ZEMEN POST GRADUATE COLLEGE

DEPARTMENT OF PUBLIC HEALTH

Mortality and Morbidity Trends and Predictors of Mortality among Under-five Children with Sever Acute Malnutrition in Sekota, WAG Zone, North Ethiopia: A Hospital based retrospective cohort study

By: Barkot Tamiru

July 2022

Dessie, Ethiopia

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Advisor: Wolde Melese [BSc, MPH-FE, Assis.Prof]

A Thesis Proposal to be Summited to Department of Public Health, Zemen Post Graduate College in Partial Fulfilment of The Degree of Masters of General Public Health

July, 2022

Dessie, Ethiopia

DECLARATION

I the undersigned MSc student declare that a thesis work entitled ***Mortality and Morbidity Trends and Predictors of Mortality among Under-five Children with Sever Acute Malnutrition in Sekota, WAG Zone, North Ethiopia*** submitted to the Department of Public Health of Zemen Postgraduate College in partial fulfillment of the requirements for the award of the degree of ***Master of Arts in Public Health*** is a record of original work done by me during this academic year under the supervision and guidance of _**Wolde Melese [BSc, MPH-FE, Assis.Prof.]** and it has not formed the basis for the award of any Degree/Diploma/Associate ship/Fellowship or other similar title of any candidate of any university.

Place: Dessie, Ethiopia

Date: _____

_____

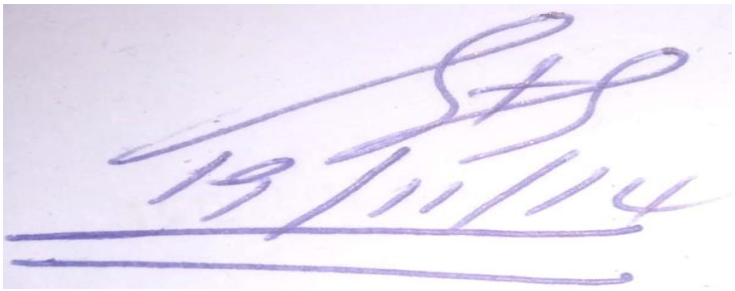
Signature of the Candidate

ADVISORS' APPROVAL SHEET

This is to certify that the thesis proposal entitled "***Mortality and Morbidity Trends and Predictors of Mortality among Under-five Children with Sever Acute Malnutrition in Sekota, WAG Zone, North Ethiopia***" submitted to the **Department of Public Health, Zemen Post Graduate College** has been carried out by ***Barkot Tamiru*** Id. Nº ___ZPGC/099/13__, under my supervision. Therefore, I recommend that the student has fulfilled the requirements and hence hereby can submit the thesis to the department.

Name of Major Advisor: **Wolde Melese [BSc, MPH-FE, Assis.Prof.]**

Signature:



APPROVAL BY THE BOARD OF EXAMINATION

ZEMEN POSTGRADUATE COLLEGE

DEPARTMENT OF PUBLIC HEALTH

MASTER OF ARTS IN PUBLIC HEALTH

As members of the Examining Board of the Final Thesis Open Defense, we certify that we have read and evaluated the thesis prepared by ***Barkot Tamiru*** entitled ***Mortality and Morbidity Trends and Predictors of Mortality among Under-five Children with Sever Acute Malnutrition in Sekota, WAG Zone, North Ethiopia*** and recommend that it will be accepted as fulfilling the thesis requirement for the degree of ***Masters in Public Health***.

