ASRAT WOLDEYES HEALTH SCIENCE CAMPUS

SCHOOL OF NURSING AND MIDWIFERY

DEPARTMENT OF PEDIATRICS AND CHILD HEALTH NURSING

SURVIVAL STATUS AND PREDICTORS OF MORTALITY WITH SEVERE ACUTE MALNUTRITION AMONG CHILDREN 6-59 MONTHS OF AGE ADMITTED AT PEDIATRIC WARD IN SELECTED COMPREHENSIVE SPECIALIZED HOSPITALS, SOUTHERN NATIONS NATIONALITY AND PEOPLE'S REGIONAL STATE, ETHIOPIA, 2023

INVESTIGATOR: SHEWAKENA DEGEFA(BSc)

A THESIS SUBMITTED TO ASRAT WOLDEYES HEALTH SCIENCE CAMPUS SCHOOL OF NURSING AND MIDWIFERY, DEBRE BREHAN UNIVERSITY, FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR MASTER'S IN PEDIATRICS AND CHILD HEALTH NURSING.

JUNE,2023

DEBRE BERHAN, ETHIOPIA

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The full title of the research project	Survival status and predictors of mortality with severe acute malnutrition among children 6-59 months of age admitted at pediatric ward in selected comprehensive specialized hospitals, SNNPRS Ethiopia, 2023
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ACRONYMS AND ABBREVIATIONS

AHR	Adjusted Hazard Ratio
CI	Confidence Interval
EDHS	Ethiopian Demographic Health Survey
HIV	Human Immune Deficiency Virus
HR	Hazard Ratio
IV	Intravenous
KM	Kilo Meter
MAM	Moderate Acute Malnutrition
MUAC	Mid Upper Arm Circumference
ReSoMal	Rehydration Solution for Malnutrition
SAM	Severe Acute Malnutrition
SC	Stabilization Center
SD	Standard Deviation
SNNPR	South Nation Nationality and Peoples Region's
TB	Tuberculosis
TFU	Therapeutic Food Use
UNICEF	United Nation International Children Emergency Fund
WCUNEMMCSH	Wachemo University Nigist Eleni Mohamed Memorial Comprehensive Specialized Hospital
WFH	Weight For Height
WHO	World Health Organization

Abstract

Background: Complicated severe acute malnutrition is the common reason for pediatric hospital admission in many poor countries, which pauses additional burden on limited resources. In hospitals, it remains poorly managed which led to mortality rate of under-five children became higher than the acceptable level as different studies revealed. However, survival status and its associated factors for complicated severe acute malnutrition were yet not get attention. In these study tries to determine predictors and assess treatment outcome among children with severe acute malnutrition admitted in stabilization center at SNNPRS, Ethiopia,2023.

Objective: To assess survival status and predictors of mortality with severe acute malnutrition children 6-59 months of age admitted to pediatric ward selected comprehensive specialized hospital, SNNPRS Ethiopia, 2023.

Methods: Multi- center Institution -based retrospective follow-up study was conducted at selected comprehensive specialized hospitals, SNNPRS Ethiopia, 2023, from January 2019 to December 30, 2021. Participants were selected using a systematic random sampling technique. Data was collected by trained data collectors using a pre-structured data collection checklist. Different Predictors of mortality were analyzed by the Cox proportional hazard model, hazard ratio, 95% CI and $P < 0.25$ level in bivariable analysis were entered final Cox-regression hazard model, a statistical test considered as significant at P value less than 0.05.

Result: A total of 622 severely malnourished children chart were reviewed 6834-person day of observation, 89 (14.3%) had died. The median time for occurrence of an event(death) was 10 days with(95%CI=8.33-11.74). The overall incidence rate was 13 cases per 1000 person-days. Types of admission(readmission)AHR: 2.17(95%CI=1.20-3.90), presence of shock AHR: 2.11(95%CI=1.04-4.27), immunization status AHR: 2.12(95%CI=1.00-4.49), vitamin A supplementation AHR: 3.06(95%CI=1.37-6.85), Naso-gastric tube feeding AHR: 2.61(95%CI=1.23-5.53) and blood transfusion AHR: 2.22(95%CI=1.06-4.65) were independent determinants of mortality for severe acute malnutrition.

Conclusion and recommendation: In this study, mortality rate for severely malnourished children was higher than global SPHERE and national protocol. Therefore, an intervention that focuses on the identified predictors could have a paramount effect in reducing child mortality related to severe acute malnutrition.

Key words: Survival status, under-five children, mortality, determinants, SAM, SNNPRS

1 Introduction

1.1 Background

Malnutrition is a condition caused by not consuming enough calories and adequate amounts of essential nutrients such as vitamins and may occur when there is a lack of nutrients in the diet or when the body cannot absorb nutrients from food (1). Malnutrition, one of the most common causes of morbidity and mortality in children all over the world (2).

Severe Acute Malnutrition (SAM) is defined as very low weight for height (below -3 z scores of the median world health organization (WHO) growth standards, and by the presence of nutritional (Bilateral pitting Edema) edema or middle upper arm circumference (MUAC) less than 11.5cm for children age 6-59 months(3). Although SAM occurs globally and may affect all ages, infants and young children are most vulnerable, as they have higher nutritional requirements for growth and development and sub Saharan Africa bears the greatest burden of SAM(4).

In clinical assessment of sever acute malnourished patient, skeletal appearance resulting from significant loss of muscle mass and subcutaneous fat, bilateral pitting oedema of the lower limbs sometimes extending to other parts of the body (e.g., arms and hands, face), and discolored, brittle hair; shiny skin which may crack, weep, and become infected (3, 5).

Acute Malnutrition is classified into severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) according to the degree of wasting and the presence of oedema. It is severe acute malnutrition if the wasting is severe (W/H < 70% NCHS median or a low MUAC) or there is oedema. Acute Malnutrition is defined as moderate acute malnutrition if the wasting is less severe (W/H between 70% and 80% NCHS median); edematous cases are always classified as severe. These guidelines address the treatment of SAM(6).

Severe acute malnutrition is diagnosed by both anthropometric and clinical factors such as mid- upper arm circumference is less than11.5 cm very low weight-for-height/length (Z-score below -3 SD of the median WHO child growth standards) and the presence of bilateral pitting oedema of the lower limbs indicates SAM and significant mortality risk (7).SAM is still among the most widespread factors contributing to morbidity in children in poor nations(8).

Severe malnutrition is both a medical and a social disorder. Successful management of the severely malnourished patients requires that both medical and social problems be recognized and corrected. If the illness is viewed as being only a medical disorder, the patient is likely to relapse when he/she returns home and the rest of the family will remain at risk of developing the same problem. Therefore, successful management of severe malnutrition does not require sophisticated facilities and equipment neither highly qualified personnel. It does, however require that each child be treated with proper care and affection(9).

With this management the products (F75, F100 and RUTF) and other treatment usually leads to very rapid reversal of the clinical features of SAM. Unfortunately, this entails large movements of electrolytes and water between the various compartments of the body. This temporary electrolyte disequilibrium makes the patients even more vulnerable to misdiagnosis and mismanagement of such conditions as dehydration or severe anemia that can lead to death from heart failure.

Thus, it is very important that the whole guideline is implemented particularly the diagnosis and management of the complications during in-patient care. It is only appropriate to refer SAM patients to facilities where the proper training in the care of the severely malnourished has been accomplished; in particular, the staff in emergency wards need to understand that the standard treatment of complications given to non-malnourished children can lead to the death if the patient is severely malnourished. (10)

The burden and severity of childhood severe acute malnutrition in Ethiopian children are high due to the limited coverage and affordability of effective preventive measures such as; inadequate care and prescription errors, lack of maternal participation in feeding programs, and over-prescription of intravenous therapies and blood transfusions lack of adequate access to health care and unavailability of effective treatment strategies(11).

Therefore, considering the combination of strategy and critically close to the current gap in the prevention of child mortality due to SAM is important to prevent under- five age mortality in order to achieve the sustainable development goal (MDG-3). Despite the improvement on the reduction of the problem, SAM remains a common cause of child mortality. So, data on survival status and predictors of mortality important for planning child health services. Therefore, this study aimed to evaluate the survival status and determinants factors of child mortality.

1.2. Statement of the problem

Severe acute malnutrition is a relevant public health issue because it consistently emerges as one of the main causes of child morbidity and mortality(12). Globally severe acute malnutrition is one of the major causes of child morbidity and mortality in despite recent advances the healthcare system and is an ongoing major global public health challenge(13).

In 2018, 1 in 12 of the expected 52 million children under the age of five were anticipated to have SAM, and 2.9 million of these children were hospitalized, according to a World Health Organization (WHO) report(14).According to a different WHO report stated that Globally wasting affected 6.9% or 47.0 million children under the age of five in 2019, including 14.3 million with severe wasting ,and half of the children died related to sever wasting (15).

In 2020 45.4 million of children under the age of five are wasted,13.6 million children under five were severely wasted, nearly 8 million children under the age of 5 are risk of dying from severe acute malnutrition(4).However, despite the availability of outpatient care, 50% of malnourished children admitted stabilization centers die a result of inadequate treatment (16).

The global burden indicates that up to 8 million annual deaths among children <5 years of age are attributable to severe wasting, it accounts for around 800,000–875,000 childhood deaths attributed to sever wasting annually (17). In sub-Saharan African, SAM affects about 3% of under-five children, with more than 400,000 child deaths each year (18). The burden of malnutrition vary from country to country Yemen is 45.4,Central Africa Republic 45.1%, Democratic Republic of Congo 37.8%, Lesotho 32.4% and Sierra Leon 3l,5% (19). Most of the child deaths occur in developing countries, particularly in sub-Saharan Africa.

World Health Organization established guideline for the management of SAM, which strictly- care and follow to keep the mortality rate below 10%, In many Sub-Saharan Africa hospitals; the mortality rate from SAM has consistently remained between 10 and 40%,even-though the requirements are followed (20).

Ethiopia’s current early childhood mortality rate is one of the highest in the world, and comprises a significant proportion of the under-five mortality in the country(21). The under-5 mortality declined from 166 deaths per 1000 live birth in 2000 to 67 deaths per 1000 live births in 2016(22), Ethiopia's plans to decrease under-five mortality from 64 per 1,000 to 29 per 1,000 by 2019/2020 through the implementation of the National Child Survival Plan, but the mini Ethiopia demographic health Survey 2019 reports that 55/1,000 children die (23).

Other government plans to reduce the under-five mortality rate to 31 and 14 per 1,000 by 2025 and 2035, respectively, as part of the National Health Sector Transformation Plan (HSTP)(24). Despite the increasing availability of various prevention strategies and management guidelines, still many cases and deaths from SAM in developing countries, including Ethiopia(25).In Ethiopia, Over 25,000 children with SAM are admitted to hospitals each month, with 20% of pediatric hospital admissions and contributing to in 25%–30% of deaths in many developing countries (15, 26). The country is among the top five countries for sever acute malnutrition deaths (27).

