05-0.59)	0.005*
	No	350	1	
TB	Yes	54	0.48(0.27-0.87)	0.015*
	No	302	1	
Deworming	Yes	129	1.8(1.18-2.73)	0.006*
	No	246	1	
Amoxicillin	Yes	270	1.54(1.008-2.34)	0.046*
	No	105	1	

7. Discussion

This study revealed important information about nutritional recovery time of children with SAM managed in nutritional rehabilitation unit and predictors of time to nutritional recovery. The overall median length of stay of the entire cohort was 17 days ± 9 days and median nutritional recovery time for cohort of SAM children was observed to be 19 days (95%CI: 17.95-20.05) both are within the accepted national minimum standards of average length of stay for inpatient treatment (4). This result was in line with other studies conducted in northern Ethiopia and other developing countries (35). However, in contrast to studies conducted in southern Ethiopia (15, 21), this study found a short recovery time. This may be due to difference in implementation of SAM management guideline (4), staffing and setting. Looking at type of SAM, edematous malnutrition accounted for more than half 247(65.9%). This was in line with studies done in Ethiopia and other African countries (15, 19, and 28). High prevalence of edematous SAM may be due to frequent intake of mostly carbohydrate and low intake of protein rich foods (28). Diarrhea is the commonest co-morbidity seen in 268(71.5%) children which is consistent with reports from studies 70.3 in Kenya (30), 44.6% in Sekota (17) and 63.4% in Mekelle (22).

Regarding treatment outcome, the minimum acceptable standard of sphere project is >75% recovery, <15% default rate, <10% death rate (7). In this study the recovery rate is 73.1% (95% CI: 68.5-77.4) which is in line with the minimum standard. This result is greater than reports from Gondar University Referral Hospital (36), Mekelle (22) and Bahirdar (27). In contrast to study done in therapeutic feeding centers in southern Ethiopia that reported the nutritional recovery rate was 3.61 (95 % CI: 3.24–4.0) per 100 person day observations. Rate of recovery in this study was 4.06 per 100 person days (40.6 recovery /1000 person days). This difference can be evidenced by the availability high level professionals like pediatricians and pediatric residents in this study setup.

Among socio-demographic characteristics vaccination status is independent predictor of nutritional recovery time. In this study children who are not fully vaccinated for age had 2.26 (AHR: 2.26; 95% CI: 1.12-4.57) times (delayed) longer recovery time as compared to their fully vaccinated for age counter parts. Similarly a study conducted in Felegehiwot Referral Hospital reported that fully vaccinated SAM children had 4.12 (AOR; 95% CI: 1.64-10.35) times better

recovery rate than their unvaccinated counter parts (27). This can be explained by the role of vaccination in preventing several contagious diseases.

Findings from play therapy Africa (32) indicated that play stimulation increased speed of recovery; children who received play therapy were discharged as cured before the end of 4^{th} and 5^{th} week from admission but among control who do not received play stimulation no one was discharged before the end of 6^{th} week. Also another study conducted in Bangladesh reported that severely malnourished children who received play stimulation have improved weight for age Z-score than their counterparts (33). In this study it was also indicated that children who were provided with a combination of psychosocial stimulation and therapeutic feeding tended to gain weight at a faster rate than children who were only provided with therapeutic feeding. This was in line with our study finding that revealed play stimulation shortens the time to recovery by 1.93(AHR=1.93, 95% CI: 1.23-3.03). Even if play stimulation was included in Ethiopian SAM management guideline, it was not common to see the service in health institutions giving SAM management, as mentioned above introducing play stimulation therapy to the existing SAM management has a rewarding effect via reducing hospital stay. This shortened hospital stay has a direct implication in terms of cost and quality of SAM management.