Approved by:

Research Advisor

_____	_____	_____
Name	**Signature**	**Date**

Internal Examiner

_____	_____	_____
Name	**Signature**	**Date**

External Examiner

_____	_____	_____
Name	**Signature**	**Date**

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ACCRONYMS AND ABBREVATION

AHR	Adjusted Hazard Ratio
CD	Comorbid Diseases
CI	Confidence Interval
DHN	Dehydration
EDHS	Ethiopian Demographic and Health Surveys
FMOH	Federal Ministry of Health
F75	Therapeutic milk used only in Phase 1 of treatment for SAM
F100	Therapeutic milk used in Transition Phase and Phase 2 of treatment of SAM
IMCI	Integrated Management of Childhood Illness
MAM	Moderate Acute Malnutrition
MUAC	Mid-Upper Arm Circumference
NCHS	National Center for Health Statistics
OTP	Out Patient Program
ReSoMal	Rehydration Solution for Malnourished
RUTF	Ready to Use Therapeutic Feeding
SAM	Severe Acute Malnutrition
SC	Stabilization Center
SPHERE	Social and Public Health Economics Research Group
TFC	Therapeutic Feeding Center
UNICEF	United Nations International Children's Emergency Fund
WHO	World Health Organization

Abstract

Background: Under nutrition is one of the leading causes of morbidity and mortality in under-five children in developing countries including Ethiopia. In Ethiopia, many children with severe acute malnutrition are treated at inpatient therapeutic feeding centers. However, in most occasions the survival status and its determinants are not well understood.

Objective: The main objective of this thesis proposal is to assess and determine the predictors of mortality and morbidity among under five children with severe acute malnutrition admitted to stabilization center in Sekota Hospital from January 2019 to December 2021.

Methods: Retrospective cross-sectional study was conducted on 376 children aged 0-59 months who were admitted for complicated severe acute malnutrition at Sekota hospital from January 2019 to December 2021. Data were collected from a randomly selected chart after getting ethical clearance. Data was cleaned and entered by Epi data version 6 and exported to SPSS version 27 for analysis. Bivariate and multivariate logistic regression model were fitted to identify factors associated with treatment outcomes. Adjusted Odds ratio with its 95% CI is reported and P-value less than 0.05 were considered to declare presence of significant association.

Result: From 388 expected samples, 376 records were included in the analysis. Independent predictors of mortality were TB [AHR= 3.4], hypothermia [AHR = 2.71], DHN [AHR= 3.97], shock [AHR= 2.45] and Malaria [AHR= 2.51]. Other predictors of mortality of the children were children who are not supplemented with folic acid [AHR=0.411, 95% CI=0.209, 0.807], and also not supplemented for Resomal [AHR= 0.497, 95% CI= 0.177, 1.395]

Conclusion: The overall mortality among children aged 0-59 months with complicated SAM admitted to Sekota hospital was higher than the minimum SPHERE standard for stabilization centers. TB, hypothermia, shock, DHN, malaria and mismanagement of complicated SAM, attributed to the majority of death. So improving this gap may have paramount effect on child survival.

Key words: Survival status, severe acute malnutrition, under-five children, Northern Ethiopia, Sekota Hospital

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1. INTRODUCTION

1.1. Background

The term Malnutrition is a clinical condition, which results from lack of one or more nutrients leading to altered physical functioning up to the body, can no longer maintain enough bodily performance. It encompasses both over nutrition, associated with overweight and obesity, and under nutrition, referring to multiple conditions including acute and chronic malnutrition and micronutrient deficiencies. Malnutrition, including both calorie and micronutrient deprivation, causes acute and chronic morbidity, contributes to reduced immunity, and increases the likelihood of mortality and morbidity in association with infectious diseases [1] [2].

Childhood under-nutrition encompasses overabundance of nutritional disorders that include stunting, underweight, wasting, severe acute malnutrition (SAM), and micronutrient deficiency disorders. Under-nutrition is often a consequence of low dietary intake of various nutrients and diseases. According to the degree of wasting and the presence of edema, it is classified into severe acute malnutrition (SAM) and moderate acute malnutrition (MAM) [1].

According to World Health Organization, Severe Acute Malnutrition (SAM) is defined as a Weight-for-Height value < 3 Z scores or Middle Upper Arm Circumference (MUAC) < 11.5 mm or children having bilateral pitting edema. In other way, severe acute malnutrition is characterized by wasting (marasmus), oedema (kwashiorkor), or both (marasmic kwashiorkor), and occurs mostly in children. SAM is a life threatening condition, and has been associated with poverty, inadequate nutrient intake, lack of access to adequate health services, and concurrent diseases. Children with SAM have weakened immune system and they are more susceptible to diseases and have an increased risk of mortality [2] [3].