In Ethiopia, the under-five mortality rate for children with SAM ranged from 2.1% to 28.6% (25), showing a variance of 27% between studies. This shows that prevention and management of severe acute malnutrition were not uniform and unfinished agendas across the country may be as a result of limited access to appropriate healthcare, inconsistent application of the SAM treatment program, etc. So, to reducing child mortality with severe acute malnutrition, for this purpose the exact predictors of mortality will be identified.

As indicated by many studies conducted in different parts of Ethiopia, the magnitude of severe acute malnutrition varies geographically. Thus, there is a need to perform periodic assessments of the problem and no multi-center institutional-based studies conducted at a regional level. However, this study aims to assess the survival status and predictors of mortality admitted to the stabilization centers of the selected public referral hospitals in SNNPRS, Ethiopia 2023.

1.3 Significance of the Study

Evidence-based child mortality estimates are the cornerstone of tracking progress toward child survival goals and identifying priority areas to improve progress toward eliminating preventable deaths due to SAM. Improvement in child survival is a good indicator of quality care. So, understanding survival time indicators for children with malnourished can help health professionals and parents understand how long a child will be hospitalized. This enables them to mobilize resources for inpatient care and to prepare for any disruptions that admission may cause. Knowing the length of hospitalization reduces the impact of discharge against medical advice, provides appropriate treatment, and reduces the risk of death. it is important for healthcare providers and health officials to prioritize and improve outcomes.

The hospital managers can use it to design an intervention project to improve SAM management. In addition, the information from this study was used to update the existing knowledge and skills of healthcare workers, particularly pediatricians and pediatric ward nurses, regarding the proper management of SAM. finally, the results of this study will serve as inputs for further studies.

2. Literature review

The most severe type of childhood malnutrition, severe acute malnutrition is a significant public health issue that is linked to extremely high rates of morbidity and mortality. It is one of the key drivers of child mortality in developing countries. SAM is one of the main reasons for children's admission and one of the key drivers of child mortality in developing countries(28).

SAM among children has adverse outcomes it has serious physiological consequences, including reductive adaptation, marked immunosuppression, and concurrent infection such as diarrhea and pneumonia. It can lead to an increased risk of dying by 12-folds. A higher risk of stunting, possible eventual obesity and non-communicable diseases, and impaired cognitive development are additional long-term effects. It is linked to reduced learning ability and school performance(29).

2.1 Survival status of SAM

Children with SAM who are admitted to a stabilization center (SC) can be discharged if they recover, pass away, default, or are transferred , in the presence of a functional stabilization center following standard protocol, the acceptable proportion of discharges from therapeutic care, greater than 75% by recovery, less than 15% by default and less than 10% by death (30). Study conducted at the Gandhi Hospital in India, severe acute malnutrition(SAM) mortality rate(3.5%), his median length of hospital stayis14.2 days (31) . Analytic study conducted in three hospitals in Dhaka city in Bangladesh showed that an unacceptably high mortality rate (13.7%) majority of the death (64%) were registered within three days of admission (32).

2.2 Predictors of mortality in 6-59 months children with SAM

Predictors of mortality in children admitted to stabilization center include Socio-demographic characteristics, anthropometric measurement, types of malnutrition, medical comorbidity, clinical condition and therapeutic feeding and medication (33-36).

2.2.1. Socio-demographic factors

Study in Jimma and Gedeo zone revealed that children age less than 24 months were two times more likely to die earlier than children with age above 24 months (37, 38).study conducted in Amhara Regional State Referral Hospitals revealed that being male and living in rural area were significant predictors of mortality (39).

2.2.2. Baseline anthropometric measurements

A study done among children 6-59 months of age in Delhi, India to assess MUAC and WFH Score predicting mortality in hospitalized children. As the findings of this study, MUAC < 11·5cm and WHZ<-3 were independent predictors of inpatient mortality (40). A study conducted in Tanzania showed that children Weight for Age Z score(WAZ) score from ≤-2 to ≤-3 had a double risk of death and those with severe underweight (WAZ <-3), the risk was more than tripled (41).

2.2.3 Types of SAM and vaccination status

The study conducted in Zambia showed that, kwashiorkor was a significant impact on child mortality with SAM children's than marasmus and Marasmus–kwashiorkor. Study in Zambia showed edematous malnutrition (kwashiorkor) children have 50% times more likely to die than none- edematous children(42).Study conducted in Gedeo zone shows; partial vaccination status among children increased their risk of death by 1.9 times compared to complete immunization status.

Study done Jinka southern Ethiopia, according to the study, SAM children with marasmus were 1.8 times more likely to risk of mortality than moderate wasting children(35).similar finding also revealed kwashiorkor and nutritional oedema was the major predictor of mortality(43).similarly, children with edematous malnutrition (kwashiorkor) are 50% more likely to die than non-edematous children(43).The study done Felege-Hiwot comprehensive specialized hospital show the risk of death for those children with edema was 61.5%, compared to 16.9% for non-edematous children (38).

2.2.4. Medical co-morbidity

Several studies have been reported on the magnitude and association of co-morbidity among children with SAM admitted in SC. Studies conducted in developed countries show that; HIV, Pneumonia, Malaria, TB, Anemia, Sepsis, CHF and diarrhea has a significant impact on mortality of child with sever acute malnutrition(38, 44-47).

A study conducted in Nigeria revealed that persistent diarrhea, pneumonia and pulmonary tuberculosis were the commonest morbidities seen in severe acute malnourished patients (34). A result in Malawi also revealed that severe pneumonia and anemia were a strong predictors of mortality(48).Similar study done in Uganda, diarrhea at admission were 19 % times more likely to die than no diarrhea(49).

Other study done Northern Uganda, showed an association between medical comorbidity and survival status, with HIV-positive children were three times more likely to die than HIV-negative children(50, 51). study in North Shoa Zone children with SAM, as the finding of this study, children who had pneumonia were 29% more risky to die as compared to children who had no pneumonia, in addition, children with tuberculosis were almost three times more likely to die than counter parts (52).

Study done in Gedeo Zone showed that risk of death among children with anemia was more than six and half times more likely to die than children with no anemia (53). Additionally, another study conducted in Dilchora Hospital, eastern Ethiopia showed the children with malaria were more than twelve times more likely to die than children who were not infected with malaria(54).Study done in Wolaita zone south Ethiopia showed children with sepsis had 2.9 times higher risk of dying compared to them who do not have sepsis (55, 56).

2.2.5 Clinical condition

Clinical conditions affect the outcome of sever acute malnutrition by clinical factors such as Shock, Fast breathing, dehydration, altered body temperature, hypoglycemia, Oxygen saturation Chest indrawing(34, 57-59).

Study done in Uganda, SAM children with lack of appetite test were 4.5 times more likely to die at any given time than have full appetite, suspected sepsis and skin ulcers increased risk of death by 23% and oxygen saturation less than 90% and chest indrawing were significant predictors of mortality during admission of SAM children to stabilization center(49). Study done at Felege-hiwot comprehensive specialized hospital showed SAM children with oxygen saturation below 90% were 3.32 hazard of death as compared to children with ≥90% oxygen saturation(38, 60).

Study at Felege-hiwot comprehensive specialized hospital showed SAM children oxygen saturation below 90% were 3.32 hazard of death as compared to children with ≥90% oxygen saturation (25, 60). Study done in Wolaita zone southern Ethiopia showed risk of hypothermia in children was 11.8 times higher die compared to children normal temperature (55).

Another study was done among children admitted to stabilization centers in Jinka hospital, south Omo zone, Ethiopia showed that children with Altered pulse rate were nearly 6 times more likely to die at any given time than un altered, children with altered body temperature were nearly seven times more likely to die than normal, while shock increased risk of death by 15%, while IV infusion increased risk of death by 24%, children with septicemia were nearly three times more likely to die at any given time than counterparts(33).

2.2.6 Therapeutic Feeding and Medication

A retrospective cohort study done Northern Uganda showed that children who received intravenous infusions were significantly more likely to die than children who did not receive IV fluids, and also significantly higher proportion of children that received blood transfusion died compared to those who were not transfused (27.6 %).Children did not use antibiotics were also 2.3 times more likely to die children who had ever received antibiotics and children who did not receive F75 were also 60% more likely die than those who took F75 in spatialization center, SAM children who did not receive F100 were 3 times more likely to die than who takes F100 and deworming were 1.44 times more likely to recover faster those who did not (45, 50).

Study conducted in Gondar university general hospital showed that Children who did not took antibiotics were 2.3 times more likely to die children who had ever received antibiotics, also children did not take IV fluids were 3.2 times more likely to die than who took IV fluid, and children who did not receive F75 were also 60% more likely die than those who took F75, children who has no deworming 2.7 more likely recover faster to those who did not and children who did not receive F100 were 3 times more likely to die ever than one who takes F100 (33)

A retrospective cohort study done at Sekota hospital, Wag Hemra zone, according to this study, children not supplemented folic acid during their hospitalization were more than two times hazard of death and children not supplemented, for Vitamin A were 53% times higher risk of death than their counterparts (18, 35, 54). An institution based retrospective study conducted in northwest Ethiopia to assess the study reveals, children not treated with routine antibiotic , were about two times more likely to die as compared treated with routine antibiotics (45, 61).

Generally several studies conducted in Ethiopia and showed the above predictors but there is a gape like the evidence from earlier studies on survival status and predictors of mortality for SAM is conflicting and unreliable result and those studies did not consider factors like low oxygen saturation, chest indrawing and fast breathing which have significant effect on child mortality admitted with SAM(31).