Results from a randomized placebo controlled trial conducted in southern Malawi on SAM children showed that nutritional recovery was 1.38 times greater for those who took amoxicillin than the placebo group and it also indicated nutritional recovery time was shorter for those who took amoxicillin than the placebo group (31). Similarly, this study found amoxicillin to speed up recovery. Children who took amoxicillin found to have 54% (AHR =1.54, 95% CI: 1.008-2.34) increased speed of recovery than those children who did not take amoxicillin. Recent updates of WHO (9) and national guideline for SAM management (4) recommend provision of broad spectrum antibiotic like amoxicillin for all severely malnourished children regardless of signs of infection and complications. Deworming was also found to be predictor of short recovery time in this study. Severely malnourished children who took albendazole/mebendazole were 1.8 times more likely to have shorter recovery time as compared to those children who did not (AHR=1.8, 95% CI: 1.18-2.73). This may be due to high prevalence of intestinal parasite in severely malnourished children which results in reduced appetite and nausea in children who do not get dewormed.

The hazard of death due to TB was nearly three times higher as compared to children with no TB (AHR= 2.88, 95%CI= 1.72, 4.65) as reported by Kebede (17). However in this study it was found that among children who had tuberculosis nutritional recovery time was delayed by 51.7 %. This can be explained by diminished immunity of SAM children which predisposes them to tuberculosis resulting in disease and inflammatory response. This in turn worsens the nutritional state thus delaying the recovery time. This may highlight the vicious cycle of malnutrition and disease; however the mechanism underlying the association between tuberculosis and malnutrition remains unclear (37).

Malaria is among the common febrile illness which affects children. Its effect is highly devastating in severely malnourished children. Even if there is a shortage of studies showing the impact of malaria on recovery rate and recovery time a study done in Sekota Hospital (17) showed that malaria increases death rate and shortens time to death (AHR= 2.13, 95% CI : 1.12-7.15). However this study revealed that those severely malnourished children having malaria have 65.9 % delayed recovery than their non malarious counter parts. This could be due to the febrile nature of the disease which puts the child in catabolic state this in turn may worsen the child's nutritional state and also may be via reduced appetite. Above mentioned possible reasons thus could lengthen the time needed to recover.

A study done in therapeutic feeding centers in Gedeo Zone showed that development of shock significantly increased the hazard of death by 3.8 times more (38). But the finding of this study shows that children who developed shock had 82% longer nutritional recovery time as compared those who did not develop shock. The possible explanation may be in children who developed shock there is a decreased perfusion to vital organs that may lead to end organ damage, thus prolonging the nutritional recovery time.

A study done in Woldia Hospital indicated that severely malnourished children having HIV/AIDS co-morbidity were 90% less likely to be cured as compared to those without HIV/AIDS co-morbidity. HIV infection was a predominant factor that compromised recovery rate and increased mortality rate. (26) There are also another studies that support the finding that being co morbid with HIV reduces the likelihood of recovery (8 and 9).However in this study HIV is not a significant predictor of nutritional recovery time ($p>0.05$). This may be due to shift in practice from routine provider initiated HIV counseling and testing (PIHCT).

SAM children who did not get vaccination for their age have a longer hospital stay so; implementation of the extended immunization program should be strengthened. The results pose arguments for integration of play stimulation therapy in the management of severe acute malnutrition at scale level to prevent childhood mortality thereby to achieve sustainable development goal. Provision and use of routine medications like amoxicillin and deworming; management of complication like shock, TB and malaria should also stick to national guideline for management of SAM. All the aforementioned results showed reduced hospital stay thus, implying reduction in the cost needed for treatment and burden of health institutions; which will in turn ensures quality of care.

Longitudinal nature of the study design, giving an insight for researchers who wish to use a prospective design and addressing the effect of variables like season of admission, vaccination status and play stimulation were some of the strength of this study. However, difficulty ascertaining the reliability of recorded data, potential bias due to excluded records and unknown status of defaulters, and failing to address variables like educational status, house hold wealth index, socioeconomic status, maternal nutritional status, and child's feeding practice that might have affect on recovery, were some of the limitation of the study.

8. Conclusion and recommendation

8.1 Conclusion

Based on the finding of this study, average length of stay for the entire cohort and median time of recovery was within the sphere standard. The probability of recovery decreases with increased hospital stay. Play stimulation, vaccination, amoxicillin and deworming were independent predictors of short nutritional recovery while, the presence of malaria, TB and shock were found to be independent predictors of delayed nutritional recovery time. Appropriate provision of routine medication and management of medical co morbidity as per the national SAM management protocol enhances fast recovery.