Severe acute malnutrition in early life can continue to manifest in the later life and can results in disability, diet related non-communicable diseases, and high economic burden. Inversely, improving child nutrition can have a powerful effect across multiple aspects of development, environmental sustainability, and peace and stability. A faulty case management, co-morbidities (TB, HIV), severity of illness at presentation for treatment and geographic and socio-economic changes determined the continuing burden of high mortality rate [4] [5].

Ethiopia has a long history of food insecurity and nutritional disorders aggravated by larger population size, land degradation, and droughts affecting a larger proportion of population

consequently, the country has been experiencing malnutrition related problems, although both community- and facility-based interventions are in place [6] [7].

According to the 2019 Ethiopian Mini Demographic and Health Survey, 7 % of under five children were wasted, of which 1 % were severely wasted [8]. The previous studies conducted in Ethiopia revealed that the prevalence of death among children with SAM ranged from 2.1% in Harar to 28.67% in Waghemra [9] [10]. Ethiopia has one of the highest child mortality rates in the world with 57% of all deaths in children who have stunting and wasting as the underlying cause. The percentages of children with stunting, wasting, and underweight at national level were 40, 9, and 26, respectively. The minimum international standard set for management of severe acute malnutrition is a recovery rate of at least 75% and death rate less than 10% [11] [12].

This implies that the issue is still a public health problem even though the country has been implementing global and national commitments since 2009 to end all forms of malnutrition by 2030. The presence of high burden of deaths associated with SAM placed the country as one of the slow progressing countries to address Sustainable Development Goals [13] [14].

The health sector in Ethiopia has attempted to upgrade nutritional intervention and improve treatment outcomes through health promotion, effective treatment strategy and supplementation of essential micronutrients for children and mothers. Different small scale fragmented studies have been conducted to determine treatment outcomes of children with SAM.

1.2. Problem statement

Under nutrition is a major global health problem, contributing to childhood morbidity, mortality, impaired intellectual development, suboptimal adult work capacity, and increased risk of diseases. Still under nutrition remains, one of the most common causes of morbidity and mortality among children and it contributes up to 50 - 60% of deaths in children globally. Nearly 20 million children below 5 years of age suffer from wasting and are at risk of death or severe impairment of growth and psychological development. Of these, over 90% are found in South and Southeast Asia and sub-Saharan Africa. About one million deaths occur annually among children under five years of age in developing countries [15].

Ethiopia has one of the highest child mortality rates in the world with 57% of all deaths in children who have stunting and wasting as the underlying cause. The percentages of children with stunting, wasting, and underweight at national level were 40, 9, and 26, respectively. It affect all age groups, but is more frequent among infants and young children [16].

This figure is significantly high, because comparing with well-nourished children; those with severe acute malnutrition are more than nine times more likely to die. It is due to the direct result of malnutrition itself, and the indirect effect of childhood illnesses like pneumonia, diarrhea and measles that severely malnourished children are too weak to survive. Moreover, children suffering from wasting are susceptible to long-term developmental delays [15] [16].

The current strategy for Community-based Management of Acute Malnutrition (CMAM) is a focused and holistic approach for better SAM case management. It aims to increase the capacity to manage SAM children properly for a better treatment outcome. Whereas, stabilization center is a place where children with SAM are kept for stabilizing their health. The principle of management of severe acute malnutrition at SC; children who failed appetite test, and/or with one or more medical complication, and/or with severe edema (+3) are first admitted to a stabilization center for consecutive phases of treatment [18].

Children with severe acute malnutrition can be discharged from therapeutic care includes those who have recovered, died, defaulted or not recovered. According to Nutrition Fact Sheet, Ethiopia 2018, a recovery rate for severe acute malnutrition is 88.7%. As WHO and Sphere Hand Book 2018, with the existence of functional SCs following standard protocol, the acceptable proportion of discharges from therapeutic care who have, recovered >75%, defaulted <10% [17] [18].