2.3. Conceptual framework

SAM is main cause of mortality and morbidity among children under five years of age. Ahigh death rate and lower survival in SAM children aged 6-59 months admitted to SCs are largely dependent on the potential determining factors such as the socio-demographic characteristics of children (age, gender, place of residence), anthropometric characteristics (MUAC, WFH, edema), SAM type (marasmus, kwashiorkor ,Marasmus-Kwashiorkor),concurrent, medical illnesses/infections (malaria, pneumonia, HIV/AIDS, tuberculosis, diarrhea), clinical complications at admission (vomiting, level of consciousness, severe anemia, shock, dehydration, sepsis change in body temperature) and therapeutic nutrition and medication (F75/F100/RUTF, Po Antibiotics, IV Fluid, IV Antibiotics, oxygen saturation, chest indrawing,) Effects on Child Survival of SAM children (33)

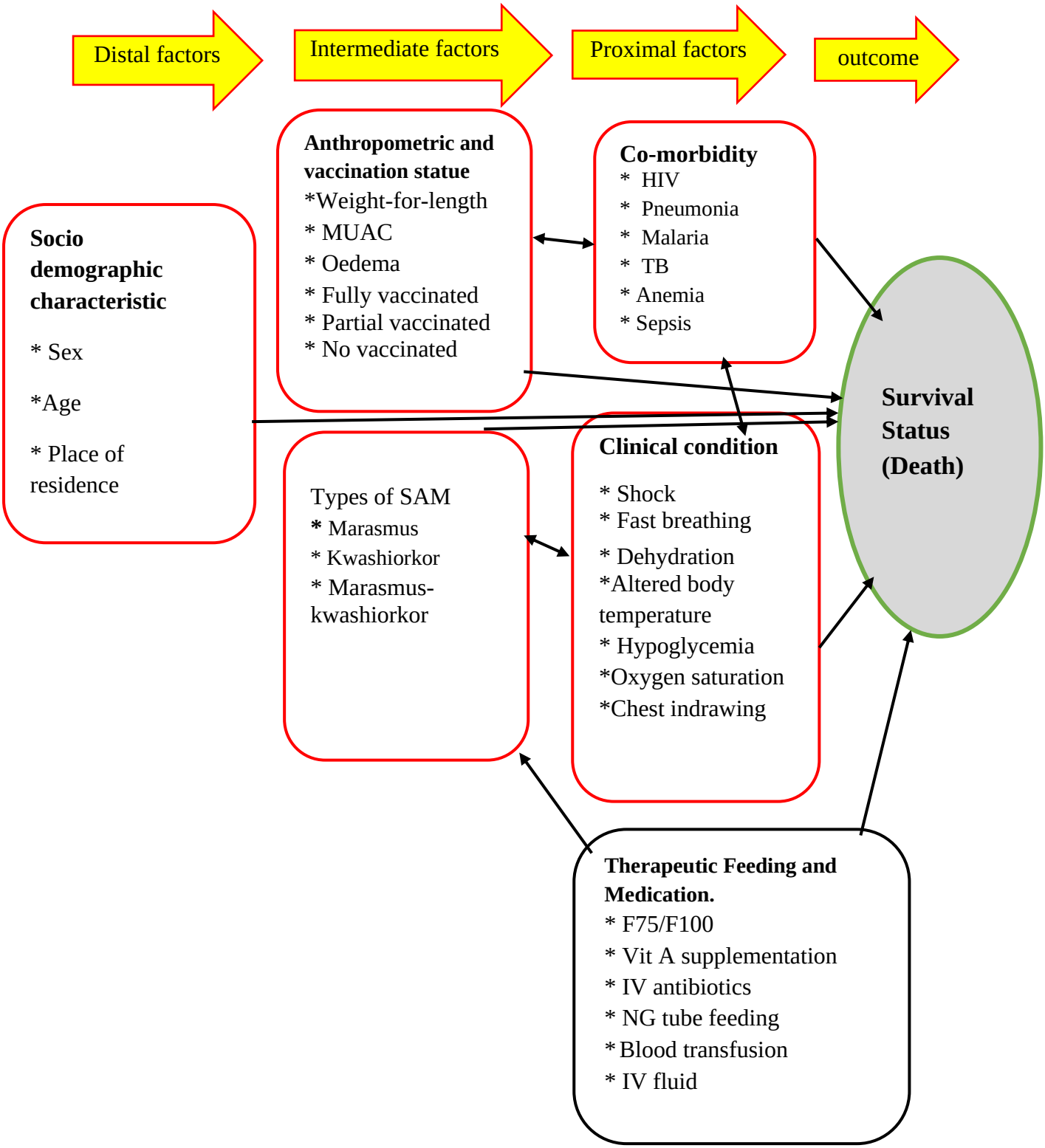


Figure: Conceptual framework for factors associated with predictors of mortality with sever acute malnutrition adapted from different related literatures 2023(25, 33, 34, 55).

3. Objective

3.1 General objective

To assess survival status and predictors of mortality with severe acute malnutrition among children 6-59 months of age admitted at pediatric ward in selected comprehensive specialized hospitals, SNNPRS Ethiopia, 2023.

3.2 Specific objective

- To determine survival status child with severe acute malnutrition among children 6-59 months of age admitted at pediatric ward in selected comprehensive specialized hospitals, SNNPRS Ethiopia, 2023.
- To identify predictors of mortality with severe acute malnutrition among children 6-59 months of age admitted to stabilization center in selected comprehensive specialized hospitals, SNNPRS Ethiopia, 2023.

4. METHODS AND MATERIALS

4.1. Study area and period

The study was carried out from, May 1st to May 30th, 2023 among children with SAM at selected comprehensive specialized hospitals in SNNPRS.

South Nation Nationality and People`s regional state is one of the administrative regional states in southwestern Ethiopia. It is the most diverse region in the country in terms of culture, language and ethnicity. The SNNPRS border Kenya to the south and South Sudan to the southwest. There are five comprehensive specialized hospitals in the region namely; Wachemo University Nigist Eleni Comprehensive Specialized Hospital, Wolaita Sodo University Comprehensive specialized hospital, Worabe comprehensive specialized hospital, Wolkite university comprehensive specialized hospital and Dilla comprehensive specialized hospital from those we selected; -

Wolaita Sodo University comprehensive specialized hospital is located in Sodo town of Wolaita zone, which is 380 km away from the national capital of Addis Ababa. There are an estimated 293,910 under-five children concerning the study area location Wolaita Sodo University Teaching Referral Hospital, pediatric ward of this hospital has 19 patient beds in pediatric ward and 5 beds in pediatric ICU,16 nurses in pediatrics,2 nutritionist and 4 Doctors specialized in pediatrics.

Wachemo University Nigist Eleni Mohammad memorial comprehensive specialized hospital is located in Hadiya zone in SNNPR which is 232 kms far for Werabe m Addis Ababa, Ethiopia. It is one of the frontline hospitals in Ethiopia. The pediatric ward of this hospital has 23 patient beds. And Werabe comprehensive specialized hospital is found in silte zone. The town Werabe is located 172 kms south of Ethiopia’s capital, Addis Ababa. The pediatric ward of this hospital has 20 patient beds.

5.2. Study design

Multi-center institution based retrospective follow-up study was conducted

5.3. Population

5.3.1 Source population

All children aged 6-59 months with sever acute malnutrition admitted to stabilization centers in selected comprehensive specialized hospitals, SNNPRS, Ethiopia, 2023.

5.3.2 Study population

All selected children aged 6-59 months with severe acute malnutrition admitted to stabilization centers in selected comprehensive specialized hospitals, SNNPRS, Ethiopia, 2023

5.4 Eligibility Criteria

5.4.1 Inclusion criteria

All medical record of children aged 6-59 months admitted to stabilization centers in selected comprehensive specialized hospitals, SNNPRS with confirmed diagnosis SAM child from1st January,2019 to 30th December 2021.

5.4.2 Exclusion criteria

Records of children whose anthropometric data not completely registered, treatment outcome not recorded, and admission and discharge date not recorded, duplicated record and children with chronic illness with congenital anomalies was excluded from study

5 Sample size determination

The sample size was calculated using Epi-info version 7 statical software by considering factors like presence of dehydration ,vomiting, presence of shock and sepsis**(33, 55)**. The sample size was calculated by Using Epi info version7, one to one allocation ratio of exposed to non-exposed (1:1) was assumed. Finally, by using a 95% level of confidence, with a power of 80% the total sample size was Sepsis was considered as independent predictor since it produces a maximum sample size (644).

$$n_1 = \frac{\left[Z_{\alpha/2}\sqrt{\left(1+\frac{1}{r}\right)P(1-P)} + Z_{\beta}\sqrt{\frac{P_1(1-P_1)+P_2(1-P_2)}{r}}\right]^2}{(P_1-P_2)^2}$$

Table:1 The sample size calculation to identify predictors of mortality with severe acute malnutrition among children 6-59 months of age admitted in pediatric ward of selected compressive specialized hospitals, SNNPRS Ethiopia, 2023.

Variables	Assumptions	Proportion	AHR	Total sample size	After adding 10%
Presence of dehydration	CI=95% Power=80 Ratio =1:1	P1=3.4 P2=7.1	3.94	278	306 (33)
Vomiting	//	P1= 5.3 P2= 41.5	1.6	286	315 (55)
Presence of shock	//	P1= 3.4 P2= 7.1	4.15	218	240 (33)
Sepsis	//	P1= 1.8 P2= 5.9	2.9	586	644 (55)

Where, AHR=adjusted hazard ratio

P1=% outcome in exposed group

P2 = % outcome in unexposed group

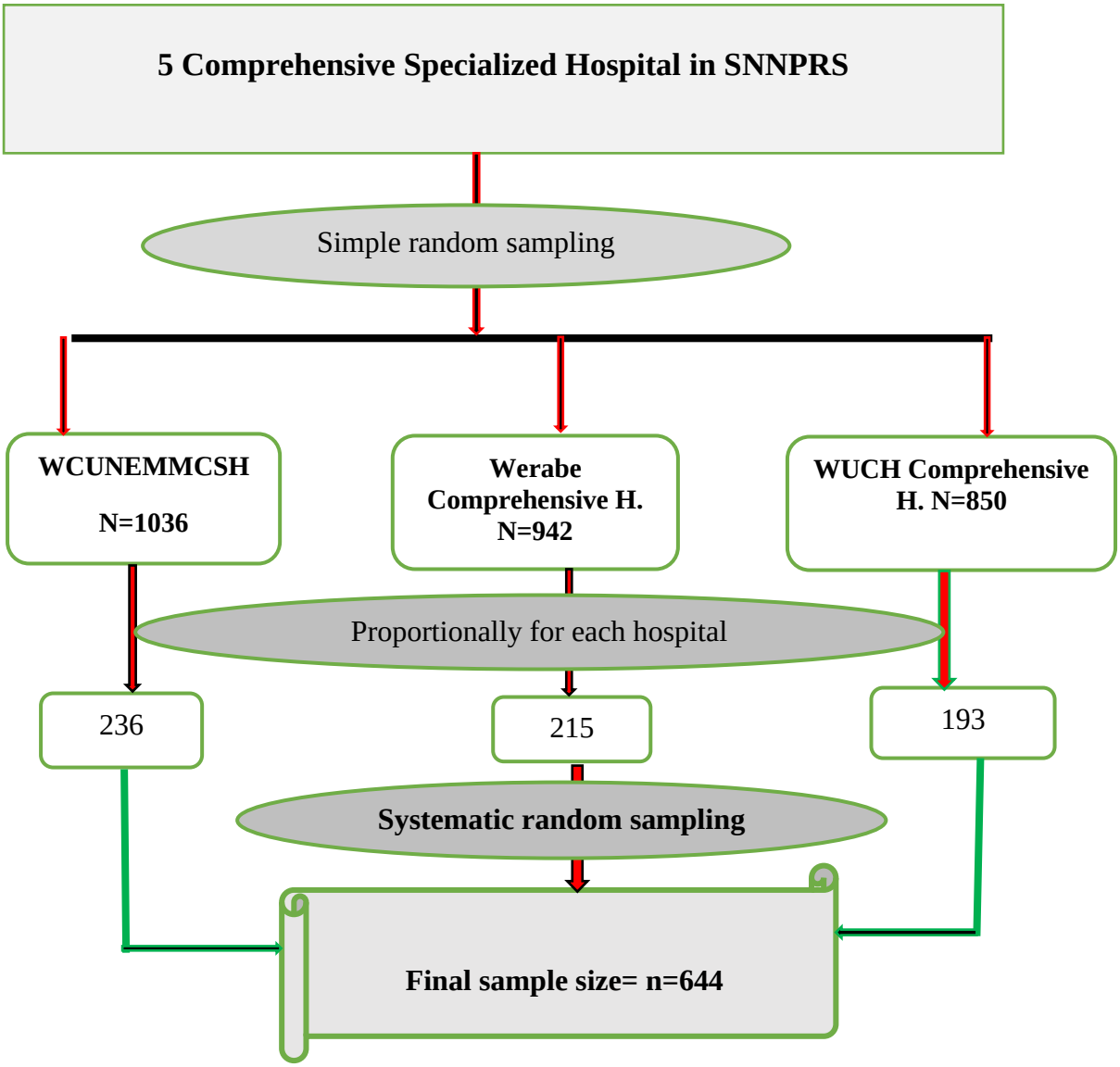
Therefore, the minimum required sample size required for this study is 644