8.2 Recommendation

Based on the above finding of this study the following recommendations are forwarded

For Federal Ministry of Health

- ✓ To promote and strengthen integration of play stimulation therapy on institutions giving SAM treatment.

For Jimma university medical center

- ✓ The death rate and defaulter rate are above the national standard. So adherence to the national SAM management guideline should be strengthened.
- ✓ Management of complications like malaria, TB and shock seeks special attention.

For Jimma city and Jimma zone health bureau

- ✓ Continuous training and programmed supportive supervision should be in place to promote good recovery and reduce death.
- ✓ Case identification, referral and follow up of cases of children with severe acute malnutrition at the community level should be given emphasis.

For researchers

- ✓ Further studies on level of implementation of national and WHO guideline for SAM management are needed.

References

1. Benson T. An Assessment of the Causes of Malnutrition in Ethiopia: A Contribution to the Formulation of a National Nutrition Strategy for Ethiopia. International Food Policy Research Institute. 2006:1-99.

2. Pelletier DL, Frongillo EA. Changes in Child Survival Are Strongly Associated with Changes in Malnutrition in Developing Countries. Journal of Nutrition, 2003; 133(1):107-19.

3. Victora CG, L A, C F, HallalP C, Martorell R, Richter P, et al. Maternal and child under nutrition: consequences for adult health and human capital. Lancet, 2008; 371:340-57.

4. Federal ministry of health. Protocol for the management of severe acute malnutrition. Addis Ababa, Ethiopia, 2007:1-120. https**:/**files.ennonline.net/attachments/897/ethiopia-sam-guideline -march-2007.pdf

5. Hobbs B, Bush A. A 10 point plan for tackling acute malnutrition in under fives. Acute malnutrition an everyday's emergency 2014. https:/www.popline.org/node/579688

6. Federal ministry of health. Training Course On the management of severe acute malnutrition. Addis Ababa 2013.https://www.medbox.org/training-course...severe-acute-malnutrition.../ download.pdf

7. The sphere project Humanitarian Charter and Minimum Standards in Humanitarian Response. Minimum Standards in Food Security and nutrition: Management of acute malnutrition and micronutrient deficiencies, 2011: 168-69. http://www.spherehandbook.org/en/management-of-acute-malnutrition-and-micronutrient-deficiencies-standard-2-severe-acute-malnutrition/

8. Bhutta Z, Das J, Rizvi A, Gaffey MF, Walker N, Horton S, et al. Evidence-based interventions for improvement of maternal and child nutrition: what can be done and at what cost? Maternal and Child Nutrition 2013; 2:1-15.

9. WHO. Guideline: Updates on the Management of Severe-Acute Malnutrition in Infants and Children. Geneva: world health organization; 2013. http://www.who.int/elena/titles/full_ recommendations/sam_management/en/

10. Levels and trends in child malnutrition. UNICEF / WHO / World Bank Group Joint Child Malnutrition Estimates, 2016. https://www.who.int/nutgrowthdb/estimates

11. CSA, ICF. Ethiopia Demographic and Health Survey 2016: Key Indicators Report. Addis Ababa, Ethiopia, and Rockville, Maryland, USA 2016.

12. Beyene TT. Predictors of Nutritional Status of Children Visiting Health Facilities in Jimma Zone, South West Ethiopia International Journal of Advanced Nursing Science and Practice 2012; 1(1):1-13.

13. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, et al. Maternal and Child Undernutrition: Global and Regional Exposures and Health Consequences. Lancet 2008;371(9608):243-60.

14. WHO. Serious Childhood Problems in Countries with Limited Resources: Background Book on Management of the Child with a Serious Infection or Severe Malnutrition. Geneva, Switzerland 2004.

15. Teferi E, Lera M, Sita S, Bogale Z, Datiko DG, Yassin MA. Treatment Outcome of Children with Severe Acute Malnutrition Admitted to Therapeutic Feeding Centers in Southern Region of Ethiopia. Ethiopian Journal of Health Development 2010;24(3):234-38.

16. Saaka M, Osman S, Amponsem A, Ziem JB, Abdul-Mumin A, Akanbong P, et al. Treatment Outcome of Severe Acute Malnutrition Cases at the Tamale Teaching Hospital Journal of Nutrition and Metabolism 2015:1-8.