The expansion in the coverage of outpatient treatment services is reducing the need for inpatient treatment of children with SAM. However, there will arguably be certain proportion of children with SAM that will be identified at a late stage requiring inpatient treatment to stabilize their condition. The treatment success in such inpatient setups is variable. It is almost impossible to stipulate with certainty the key reasons behind the successes in those institutions with low mortality or failures in others [19].

Over the last decade, major improvement in the survival of children with SAM treated in outpatient set-ups have been achieved. However, the mortality rate of children with complicated SAM that receive treatment in inpatient set up has remained unacceptably high. Such high mortality in inpatient units has been attributed to either co-morbidities such as HIV, TB, diarrhea, malaria or other infection or to poor adherence to the WHO therapeutic guidelines [19] [20].

A hospital based study in Ethiopia revealed an alarming low cure and high death rate of 46 and 29%, respectively. Such high mortality in inpatient units has been attributed either to co-morbidities such as HIV infection and diarrhea or to poor adherence to the existing therapeutic guidelines [13]. In Ethiopia 82% of all cases of child, malnutrition and its related pathologies are not appropriately treated or left untreated [18].

Despite the existence of in-patient and other nutrition programs in every corner of the country, the national survey and different studies have showed that deaths due to severe acute malnutrition is indicated to be still high, and at the same time its prevalence has not been significantly reduced during the past three decades [21].

This implies that investigating this important to obtain evidences regarding the in-patient survival status and determining predictors of mortality. Therefore, this paper will determine and assess the survival status and predictor of mortality among under five children with SAM that were managed at stabilization centers in Sekota hospital Amhara region.

1.3. Significance of the study

Evidence-based estimation of child mortality is a cornerstone for tracking progress towards child survival improvement and identifying priority areas to improve progress towards eliminating preventable deaths due to SAM.

This research study is significant in generating baseline information on survival status and predictors of mortality among children aged 0-59 months admitted to stabilization centers in Sekota hospital. The premise for the study will anchor in the evidence indicating that as systematically identify bottlenecks and areas of improvement and taking an appropriate decision and in this area helps

On top of that, this study will contribute for policy makers to develop strategies and guidelines or standards for scaling up the management guidelines for sever acute malnutrition in order to boost treatment outcome of SAM. Another contribution will be for Hospital Managers to design an interventional project towards improving SAM management at SC centers.

Furthermore, the finding of this study will be crucial to intensify the knowledge and skill of health care professionals concerning proper management of SAM in order to upgrade the survival status and treatment outcome of children with SAM.

2. LITERATURE REVIEW

Malnutrition encompasses both ends of the nutritional spectrum, from undernutrition to over-weight. Different dictionaries and organizations have defined malnutrition. The free encyclopedia defined malnutrition as a general term for the medical condition caused by an improper or insufficient diet. According to WHO, malnutrition is an imbalances in a person's intake of energy or nutrients which encompasses two broad groups of malnutrition. One is "under nutrition" which includes stunting, wasting, and micronutrient deficiencies. The other is overweight, obesity and diet related non-communicable diseases [2].

Globally in 2017, nearly 51 million children under five were wasted and 16 million were severely wasted. This figure is shocking, because comparing with well-nourished children; those with severe acute malnutrition are more than nine times more likely to die. Sub-Saharan Africa and southern Asia are significantly affected by acute malnutrition. According to UNICEF, WHO, World Bank Group joint malnutrition estimates, in 2017, more than two thirds of all wasted children under-5 lived in Asia. In Africa, about 13.8 million children under five were wasted from which 4 million children were severely wasted [22]. In Ethiopia, about 10% children under 5 years of age suffered from wasting including 3% who were severely wasted [18].

A child with SAM especially presenting with medical complications is vulnerable and at increased risk of death that requires specialized hospital care, which differs from the standard treatment of children who do not have SAM [22].