5.6 Sampling procedure

First, by using simple random sampling 3 comprehensive specialized hospitals was selected out of 5 comprehensive specialized hospitals. The selected hospitals are Wachemo University Nigist Eleni comprehensive specialized hospital, Wolaita Sodo university comprehensive specialized hospital and Werabe comprehensive specialized hospital. For record reviews, three consecutive years, January 2019 to December 2021 was chosen deliberately because they provide the latest data on the issue under investigation.

By calculating the interval from the sampling frame, the total sample size for each year was proportionally allocated for Wachemo University Nigist Eleni comprehensive specialized hospital (WUNEMMCSH,) N=1036, Wolaita Sodo university comprehensive specialized hospital (WSUCSH), N=942 and Werabe comprehensive specialized hospital (WUCSH,) N=850 the interval was calculated as (k=N/n) while N=2828 and sample size n=644.

The interval (k=2828/644=4) so the data was collected every 4th chart which is similar for each hospital. The first chart to start was selected randomly 1-4. Then, every 4th medical chart within the three consecutive years was reviewed using systematic random sampling.



Figer: 2 Schematic presentation of sampling procedure to assess survival Status and Predictors of mortality with severe acute malnutrition among children 6-59 months of age admitted in pediatric ward of Comprehensive Specialized Hospital in SNNPRS, Ethiopia 2023.

5.7. Study variable

5.7.1 Dependent variable

Survival status (death)

5.7.2 Independent variables

- Socio-demographic characteristics: Age, sex and place of residence
- Baseline anthropometry**:** MUAC**,** WFH
- Co-morbidity**:** HIV**,** Pneumonia**,** Diarrhea**,** Malaria, TB and Sepsis
- Clinical condition**:** Vomiting, level of consciousness, anemia, shock, hypoglycemia, dehydration, altered body temperature and skin lesion Oxygen saturation Chest indrawing Fast breathing and bilateral pitting oedema
- Therapeutic feeding and medications**:** ReSomal, F75/F100/RUTF, Oral antibiotics, Deworming, NG tube feeding, IV fluid, IV antibiotics and Blood transfusion

5.8 Operational Definitions of variables

Severe acute malnutrition (SAM): defined as a weight for height/length <–3 Z-score of the WHO growth standard, and/or MUAC of less than 11.5 cm, or the presence of bilateral pitting oedema**(33)**

Cured: patient that has reached the discharge criteria with nutritional improvement(62).

Death: child that has died whiles h/she was in the program at stabilization center (62).

Survival time: defined starting point/from admission of under-five children diagnosed with SAM to TFU up to the occurrence of the event (63).

Survival status: Is the outcome of severe acute malnourished children either death or censored (63).

Censored: lack of experience of death(34)

Length of stay: The number of days that sever acute malnutrition children stayed in the hospital from admission until discharge (64)

Time period; - The time from the beginning of the study (1st January 2019) to an event, the end of the study (30th December 2021).

Medication: routine antibiotic (amoxicillin, deworming) and special medication (IV fluid, IV antibiotics, blood transfusion)(65)

Very severe anemia: If the hemoglobin concentration is less than 4g/dl or the packed–cell volume is less than 12% the child has very severe anemia(66)

5.9 Data collection procedure

5.9.1 Data collection tool

A data abstraction format was adopted from another peer-reviewed article conducted in Ethiopia(33, 38, 67) and contains six parts; a checklist related to socio-demographic information, anthropometric characteristics and child comorbidities information. therapeutic feeding and medication, clinical condition and type of malnutrition which was collected from medical records.

5.9.2 Data collection procedure

All available information on patient records was checked in the selected compressive specialized hospitals from January 2019 to December 30, 2021, and was retrieved from the inpatient Health Management Information System (HMIS) registry book. The time from the diagnosis of SAM was the starting point for retrospective follow-up and the end-point is the date of recovery, the date of loss to follow-up or censored (improved, referred, or against medical treatment), or the date of death.

All SAM charts admitted to the selected three hospitals from January 1, 2019 to December 30, 2021, were checked from the HMIS registration book and medical records. The records of all study participants were selected according to the eligibility criteria. Death was confirmed by death summary note complemented by registration and was identified by their medical record number. Three BSC nurse for supervision and three BSC Nurse for data collection was available. One day training was given to data collectors and supervisors regarding the significance of the study and ways of the data collection process and supervisors monitor the data collection process.

5.10. Data Quality Control

To ensure the quality of the data, the supervisor and data collectors were trained on how and what information they should collect from the targeted data sources. Before data collection, the data extraction form was pre-tested on 5% (30 charts) with severe acute malnutrition at Wilkeite University comprehensive specialized hospital before data collection to ensure that the data abstraction format is consistent with study requirements. Completeness of the collected data was checked on-site daily basis during data collection and give prompt feedback by the supervisor and investigator. During data management, storage, cleaning, and review, all completed data collection forms were checked for completeness and accuracy.

5.11. Data processing and analysis

The data was coded and then enter into Epi-data version 4.6 software then exported to STATA version 14 for analysis. Percentages and frequencies were used to summarize categorical variables. Results were also presented in text, tables, and graphs based on the type of variable Microsoft Excel was used to construct the graph. The outcome of each participant was dichotomized into censored "0" or "1" & Incidence density rate (IDR) was calculated for the entire study period. The Kaplan Meier estimator and log-rank tests, applied to describe survival functioning and compare survival curves. Survival time was calculated as the time between the dates of admission to the date of death.

Proportional hazard regression assumption was checked using Schoenfeld's residual test with variables having p-values greater than 0.05 being considered as fulfilling the assumption. To investigate predictors of mortality, data were analyzed by Cox proportional hazard model. Hazard ratio (HR), 95% CI, and P-value was used to assess the strength of association and statistical significance, Variables significant at $P < 0.25$ level in the bivariable analysis was entered in the final Cox-regression analysis to identify independent predictors of mortality. Finally, statistical significance was declared at p-value < 0.05.

5.12. Ethical considerations

Ethical clearance was obtained from post graduate office of Asrat Woldeys, Health Science Campus, on behalf of the institutional ethical review board of Debre Berhan University. An Official permission letter was obtained from each comprehensive hospital. All information collected from patients' cards was kept strictly confidential

6. Result

6.1 Socio-demographic and Anthropometric Characteristics SAM Children

Out of the total of 644 selected SAM records, 622 patient cards were extracted with their necessary information, with a retrieval rate of 96.58%, while the remaining 22 (3.41%) records were incomplete with treatment results. Majority of admitted children 342 (55.0%) were male. Nearly half of (48.6%) children admitted were aged between 6 and 23 months, with a mean age of 23.9 month (SD=15.7) a minimum age of six months and a maximum age of 56 months. Concerning MUAC of study participant, the majority (76.2%) were<11.5cm and three –fourth (75.6%) of children fell in to <-3Z score of weight for height (Table 3)

Table: 3 Socio-demographic and anthropometric Characteristics SAM 6-59 months of age admitted in pediatric ward in selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622).

Variables	Category	Frequency (%)	Survival status	
			Died N (%)	Censored N (%)
	6 -23month	302(48.6)	46(51.69)	256(48)
Age	24-41month	190(30.5)	16(17.98)	174(32.6)
	42-56 month	130(20.9)	27(30.33)	103(19.4)
Sex	Male	342(55.0)	52(58.4)	290(54.4)
	Female	280(45.0)	37(41.6)	243(45.6)
Residence	Urban	126(20.3)	14(15.7)	112(21.01)
	Rural	496(79.7)	75(84.3)	421(78.9)
MUAC	<115mm	474(76.2)	66(74.1)	408(76.5)
	115 to <125mm	101(16.2)	13(14.6)	88(16.6)
	≥125mm	47 (7.6)	10(11.3)	37(6.9)

Weight-for height	<-3Z score	470(75.6)	66(74.2)	404(75.7)
	-3 to < -2Z score	100(16.1)	11(12.3)	89(16.7)
	-2 to <-1 Z score	52 (8.40)	12(13.5)	40(7.6)

6.2 Clinical Profile and Admission status

More than half of (51.4%) of children were hospitalized due to the diagnosis of marasmus, and 97(15.6%) of the study participants presented with shock. Regarding admission status, most of the participants (59.5%) were newly admitted. More than half (54.0%) of children presented with vomiting and 88 (14.1%) of children had a changed degree of consciousness. About 177 children (28.5%) experienced skin lesions, while 125 children (20.1%) had hypoglycemia. With regard to appetite test, 390 (62.7%) of the study's participants passed the appetite test (Table 4).

Table: 4 Clinical Profile and Admission status of SAM children with 6-59 months of age admitted in pediatric ward in selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622).