17. Kebede S. Survival Status and Predictors of Mortality among Children Aged 0-59 Months with Severe Acute Malnutrition Admitted to Stabilization Center at Sekota Hospital Waghemra Zone. Journal of Nutritional Disorders Therapy 2015; 5(2):160-71.

18. Berti A, Bregani ER, Manenti F, Pizzi C. Outcome of severely malnourished Children treated according to UNICEF 2004 guidelines: a one-year experience in a Zone hospital in rural Ethiopia. Transactions of the royal society of tropical medicine and hygiene 2008;102(9):939-44.

19. Habtamu J, Alemseged W, Fissehaye A. Survival status and predictors of mortality in severely malnourished children admitted to Jimma University Specialized Hospital from 2010 to 2012, Jimma, Ethiopia: a retrospective longitudinal study. BMC pediatrics2015;15(76):1-13.

20. Bachou H, Tumwine JK, Mwadime RK, Tylleskär T. Risk factors in hospital deaths in severely malnourished children in Kampala,Uganda BMC Pediatrics 2006;6(7):1-9.

21. Gebremichael DY. Predictors of nutritional recovery time and survival status among children with severe acute malnutrition who have been managed in therapeutic feeding centers, Southern Ethiopia: retrospective cohort study. BMC Public Health 2015; 15(1):1-11.

22. Melaku G, Afework MB, Mache T. Treatment Outcomes and Associated Risk Factors of Severely Malnourished under Five Children Admitted to Therapeutic Feeding Centers of Mekelle City, Northern Ethiopia. Open Access Library Journal 2014; 1(4):1-9.

23. Banbeta A, Seyoum D, Belachew T, Birlie B, Getachew Y. Modeling time-to-cure from severe acute malnutrition: application of various parametric frailty models. Archives of Public Health, the official journal of the Belgian Public Health Association, 2015; 73(6):1-8.

24. Aguayo VM, Agarwal V, Agnani M, Agrawal DD, Bhambhal S, Ashok K Rawat ea. Integrated program achieves good survival but moderate recovery rates among children with severe acute malnutrition in India. American Journal of Clininical Nutrition2013;98(5):1335-42.

25. Maurya M, Singh DK, Rai R, Mishra PC, Srivastava A. An experience of facility-based management of severe acute malnutrition in children aged between 6-59 months adopting the World Health Organization recommendations. Indian Pediatrics2014; 51(6):481-83.

26. Chane T, Oljira L, Atomesa GE, Agedew E. Treatment Outcome and Associated Factors among Under-Five Children with Severe Acute Malnutrition Admitted to Therapeutic Feeding Unit in Woldia Hospital, North Ethiopia. J Nutr Food Sci 2014; 4(329).

27. Desyibelew HD, Fekadu A, Woldie H. Recovery rate and associated factors of children age 6 to 59 months admitted with severe acute malnutrition at inpatient unit of Bahir Dar Felege Hiwot Referral hospital therapeutic feeding unite, northwest Ethiopia. PLoS ONE 2017; 12(2): doi:10.1371/journal.pone.017102.

28. Munthali T, Jacobs C, Sitali L, Dambe R, Michelo c. Mortality and morbidity patterns in under-five children with severe acute malnutrition (SAM) in Zambia: a five-year retrospective review of hospital-based records (2009 -2013). Archives of Public Health 2015; 73(23).

29. Savadogo L.G.B, Ivone Z, Bernard I, Maurice K, Donnen P. Impact of Anemia on Mortality and Nutritional Recovery among Hospitalized Severely Malnourished Children in Burkina Faso. Open Journal of Pediatrics 2014; 4:115-20.

30. Talbert A, Thuo N, Karisa J, Chesaro C, Ohuma E, Ignas J, et al. Diarrhoea Complicating Severe Acute Malnutrition in Kenyan Children: A Prospective Descriptive Study of Risk Factors and Outcome. PLoS ONE 2012; 7(6).