2.1. SURVIVAL STATUS AND TREATMENT OUTCOME

Children admitted to Stabilizing center (SC) with SAM can be discharged by the outcomes of recovery, death, default or transfer. As WHO and Sphere Hand Book 2018, with the presence of functional SCs following standard protocol, the acceptable proportion of discharges from therapeutic care, >75% by recovery, 15% by default and <10% by death. According to Nutrition Fact Sheet, Ethiopia 2018, a recovery rate for severe acute malnutrition is 88.7 %. This outcome can be achieved by prompt treatment of all infections in these children with appropriate antibiotics, correction of the electrolytes, hypothermia, hypoglycemia, micronutrients and macronutrients by strictly following WHO criteria [23].

Many researchers strive to determine the survival status and predictors of mortality among under-5 children with SAM throughout the world. For instance, a prospective study in Uganda to assess the predictors of mortality among hospitalized children with severe acute malnutrition reported that from the total of 400 children enrolled, 9.8% died during in-patient therapeutic care, and 81.8%, 7.3% and1.3% were respectively; improved, lost to follow-up and terminated from the study [24].

A study of 251 severely malnourished children were admitted to St. Mary's hospital Lacor, Northern Uganda shows about two third were successfully discharged as cured, 30 (11.9 %) died, and the rest had potentially unsatisfactory outcome comprising defaulting treatment, transfer out and non-response (21.2%) [25].

Likewise, different researches were conducted in Ethiopia to assess survival status and predictors of mortality among under-5 children with severe acute malnutrition admitted to stabilization center. An institutional cohort study done among 527 under-5 children at Gondar comprehensive specialized hospital shows; sixty six (12.52%) children were dead and two third of participants were recovered at the end of follow-up [26].

Another retrospective study was conducted in Gedeo Zone to assess survival status and predictors of mortality among 545 children admitted to SC and treated for SAM. During the follow-up period, 51 (9.3%) had died during treatment, about sixty percent children had been cured, eighty-nine (16.3%) had required nutritional transfer, thirty-seven (6.8%) had transferred to higher health facility due to medical reason, twenty-six (4.8%) had defaulted and sixteen (2.9%) were right-censored [27].

On the other hand, a research finding in Jimma University Specialized Hospital reported that; above three fourth (77.8 %) were cured and eighty eight (9.3 %) were died during treatment. From 88 deaths, 27.3 % occurred in the first two days and 60.2 % at the end of first week with 17.4 days of the average length of stay in the hospital [28].

Another retrospective research done in selected hospitals from Ethiopia to assess Co-morbidity and treatment outcomes shows; out of 413, 24 (5.8%) were discharged by death, whereas more than half (55.9%) and 16.3% were recovered and defaulted from TFCs respectively [29].

Furthermore, a retrospective follow-up study was conducted to determine survival status and predictors of mortality among 566 under-5 children with SAM admitted to SCs in general hospitals of Tigray. According to the study report, 21 [3.8% (95% CI 2.2–5.6)] were died where as 82%, 6.65%, 4.5% and 1.44% were cured, absconded, had got medical referral and transferred out respectively. The cumulative survival probability at the end of 1st, 7th, 14th, 21stand 28th days were 99.5%, 98%, 96.4%, 92.7% and 89.1% respectively [30].

Despite the presence of functional therapeutic feeding centers with following standard protocols, the death of children in SCs in Ethiopia is unacceptable. Therefore, the determining factors for poor outcomes are not well understood in stabilization center of Sekota General Hospital.

2.2. THEORETICAL FACTORS ASSOCIATED WITH THE DEATH OF CHILDREN WITH SAM ADMITTED TO SCS

Many scholars have tried to determine the predictors of mortality among < 5 children with SAM. Although, they found different factors associated with; socio-demographic variables, baseline anthropometric measurements, type of malnutrition, immunization status, medical co-morbidity, clinical profile during admission and treatments and supplements are considered as having association.

I. Socio-demographic factors and survival status

A prospective observational study was conducted among 120 children in Uganda to assess risk factors for death during inpatient SAM. According to this study, age ≥24 months were 5.7 times risk of death than age below 24 months [31]. Unlikely, another retrospective study done at Jimma University Specialized Hospital among 997 under five severely malnourished children showed children age less than 24 months were two times more likely to die earlier than children with age above 24 months [28].