			Survival status	
Variables	Category	Frequency (%)	Died N (%)	Censored N (%)
Types of SAM	Kwashiorkor	181(29.1)	38(42.7)	144(26.83)
	Marasmus	320(51.50)	34(38.2)	284(53.66)
	Marasmic-Kwashiorkor	121(19.5)	17(19.1)	105(19.51)
Presence of edema	Yes	287(46.1)	48(53.93)	287(53.85)
	No	335(53.9)	41(46.07)	246(46.15)
Type of admission	New admission	370(59.5)	51(57.3)	319(59.85)
	Readmission	252(40.5)	38(42.7)	214(40.15)
Vomiting	Yes	336(54)	51(57.3)	285(53.47)
	No	286(46)	38(42.7)	248(46.53)

Level of consciousness	Altered	88 (14.1)	22(24.72)	66(12.38)
	Normal	534(86.9)	67(75.28)	467(87.62)
Presence of shock	Yes	97(15.6)	27(30.34)	70(13.13)
	No	525(84.4)	62(69.66)	463(86.87)
Axillary body temperature	<35°C	13 (2.1)	5(5.62)	8(4.88)
	35 to 37°C	361(58)	56(62.92)	305(53.85)
	>37°C	248(39.9)	28(31.46)	220(41.27)
Presence of dehydration	Yes	282(45.3)	49(55.06)	233(43.71)
	No	340(54.7)	40(44.94)	300(56.29)
Presence of cough	Yes	333(53.5)	60(67.42)	273(51.22)
	No	289(46.5)	29(32.58)	260(48.78)
Oxygen saturation	≥90%	396(63.7)	43(48.31)	353(66.23)
	<90%	226(36.3)	46(51.69)	180(33.77)
Chest indrawing	Yes	149(24.0)	25(28.09)	124(23.26)
	No	473(76)	64(71.91)	409(76.74)
Presence of skin lesion	Yes	177(28.5)	35(39.33)	142(26.64)
	No	445(71.5)	54(60.67)	391(73.36)
Presence of hypoglycemia	Yes	125(20.10)	23(25.84)	102(19.14)
	No	497(79.90)	66(74.16)	431(80.86)

6.3 Comorbidity and complication status

The most prevalent comorbidity affect severely malnourished children was diarrhea 281 (45.2%) of severely undernourished children. about 32 (5.1%) of the study's participants had HIV seropositive status and 123 (19.8%) children were developed pneumonia at the time of admission. 82 (13.2%) of children experienced severe anemia complications. (Table5).

Table: 5 Comorbidity and complication status of SAM children with 6-59 months of age admitted in pediatric ward selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622).

Variables	Category	Frequency (%)	Survival status	
			Died N (%)	Censored N (%)
HIV status	Reactive	32(5.2)	3(3.37)	29(5.44)
	Nonreactive	590(94.9)	86(96.63)	504(95.6)
TB	Present	42(6.7)	0	42(6.75)
	Absent	580(93.3)	89(100)	491(92.12)
Pneumonia	Present	123(19.8)	19(21.35)	80(15.01)
	Absent	499(80.2)	70(78.65)	453(84.99)
Malaria	Present	31(5.0)	8(8.99)	23(4.32)
	Absent	591(95.0)	81(91.01)	510(95.68)
Diarrhea	Present	281(45.2)	39(43.82)	242(45.40)
	Absent	341(54.8)	50(56.18)	291(54.6)
Anemia	Present	82(13.2)	18(20.22)	64(12.01)
	Absent	540(86.8)	71(79.78)	469(87.99)
Sepsis	Present	166(26.69)	36(40.43)	130(24.39)
	Absent	456(73.31)	53(59.57)	403(75.61)

6.4 Therapeutic feeding, Routine and Special Medication Provision

Concerning immunization status of study participants, one-third of children (33.9%) were fully vaccinated. Two-thirds of children, (66.4%) were treated with ReSoMal and 256(41.2%) of children take vitamin A supplementation. Likewise, 247(39.7%) of children admitted were folic acid supplemented and 376(60.5%) of children were dewormed by anti-helmets. Moreover, 435(69.5%) of children were treated with oral antibiotics medication and 58 (9.3%) of children were blood transfused (Table 5)

Table: 6 Therapeutic feeding and medication of SAM children 6-59 months of age admitted in pediatric ward in selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622)

Variables	Category	Frequency (%)	Survival status	
			Died N (%)	Censored N (%)
Immunization status	Fully vaccinated	211(33.9)	22(24.72)	189(35.46)
	Partially vaccinated	363(58.4)	57(64.04)	306(57.41)
	Unvaccinated	48(7.7)	10(11.24)	38(7.13)
ReSoMal	Yes	413(66.4)	52(58.43)	361(67.73)
	No	209(33.6)	37(41.57)	172(32.27)
Vitamin A supplementation	Yes	256(41.2)	27(30.34)	229(42.96)
	No	366(58.8)	62(69.66)	304(57.04)
Folic acid supplementation	Yes	247(39.7)	29(32.58)	218(40.90)
	No	375(60.3)	60(67.42)	315(59.1)
Dewormed by anti-Helminthes	Yes	376(60.5)	54(60.67	322(60.41)
	No	246(39.5)	35(39.33)	211(39.59)
Oral antibiotic intake	Yes	435(69.5)	64(71.91)	371(69.61)
	No	187(30.1)	25(28.09)	162(30.39)
F 75 intake	Yes	612(98.4)	86(96.63)	526(98.69)
	No	10(1.6)	3(3.37)	7(1.31)
F 100 intake	Yes	529(85)	64(71.91)	422(79.17)
	No	93(115)	25(28.09)	111(20.83)
Iron	Yes	194(31)	29(32.58)	232(43.53)
	No	428(68.8)	60(67.42)	301(54.47)
IV fluid	Yes	191(30.7)	50(56.18)	141(26.45)
	No	431(69.3)	39(43.82)	392(73.55)
NG tube feeding	Yes	270(43.4)	64(71.91)	206(38.65)
	No	352(56.6)	25(28.09)	327(61.35)
Treated with IV antibiotics	Yes	533(85.7)	81(91.01)	452(84.80)
	No	89(14.3)	8(8.99)	81(15.2)
Blood transfusion	Yes	58(9.30)	16(18)	42(8)
	No	564(90.7)	73(82)	49(92)

6.5 Survival Status and Treatment Outcome of Children Admitted With SAM

A total of 622 severely malnourished children followed for 6834 days. The incidence rate of mortality was calculated using cases/day as a denominator for the entire cohort. The overall incidence rate of mortality among SAM children in the cohort was 13 cases per 1000 children per days. The median time of children to death for the entire cohort was found to be 10 days person day of observation Majority (71.5%) of children had got cured and discharged, 89 (14.3%) had died during follow up periods, 71(11.4%) had defaulted and left the TFU before completing their treatment. The remaining of 17(2.7%) children transferred to other health care facility in order to complete their treatment.

Median time for occurrence of event(death) was 10 days. The average length of hospital stay was 11days with the standard deviation of 6.20 and the minimum stay one day and maximum hospital stay was 35 days. The cumulative survival rates at end of 1st, 2nd and 3rd, weeks were 94.5% (95%CI: 92.28,96.10%), 83.5(95%Cl:79.46,86.79%) and 71.4(95%, CI: 64.42,77.33) respectively and the overall survival time was 28 days (95%, CI: 26.33, 29.73).

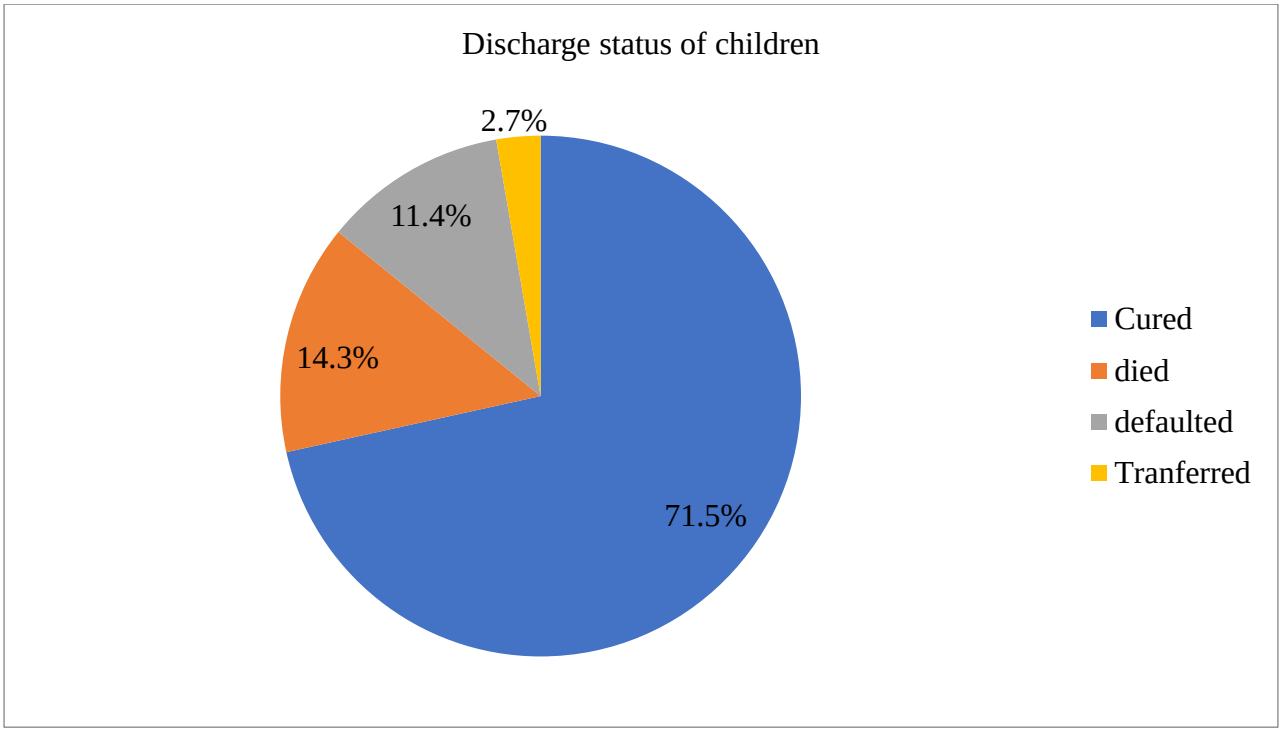


Figure: 1 Treatment outcome among severely malnourished children aged 6-59 month admitted stabilization center in selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622)