31. Food and Nutrition Technical Assistance III Project (FANTA).Studying the Use of Antibiotics for Treating Severe Acute Malnutrition. Washington, DC, 2014. https://www.fanta project.org/.../FANTA-Impact-CMAM-Antibiotics-May2014_0.pdf

32. Emotional Stimulation in the Context of Emergency Food Interventions, Play Therapy Africa: The Society for Protection and Therapeutic Aid in Africa; Final Report, Addis Ababa (2009). http://www.ennonline.net/emotionalstimulation

33. Nahar B, Hamadani JD, Ahmed T, Tofail F *et al.*, Effects of psychosocial stimulation on Growth and development of severely malnourished children in a nutrition unit in Bangladesh. European Journal of Clinical Nutrition (2009) 63,725–731; doi:10.1038/ejcn.2008.44

34. Schoenfeld D. Sample-size formula for the proportional-hazards regression model. Biometrics 1983; 39(2): 499-503. http://www.sample-size.net/sample-size-survivalanalysis/

35. Maggie P. Critical appraisal of the management of severe acute malnutrition in Malawi: a case of two hospitals in Zomba. 2011; 19–27. http://ummafrapp.de/skandal/haart/annex%209 .pdf

36. Abeje AT, Gudayu TW, Malefia YD, Befftu BB. Analysis of Hospital Records on Treatment Outcome of Severe Acute Malnutrition: The Case of Gondar University Tertiary Hospital. Pediat Therapeut 2016; 6:283.doi:10.4172/2161-0665.1000283

37. Devan Jaganath and Ezekiel Mupere. Childhood Tuberculosis and Malnutrition. The Journal of Infectious Diseases 2012; 206:1809–15

38. Girum T, Kote M, Tariku B, Bekele H.survival status and predictors of mortality among severely acute malnourished children <5 years of age admitted to stabilization centers in gedeo Zone: a retrospective cohort study. Therapeutics and Clinical Risk Management 2017:13 101–110.

Annexes

Hospital Consent Form

This is a study that will be conducted in Jimma university medical center. The main objective of this study is to determine predictor's treatment recovery of severe acute malnutrition. Such type of study expected to have good feedback for feature patient care. This study will not be done without cooperation of the hospital. Therefore, the hospital's participation and collaboration is very much helpful in generating the required information and will be very much appreciated.

In this study data will be collected from the patient chart record retrospectively. Information regarding any specific personal identifiers like the name of the clients will not be collected and information generated will be disclosed in totality. In addition, confidentiality of any personal information will be maintained throughout the study process and no unauthorized access to the information is allowed. The hospital has all the right to refuse to participate in this study and shall withdraw from the study at any time. If you would like to participate in this study, would you please confirm it by signing here

Thank you!

Hospital manager: ---------- Principal investigator: ----------

Data collection Instrument

Data Extraction Format for Research Project in Jimma University medical center.

Title: Time to recovery and Predictors of recovery among Children Aged 6-59 Months with Severe Acute Malnutrition Admitted in Jimma university medical center between September 2014 and September 2016.

Dear my data collectors thank you for time and energy in participating in my study. All the data are to be collected from patient registries and patient card. The data collected need to be logical only based on the information from records, not arbitrarily. So I kindly request you to collect the actual data from patient card honestly. The data extraction form contains five sections with socio demography up to intake of routine medication and nutritional therapy. The choice form would check through encircling. Other data should be filled as in information from card. The data should be filled with pencil plus eraser.

S. No	Questions	Response	Skip	Code
Unique SAM number…….medical record number……				
Date of data collection……...name of data collector…….				
PART-I Socio- demographic characteristics				
101	Sex	1. Male 2. Female		
102	Age	Month_____		
103	Residence	1. Urban 2. Rural District ……..		
104	Date of admission	Date ____ Month ____ Year		
105	Date of discharge/withdrawal	Date ____ Month ____Year		
106	Season of admission	1.Winter (June-August) 2.Summer(September-November) 3.Spring(December-February) 4.Autumn(March-May)		
107	Was the child breast fed?	1.Yes 2.No 3.Not documented		
108	For how long was the child only fed breast milk?(exclusive breast feeding) (in months)	……..		
109	What is the child vaccination status?	1.Fully Vaccinated 2.Partially Vaccinated 3.Not Documented 4.Unknown		