On the other hand, a retrospective study of 569 under-five children with SAM admitted to SC in general hospitals of Tigray shows the risk of mortality among children with SAM admitted to SCs from the urban areas were 2.73 times higher as compared to rural residents (AHR = 2.73) 95% CI 1.12–6.64) [30].

II. Baseline anthropometric measurements and survival status

A diagnostic test accuracy study was done among 1663 children 6-59 months of age in Pediatric emergency department of a tertiary care hospital in Delhi, India to assess MUAC and WFH Zscore predicting mortality in hospitalized children. As the findings of this study, both MUAC < 11·5cm and WHZ<−3 were independent predictors of inpatient mortality [32].

III. Types of malnutrition and survival status

Research findings in Ethiopia also show an association of anthropometric measurements with survival status. For example, a cohort study was done among 420 children with severe acute malnutrition aged from 6 to 59 months who have been managed at stabilization center in southern Ethiopia. According to the study, SAM children with oedema were 1.8 times more likely to survive than severely wasted [33].

An institution based retrospective study assessing survival status and predictors of mortality among 947 under-5 children with SAM admitted to Jimma University Specialized Hospital indicated, type of malnutrition was not independent predictor of earlier death [28].

IV. Medical co-morbidity and survival status

Several studies have been reported on the magnitude and association of co-morbidity among children with SAM admitted in SC. A retrospective study involved 251 severely malnourished children treated at St. Mary's hospital Lacor, northern Uganda has showed an association of medical co-morbidity with survival status. As the study, HIV positive children were more likely to die compared to HIV positive counterparts [25].

A retrospective cohort study was done in selected hospitals in North Shoa Zone, Ethiopia, among 413 children with SAM. As the finding of this report, children who had pneumonia were more risky to die as compared to children who had no pneumonia [39]. Another study done in Gedeo Zone revealed the hazard of death among children with anemia was more at risk to die than children with no anemia [27]. On the other hand, another study conducted in Dilchora Hospital, eastern Ethiopia showed the children with malaria were more likely die than children not infected by malaria [34].

V. Routine and special medications

According to a retrospective study involved 251 severely malnourished children treated at St. Mary's hospital Lacor, northern Uganda, indicated children who received IV fluid infusion were significantly more likely to die compared to those who did not receive IV fluids. And also significantly higher proportion of children that received blood transfusion died (27.6 %) compared to those who were not transfused (5.0 %) were died [25].

As a study conducted among 527 under-five children who were admitted to SC for SAM management at Gondar University comprehensive specialized hospital, children who did not treated with routine antibiotics were about two times more likely to die as compared to those treated with routine antibiotics [26]. Another retrospective cohort study was done to assess incidence and predictors of mortality among 450 under-5 children with SAM admitted to Dilla University Referral Hospital. The study indicated IV fluid administration was found to be independent predictor of death in severely malnourished children admitted to SC [35].

VI. Treatment and supplements

There was significant difference in the hazard of death among children who had been treated with medication and supplementation than those children not managed accordingly [36]. A retrospective cohort study done among 569 severely malnourished under-5 children admitted to SC in general hospitals of Tigray to assess survival status and predictors of mortality. According to this study, the hazard ratio of children not treated by antibiotics was three times higher compared to those treated with antibiotics. And also children not supplemented folic acid during their hospitalization and children not supplemented for Vitamin A were higher risk of death [30].

An institution based retrospective study conducted in Northwest Ethiopia to assess Predictors of mortality among 527 severely malnourished under-5 children admitted to SC. The study reveals, children who had not treated with routine antibiotics were about two times more likely to die as compared to those treated with routine antibiotics [26].