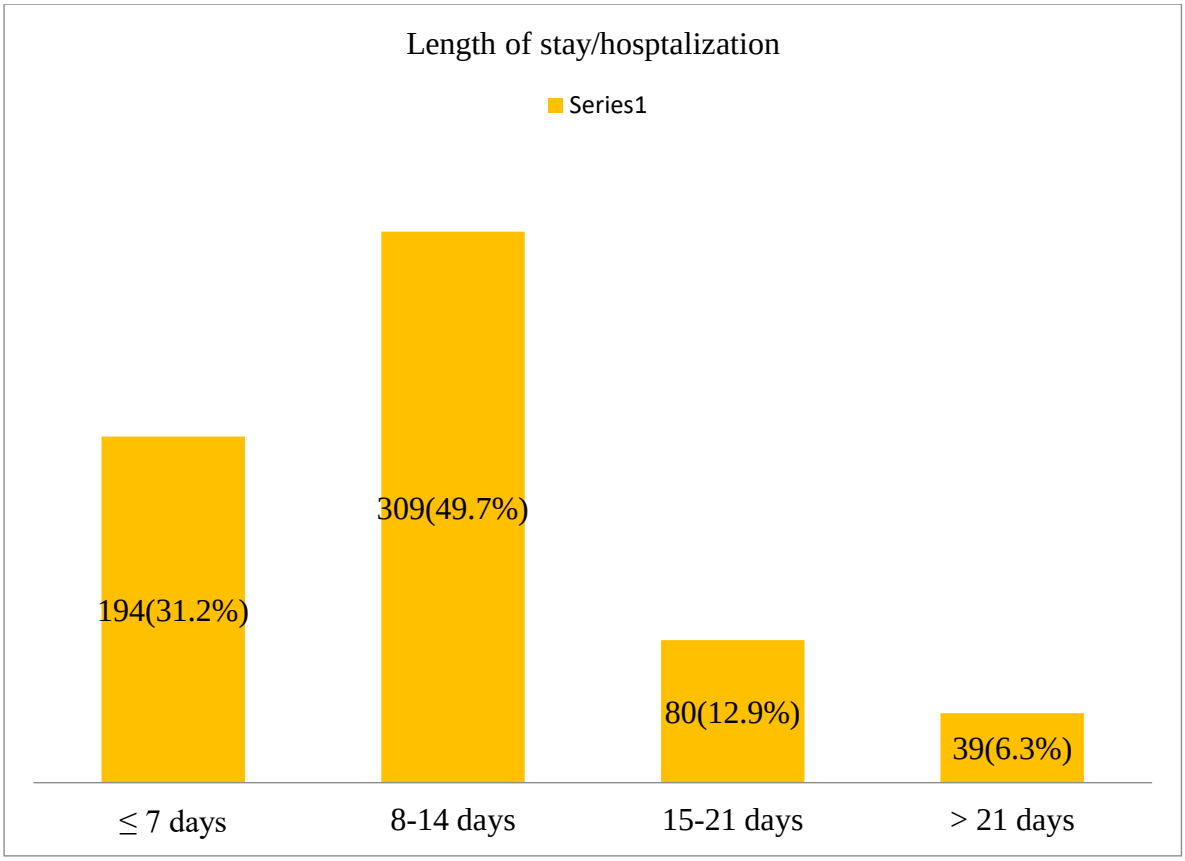
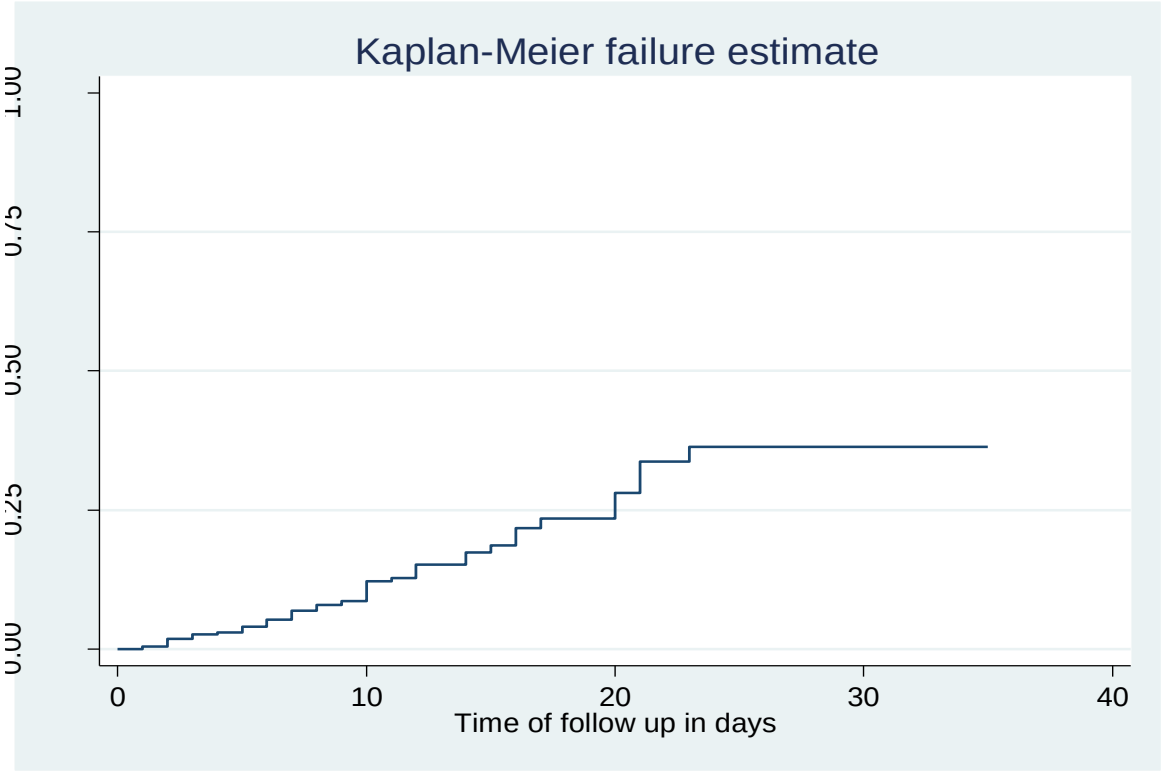


Figure:2 Length of hospitalization among SAM children 6-59 months of age admitted in pediatric ward selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622)

Table:7 Life table probability estimate of death at different time intervals among severely malnourished children aged 6-59 months

Intervals	Beginning total	Death	Lost	Survival	95%CI
0-7	622	31	116	0.945	0.9228,0.9610
7-14	475	39	281	0.8349	0.7946,0.8679
15-21	155	15	102	0.7144	0.6442,0.7733
21-28	38	4	11	0.6265	0.5197,0.7160
28-35	23	0	18	0.6265	0.5197,0.7160
35-42	5	0	5	0.6265	0.5197,0.7160



Figer: 4 Overall Kaplan Meier failure estimate survival among SAM children's aged 6-59 month admitted in SNNPRS comprehensive specialized hospital, Ethopia,2023

6.6 Mean survival time estimate among under-five children in stabilization center

There was a significant mean survival time difference among children with shock 16 days, (95%CI=14.4596,17.634) and without shock, 29 days (95% CI=27.5682,30.711) and children with NG tube feeding 17 days(95% CI=16.2918,17.938) and not NG tube feeding 31.4 days (95%CI=29.8085,32.977) .And also the analysis showed significantly different mean survival time among blood transfusion,23 day (95%CI=18.8172,27.007) and who don't 28 days (95%CI=25.976,29.486) and who were treated with ReSoMal 28.2 days (95%CI=26.27,30.1174) and don't talking ReSomal 25.7 day(95%CI=22.907,28.406) and children with anemia was 26.6 (95%CI=23.123,30.039) no significantly different mean survival time among children who don't 26.6(95%CI=24.6964,28.412).

Table: 8 Mean survival time and log-rank test among severely malnourished children admitted in stabilization center in selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622)

Variables	Category	Mean survival times	95%CI	Log rank X^{2} -	P-value
ReSoMal	Yes	28.1942	26.27,30.1174	4.40	0.0360
	No	25.657	22.907,28.406		
Treated with iv antibiotics	Yes	26.916	25.076,28.756	3.15	0.0761
	No	20.371	19.313,21.429		
Type of admissions	New	27.8382	25.927 ,29.748	2.3	0. 1268
	Re-admission	25.845	22.761,28.927		
TB	Yes	35	33.31,37833	6.84	0.0089
	No	26.93	25.1837,28.676		
Anemia	Yes	26.581	23.123,30.039	5.01	0.0252
	No	26.5542	24.6964,28.412		
Blood transfusion	Yes	22.912	18.8172,27.007	10.21	0.0014
	No	27.730	25.976,29.486		
Presence of Shock	Yes	16.0472	14.4596,17.634	20.72	0.000
	No	29.1396	27.5682,30.711		
Type of SAM	Kwashiorkor	18.57262	17.3786,19.766	8.77	0.012
	Marasmus’	28.9647	26.8338,31.095		
	Marasmus-kwashiorkor	18.6343	17.598, 19.670		
NG tube feeding	Yes	17.115	16.2918,17.938	33.55	0.000
	No	31.39	29.8085,32.977		

6.7 Testing proportional hazard assumption,

In this study goodness-of-fit (GOF) was checked by statistically. Schoenfeld residuals proportional hazard assumption test for each covariate and the global test was used. If P-value is <0.05 the assumption is rejected. The table below shows each covariant P-value is >0.05 and the global test P-value is 0.2197 the result shows proportional hazard assumption was met. Therefore, we would conclude that the proportional hazard assumption was met.

Table: 8, Schoenfeld residual test for proportional assumption of each covariant and overall Cox proportional hazard model.

Variables	Rho	Chi^2	P-value
Type of admission	0.00440	0.01	0.9623
Presence of edema	0.04227	0.21	0.6487
Presence of vomiting	0.26928	6.13	0.0133
Level of consciousness	0.19740	4.11	0.0425
Presence of shock	0.17332	3.21	0.0732
Body temperature	0.01177	0.01	0.9065
Admission hemoglobin	0.06657	0.44	0.5084
Presence of dehydration	0.16867	2.49	0.1146
Presence of coup	0.11365	1.18	0.2779
Presence of skin lesions	0.28018	8.82	0.0030
Oxygen saturation	0.17009	2.39	0.1221
Chest in drawing	0.01394	0.02	0.8911
Diarrhea	0.02770	0.07	0.7862
Anemia	0.08430	0.51	0.4760
Sepsis	0.02714	0.07	0.7977
Immunization status	0.02789	0.07	0.7868
ReSoMal	0.10064	1.22	0.2694;
Vitamins a supplement	0.23897	5.57	0.0183

Folic acid supplement	0.03048	0.10	0.7560
Deworm by anthelmint	0.02359	0.07	0.7949
Oral antibiotic intake	0.05857	0.38	0.5397
F75 intake	0.01279	0.01	0.9056
F100 intake	0.00079	0.00	0.9943
Iron supplement	0.09293	0.85	0.3578
Ng tube feeding	0.01516	0.02	0.8863
Treated with iv antibiotics	0.15621	1.93	0.1653
Global test |	36.75	31	0.2197