Part II : Anthropometry and type of malnutrition				
201	What was the weight of child at admission?	Wt_____ kg.		
202	What was the height of the child at admission?	Ht…… cm.		
203	Weight for height percent at admission (WFH %)	_____		
204	What was the MUAC of child at admission?	MUAC_____ mm.		
205	Height for age percent at admission? (HFA %)	……..		
206	What was the Weight of child at discharge?	W/ht _____ kg.		
207	What was the height of the child at discharge?	_____ cm.		
208	Weight for height percent at discharge? (WFH %)	_____		
209	What was the MUAC of child at discharge?	MUAC_____ mm.		
210	Diagnosis at admission?	1. Marasmus 2. Kwashiorkor 3. Marasmic-kwash		
211	Presence of edema?	1.Yes 2. No If yes grade……	Q.212	
212	When was the edema lost?	After ……..days		
213	Site of the edema?	1.Pretibial 2.Hands 3.Face		

		4.Generalised		

Part III : Co-morbidity

301	Did the child have complication at admission?	1.Yes 2.No	Q 302 Q 303	
302	What was the complication		Yes	No
		1. Diarrhea	1	2
		2. TB	1	2
		3. HIV	1	2
		4. Pneumonia	1	2
		5. URTI	1	2
		6. Anemia	1	2
		7. GTI & sepsis	1	2
		8. Malaria	1	2
		9. Dehydration	1	2
		10. Other (specify)…… …….		
303	Was the child tested for HIV?	1. Yes……... 2. No……	Q 305 Q 401	
304	What was the result?	1. Reactive 2. Non-reactive 3. Not documented		
305	Presence of shock at admission?	1. Yes 2. No		
306	Consciousness at admission?	1. Conscious 2. impaired		
307	Appetite at admission?	1.Failed Appetite Test 2.Passed Appetite Test		

308	If Failed, Gained Appetite within 4 Days	1.yes 2.no		
309	Co-morbidity after admission?	1.yes 2.No		
310	What is the co-morbidity after admission?	……		
Part IV: Routine medication and nutritional therapy				
401	Did the child take routine medications?	1. Yes 2. No		
402	What were the routine medications?		YES	NO
		1. Vitamin A	1	0
		2. Folic acid	1	0
		3. Amoxicillin	1	0
		4. Ampicillin	1	0
		5. gentamicin	1	0
		6. Measles(>9mnths)	1	0
		7. Iron	1	0
		8. Deworming(albendazole)	1	0
		9. Other (specify)….. ……		
403	Did the child take special medication?	1. Yes 2. No		
404	What was the special medications	_____		
405	Blood transfused at admission?	1.Yes 2.No		

406	Treated with IV Antibiotic at admission?	1.Yes ,duration……...days 2.No		
407	Intravenous fluid intake at admission?	1. Yes 2. No		
408	Plumpy nut intake?	1. Yes, duration……..days 2. No		
409	Naso-gastric tube used?	1.Yes 2.No		
410	F 100 intake?	1. Yes,…….per day 2. No		
411	F 75 intake?	1. Yes, ……per day 2. No		
413	Play stimulation given?	1. Yes 2 .No		
Part V : Base line investigations				
501	Hematocrit	_____%		
502	Glucose (random)	_____		
504	Hemoglobin level in g/dl	_____		
Part V: Discharge information				
601	Outcome at discharge?	1.Recovered 2.Death 3.Transferred Out 4.Dafaulted		

603	Length of stay?	…….. days		

Thank you!

Annex II:

Reference values for the main indicators from Sphere project

	Acceptable	Alarming
Recovery rate	>75%	<50%
Death rate	<10%	>15%
Defaulter rate	<15%	>25%
Weight gain	>=8g/kg/day	<8g/kg/day
Length of stay	<4weeks	>6weeks
Coverage	>50-70%	<40%

DECLARATION

I, the undersigned, declare that this thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been fully acknowledged.

Name: _____

Signature: _____

Name of the institution: _____

Date of submission: _____

This thesis has been submitted for examination with my approval as University advisor

Name and Signature of the first advisor

_____

_____

Name and Signature of the second advisor

_____

_____