2.3. CONCEPTUAL FRAMEWORK

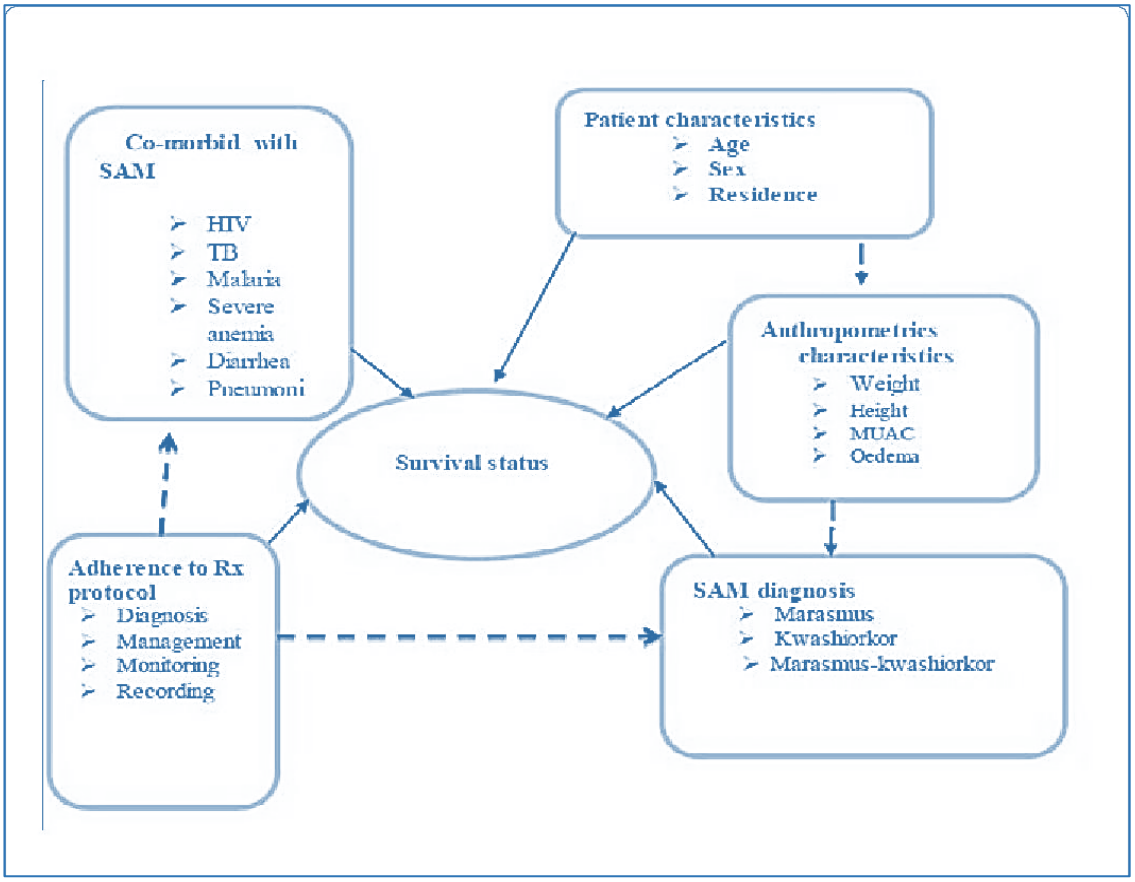

Figure 2. 1: Schematic presentation of conceptual framework developed by reviewing literatures

3. OBJECTIVES OF THE STUDY

General objective

To assess and determine the predictors of mortality and morbidity among under five children with severe acute malnutrition admitted to stabilization center in Sekota Hospital from January 2019 to December 2021.

Specific objectives

- ✦ To assess the proportion of mortality among under five children with severe acute malnutrition admitted to stabilization center in Sekota Hospital.
- ✦ To determine the morbidity trends among under five children with severe acute malnutrition admitted to stabilization center in Sekota Hospital.
- ✦ To identify the predictors of mortality among under among under five children with severe acute malnutrition admitted to stabilization center in Sekota Hospital.