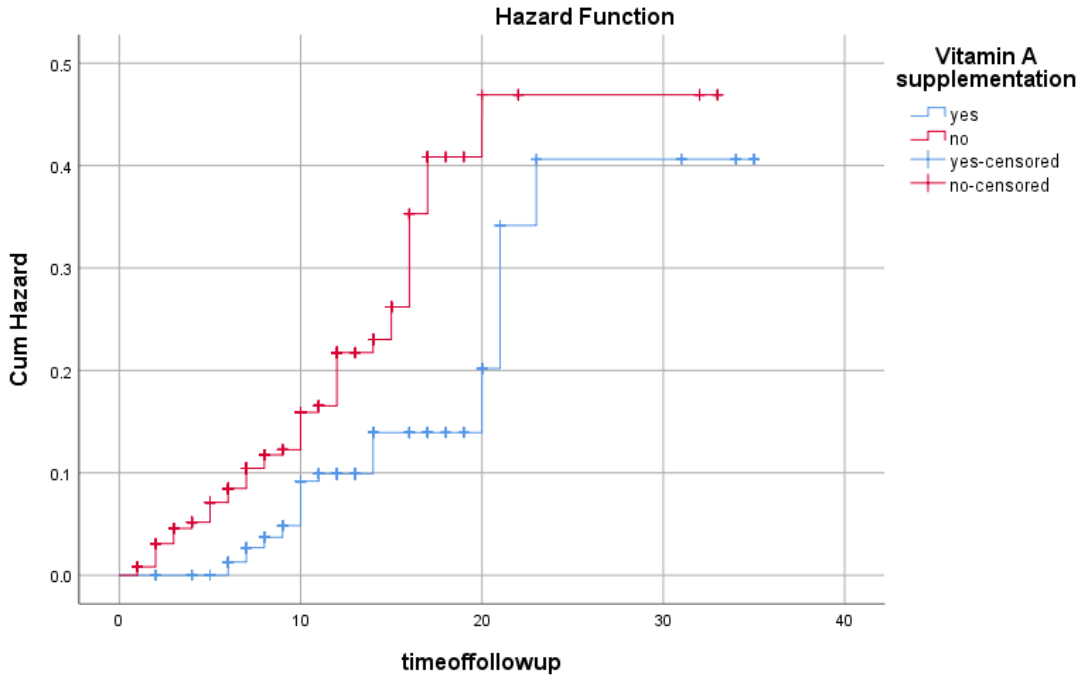
Rho: is the correlation coefficient between the residuals and time

6.8 Factors associated with mortality among Children Admitted With SAM

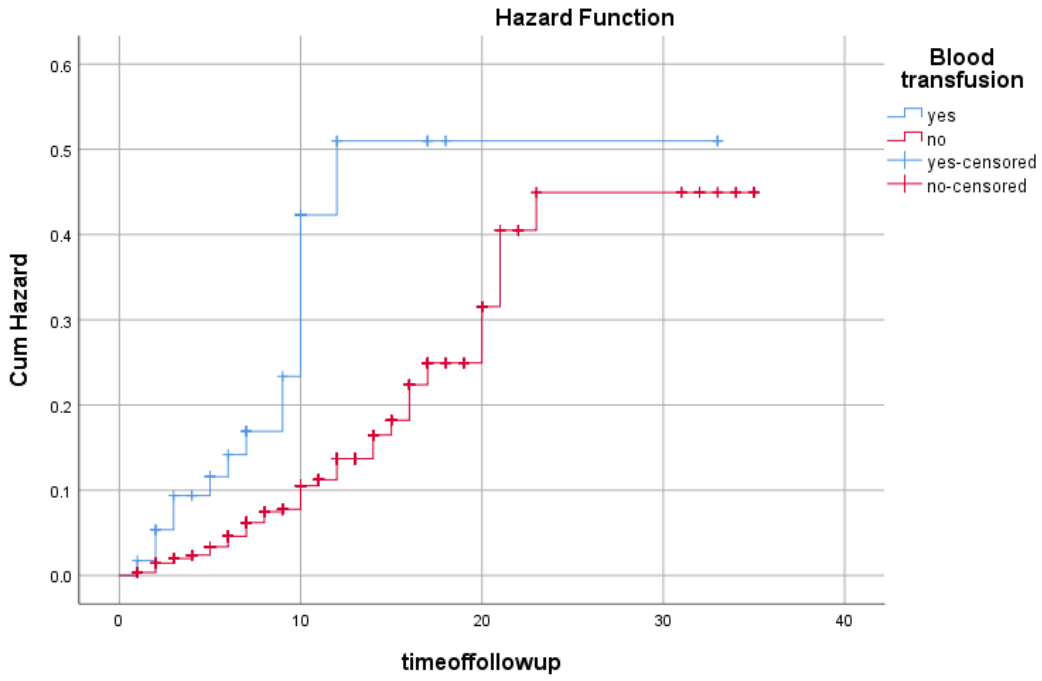
Different variables were evaluated with bivariable cox-regression analysis. Therefore, types of SAM, weight for height, types of admission(readmission), level of consciousness, presence of shock, presence of dehydration, oxygen saturation, Having chest indrawing, presence of skin lesion, Presence of hypoglycemia, presence of pneumonia, presence of malaria, anemia, sepsis ,immunization status, vitamin A supplementation, folic acid supplementation, F100 intake , IV fluid administration, NG tube feeding, IV antibiotic treatment and blood transfusion were all candidate variables with p values of less than 0.25 fitted into multivariable cox-regression model. However, on multivariable analysis, types of admission(readmission), presence of shock, immunization status, vitamin A supplementation, NG tube feeding and blood transfusion were found to be significantly associated with incidences of death among SAM children.

The hazard of death was 2.17 times more likely in SAM children who readmitted compared with newly admitted AHR: 2.17(1.20-3.90). The hazard of death was 2.11 times in SAM children with shock compared with those SAM children without shock AHR: 2.11(1.04-4.27). The hazard of mortality was 2.12 times higher in SAM children with partial immunization histories compared with fully immunized children AHR: 2.12(1.00-4.49).

Children with SAM who did not take vitamin A supplements had a 3.06-times higher risk of dying than their counterparts AHR:3.06(1.37-6.85). The risk of death was 2.61 times more common in SAM children who were treated with NG- tube feeding as compared to with those not treated with NG-tube feeding AHR:2.61(1.23-5.53). The risk of death was 2.22 times more likely in SAM children who had blood transfused in comparison with children who had not had blood transfused AHR:2.22(1.06-4.65).



Figer: 5 Cox-regression plots of hazard function show the difference in hazard of death among children with severe acute malnutrition those Vitamin supplementations with admitted in paediatric ward in selected comprehensive specialized hospitals, SNNPRS, Ethiopia ,2023



Figer:6 Cox-regression plots of hazard function shows the difference in hazard of death among children with severe acute malnutrition those with blood transfused admitted in paediatric ward in selected comprehensive specialized hospitals, SNNPRS, Ethiopia ,2023

Table: 9 Cox proportional hazard regression analysis for determinant of mortality among SAM children with 6-59 months of age admitted in pediatric ward in selected comprehensive specialized hospitals, SNNPRS, Ethiopia 2023 (N=622)

		Survival status				
Variables	**Category**	Died	Censored	**CHR (95%CI)**	**AHR (95%CI)**	**p-value**
Type of SAM	Marasmus'	38	143	1.98(1.24,3.15)	1.68(0.96,2.94)	0.06
	Marusic-Kwashiorkor	17	104	1.28(0.71,2.31)	0.72(0.31,1.68)	0.45
	Kwashiorkor'	34	286	1	1	
Weight-for height	<-3Z score	66	404	0.72(0.39,1.35)	0.93(0.33,2.62)	0.90
	-3 to < -2Z score	11	89	0.40(0.17,0.91)	0.39(0.12,1.24)	0.11
	-2 to <-1 Z score	12	40	1	1	
Admission type	New- admission	51	319	1	1	

	Re-admission	38	214	1.38(0.90,2.12)	**2.17(1.20,3.90)**	**0.01***
Level of consciousness	Altered	22	66	1.64(0.99,2.20)	1.29(0.64,2.59)	0.47
	Normal	67	467	1	1	
Presence of Shock	Yes	27	70	2.97(1.88,4.69)	**2.11(1.04,4.27)**	**0.03***
	No	62	463	1	1	
Presence of Dehydration	Yes	49	233	1.53(1.00,2.34)	1.35(0.77,2.37)	0.28
	No	40	300	1	1	
Oxygen saturation	≥ 90%	43	353	1.73(1.13,2.62)	1.28(0.71,2.30)	0.39
	<90%	46	180	1	1	
Chest indrawing	Yes	25	124	1.56(0.98,2.48)	0.73(0.38,1.41)	0.35
	No	64	409	1	1	
Skin lesion	Yes	35	142	1.45(0.94,2.25)	1.61(0.81,3.20)	0.17
	No	54	391	1	1	
Hypoglycemia	Yes	23	102	1.40(0.87,2.26)	1.58(0.79,2.68)	0.14
	No	66	431	1	1	
Pneumonia	Yes	19	80	1.59(0.95,2.65)	0.88(0.45-1.73)	0.72
	No	70	453	1	1	
Malaria	Yes	8	23	2.78(1.33,5.81)	1.46(0.47-4.52)	0.51
	No	81	510	1	1	
Anemia	Yes	18	64	1.79(1.06,3.02)	0.92(0.37-2.30)	0.86
	No	71	469	1	1	
Sepsis	Yes	36	130	2.07(1.35,3.17)	1.18(0.62-2.28)	0.60
	No	53	403	1	1	
Vaccination status	Fully vaccinated	22	189	1	1	
	Partially vaccinated	57	306	1.62(0.99,2.65)	**2.12(1.00,4.49)**	**0.04***
	Unvaccinated	10	38	2.74(1.29,5.82)	0.77(0.29-1.99)	0.59
Vitamin A supplementation	Yes	27	229	1	1	
	No	62	304	2.07(1.31,3.27)	**3.06(1.37,6.85)**	**0.00***
Folic acid supplementation	Yes	29	218	1	1	
	No	60	315	1.73(1.10,2.70)	0.63(0.28-1.40)	0.26
F100 intake	Yes	64	422	1	1	

	No	25	111	1.76(1.10,2.80)	1.74(0.96-3.15)	0.06
IV fluid	Yes	50	141	2.89(1.89,4.42)	1.25(0.60-2.63)	0.54
	No	39	392	1	1	
NG-tube feeding	Yes	64	206	3.54(2.20,5.69)	**2.61(1.23,5.53)**	**0.01***
	No	25	327	1	1	
Treated with IV	Yes	81	452	1	1	
antibiotics	No	8	81	0.52(0.25,1.09)	0.33(0.10-1.02)	0.051
Blood	Yes	16	42	2.63(1.53,4.53)	**2.22(1.06,4.65)**	**0.03**
transfusion	No	73	491	1	1	

Note * is significant variables at P –value ≤ 0.05,). Crude hazard ratio (CHR) and Adjusted hazard ratio (AHR) show bivariate and multivariate model results. Categories labeled as 1 are references to the group categories.

6. Discussion

The survival status for sever acute malnutrition was 28 days with 95% (CI: 26.33, 29.73) in the follow up of 6834 days of observation and the cumulative survival rate in three consecutive weeks,94.5% ,83.5% and 71.4%. The median time of children to death for the entire cohort was found to be 10 days person day with (95%CI,8.31-11.37) of observation. Majority of (71.5%) children had got cured and discharged, 89 (14.3%) had died during follow up periods, 71(11.4%) had defaulted and left the TFU before completing their treatment. The remaining of 17(2.7%) children transferred to other health care facility in order to complete their treatment.

The current study show that the overall survival time was 28 days (95%CI: 26.33, 29.73) in the follow up of 6834 days of observation. However, it was higher than the study conducted in Zambia13 days(68), Sekota north Ethiopia 10 days (35) (35) and lower than study conducted in Jinka 38 days (51), Tigray 41.93 days (44), Gonder 69 days(45), Diredawa 69 days (69) in Gedo 79.6 days (16) and Northwest Ethiopia 69 days (45) . This discrepancy may occur due to different in hospital facility and hospital level, study setting differences, quality of service, study population differences, sociodemographic characteristics differences, staffed with health workers with specialty training and skills, difference in adherence of international SAM management protocol, severity of cases and comorbidity can cause this variation.

In this study revealed that the overall mortality of severe acute malnourished children was 89(14.3%) 95% CI (11.6-17.3) during chart review period. case fatality rate (14.3%) was unacceptably high when compared to the WHO standards that recommend less than 10% of death(70). This discrepancy could be a result of delay at presentation to stabilization centers, the occurrence of hospital acquired infection, presence and applicability of National treatment guideline. The finding is consistent with studies done in Bangladesh 13.7%(32) ,Gondar university 12.5%(61),Mekelle 12.8%(71),Dilla university referral Hospital 12.4%(72).The finding of this study higher than study conducted in ,Gedeo Zone 9.3%(53),Jimma University 9.3%(37),Diredawa7.6%(54), Wolaita Zone 8.8%(73). This variation could be due to study setting differences, quality of service among stabilization center and some institutional factors which could likely contribute to slow recovery rate include high staff turnover, high case load, lack of training, lack of quality assurance procedures, availability of medical supplies and poor ward infrastructure, including lack of isolated rooms for malnourished children(74, 75).

On the other hand, this finding is lower than a study done in South Africa 24.4%(76) and other study in Uganda 25.2%(77), Nigeria 40.1%(78), Ghana 17.5%(79) Ethiopia 28.67% (62). this might be due to differences, study period, study population, study setting and difference on sample size.

The finding of this study showed that the mean duration of hospital stay was 11 days with (95%CI 9.42-13.33). This finding was acceptable as compared with minimum international Sphere and national standard set for management of severe acute malnutrition of less than 30 days, the study inline within Diredawa 10 day(18),Wolaita 11days (55). Lower than the study conducted in, Gedeo zone 13 days(16) India 14.2 days(80) and Dilla 15 days (81).Thise discrepancy occurred because of different adherence in management protocols, Difference in follow up periods , different in severity of complications /comorbidities, study population, study setting and skilled and trained staff availability .

In this study, children with history of re-admission were two point one seven times the hazard of death as compared with newly admitted children. which was similar to studies at Hadiya zone and Amhara region Northwest Ethiopia, (60, 82, 83) child may experience more than one episode of SAM, depending on the improvement of the underlying factors during inpatient treatment but if re-admitted with a relapse, then the risk of death is doubled and risk for infection and resistances for medication. (83).

Those children with shock were two point one times the hazard of death as compared with counterpart. This is consistent with other studies conducted in Gondar, Addis Ababa, Jinka, (25, 51, 58, 84),Dilla 15%(72) and Gedeo (53). The similarities between these study findings indicate that experiencing shock can greatly affect the death rate among SAM patients. This is because children with SAM are highly at risk of shock secondary to severe infections and diarrheal disorders, which can produce either hypovolemic or septic shocks. Besides, acute sepsis and diarrheal illnesses in malnourished children could be related to insufficient cardiac reserves, leading to shock, which leads to mortality(85).

Regarding vaccination status, partially vaccinated children admitted with severe acute malnutrition were more likely to die as compared to the counterpart. The finding of this study supported by study conducted Gedio Zone, 80% times risk of death than fully vaccinated, according to a study at Bahir Dar (56, 85). This might be due to those children who were not vaccinated and lack protection from vaccine preventable diseases in combination with malnutrition death.

This might be due to those children who were not vaccinated and lack protection from vaccine preventable diseases in combination with malnutrition. The findings of this study are in agreement with Sekota Hospital, Afar regional state (60, 62, 86-88). Vitamin A is necessary for the integrity of epithelial cells in the body as well as the maintenance of immunological function. Therefore, vitamin A is vital to combat infections and the risk of disease and mortality from childhood infections.

SAM children with NG tube feeding were two point six times the hazard of death when compared to SAM children without NG tube. This finding is consistent with a study done in Gedeo Zone, Gonder, Adis Ababa (11, 18, 58, 61, 89, 90). This might be due to the Presence of a Nasogastric tube indicates that the child is unable to feed himself or herself consciously. Children who use NG tubes are more likely to get illnesses and infections, necessitating careful medical monitoring for a better clinical outcome. In addition, NG tube feeding in the presence of other complications increase SAM children risk of death by 26%(18) this can be related to aspiration, medication related complications tube insertion produces electrolyte abnormalities largely due to fluid retention and dysfunction of many organs and systems, which can result in mortality and occasionally death.

Children who received blood transfusions had a two point two times higher risk of dying than those who did not. This finding is consistent with earlier research in Dilla, Sekota(35, 81) South Africa(91, 92), Uganda(93) and Jimma(37). This could be the result of fluid overload from inappropriate use of transfusions and infusions, transfusion associated sepsis, anaphylaxis reaction, hypothermia, inappropriate unnecessary under delayed transfusion, systemic failure and human factors.

7.Conclusion

The mortality rate for severely malnourished children was higher than acceptable levels for global SPHERE standard and national protocol. The presence of shock, immunization status, vitamin A supplementation, NG tube feeding and blood transfusion were found to be significantly associated with incidences of death among SAM children. Special attention should be given to those children with identified factors during treatment.

8. Recommendations

The finding presented that, there is a need to improve child survival and decreased in mortality from sever acute malnutrition; efforts have to be made to improve SAM management practice.

SNNPRS Compressive specialized Hospital Health workers

- Need proper adhering to routine regimens based on national management protocol to reduce early death below current level and to assure better recovery.
- Close follow up and management cases with special care for SAM children with altered clinical conditions like anemia, shock and dehydration that cause most children death at stabilization.
- Give emphasis while giving NG tube feeding for SAM children to prevent fluid overload

SNNPRS Comprehensive specialized hospital administrative

- With other NGO/stakeholders should put organizational efforts to improve SAM management practice.

Zonal health department

- Strengthening regular supervision and training on management of SAM aligned with national management protocol.
- Organized effort should be made at all levels with assigning clear responsibility to HEWs and community health workers along with strong supervision with follow up home visit and case findings before the development of medical complication
- Strengthening health education and promotion on child feeding practice.

Researcher

- To complement the limitations of this study, better to conduct further study using prospective study design

9. Strengths and Limitations of the Study

9.1 Strength of the study

Data were extracted with trained data collectors to reduce bias occur during data extraction by principal investigators. Records have been thoroughly evaluated and only those demand fit have been included in the study. Firstly, all the study variables were independently run in bivariate cox regression and those with P-value < 0.25 were used for the multivariate regression in subsequent models.

9.2 Limitation of the study

Since it is a retrospective study, it is difficult to add new variables to the study. Due to this, the data were retrospectively extracted from patients' medical records, and some relevant variables such as a history of family meals, maternal and paternal educational status, history of breastfeeding and maternal nutritional status were inadequately recorded.

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11.ANNEXES:

Data extraction form (Checklist)

The tools prepared for collecting information on survival status and predictors of mortality among under-5 children with severe acute malnutrition at stabilization center. All this information will be retrieved from individual patient card without mentioning the name of clients.

Contact information: **Shewakena Degefa** Cell phone, 0984910175

Data collection date----------

Name of data collector---------- signature----------

Name of supervisor----------signature----------

Code no----------

1	**Socio-demographic characteristics**	
101	Date of admission	_____/_____/_____(EC/GC)
102	Sex	1 male 2 females
103	Age on date of admission in months/years	----------
104	Residences	1 urban 2 rural
2	Admission and anthropometry	
201	MUAC	_____mm
202	Weight	_____kg
203	Height	_____cm
204	Weight for height	----------

205	Types of SAM	1 Marasmus 2 Kwashiorkor 3 Miasmic- Kwashiorkor
206	Presence of edema	1. yes 2. no
207	Type of admission	1. New admission 2. Relapse (readmission)
3 Clinical conditions		
301	Vomiting	1 Yes 2 No
302	Level of consciousness	1 altered 2 normal
303	Presence of shock	1 Yes 2 No
304	Axillary body temperature °C	----------°C
305	Admission hemoglobin (Anemia)	----------mg/dl
306	Presence of dehydration	1 Yes 2 No
307	Presence of cough	1 Yes 2 No
308	Presence of skin lesion	1 Yes 2 No

309	Presence of hypoglycemia	1 Yes 2 No
310	Appetite test	1 Pass 2 failed
4 **Co-morbidity**		
401	HIV Status	1. Reactive 2. Nonreactive
402	TB	1. Present 2. Absent
403	Pneumonia	1. Present 2. Absent
404	Malaria	1. Present 2. Absent
405	Diarrhea	1. Present 2. Absent
406	Anemia	1. Present 2. Absent
407	Others	
5 Therapeutic feeding and special medication given		
501	Immunization status	1 fully vaccinated 2 Partially vaccinated 3 Unvaccinated

502	ReSoMal	1 Yes 2 No
503	Vitamin A supplementation	1 Yes 2 No
504	Folic acid supplementation	1 Yes 2 No
505	Dewormed by anti-helmets	1 Yes 2 No
506	Oral antibiotic intake	1 Yes 2 No
507	F 100 intake	1 Yes 2 No
508	F75 intake	1 Yes 2 No
508	Iron	1 Yes 2 No
509	IV fluid	1 Yes 2 No
510	NG tube feeding	1 Yes 2 No
511	Treated with IV antibiotics	1 Yes 2 No

512	Blood transfusion	1 Yes 2 No
6 Discharge information		
601	Date of discharge	_____/_____/_____(EC/GC)
602	Length of hospital stay	_____days
603	End result /outcome/	1. Cured/discharged 2. Dead 3. Defaulter 4. Transferred 5. Research terminated