4. MATERIALS AND METHODS

4.1. Study Area

The study was conducted in Sekota Hospital Waghemar zone, of Amhara regional state, which is located 719 km from Addis Ababa. Waghemara zone has eight woredas and one hundred thirty six kebeles and has estimated populations about 567,634 from this about 264,894 are males. There are an expected 65,136 under five children in the Zone. Regarding public health facilities there is three district hospitals, thirty-four health centers and 133 health posts. Most of the people are agro pastoralist and prone to recurrent food insecurity. The common health problems in this zone are malaria, diarrhea, under five-pneumonia and malnutrition [***unpublished, Wghemira Zone annual report***].

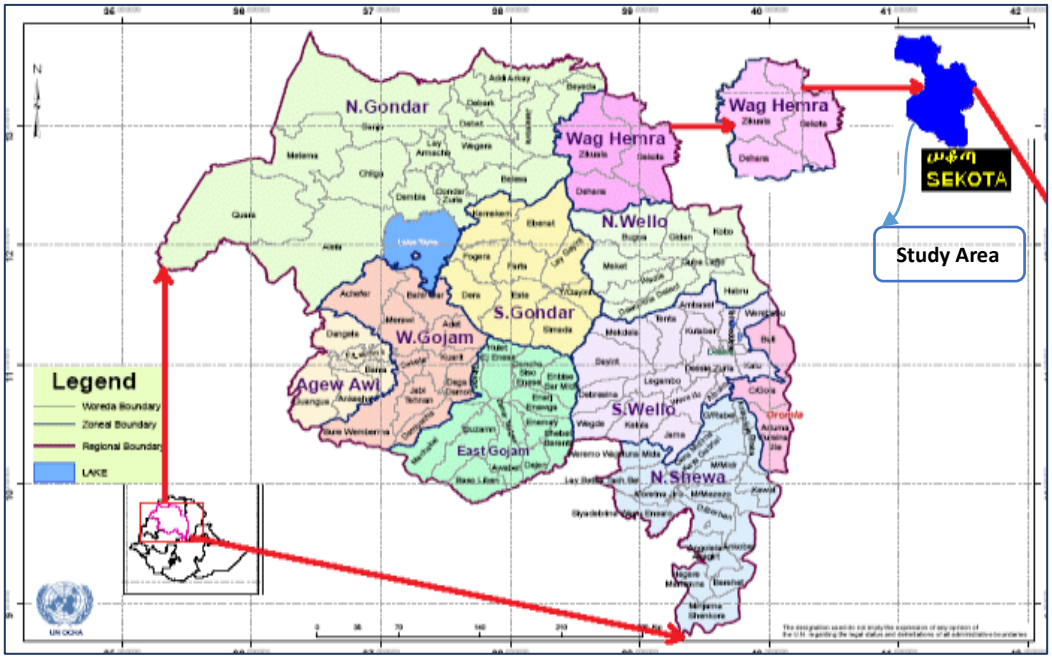

Figure 4. 1: Map of the study area [*unpublished, Wghemira Zone annual report*].

4.2. Study Design and Period

Hospital based retrospective cohort study with record review was carried out from January 2019 to December 2021.

4.3. Source Population

All children aged 0-59 months with severe acute malnutrition admitted to stabilization centers in Sekota Hospital, from January 2019 to December 2021.

4.4. Study Population

Records of randomly selected eligible under-five children with SAM admitted to stabilization centers at Sekota hospital from, January 2019 to December 2021.

4.5. Inclusion and exclusion criteria

Inclusion criteria:

All Children aged 0-59 months with severe acute malnutrition that were admitted to stabilization center at Sekota hospital, between January 2019 to December 2021 were included in the study.

Exclusion criteria:

- Children with incomplete records of anthropometric data
- Children whose treatment outcome not recorded
- Children whose admission date and discharge date not recorded will be excluded from enrolment to the study

4.6. Sample size determination and sampling technique

i. **Sample size for the first objective (mortality as outcome of SAM treatment)**

The sample size needed for determining the incidence of mortality in severely acutely malnourished under five children is calculated based on double population proportion formula. Institution based study conducted at Jimma University Specialized Hospital indicated that the death rate among exposed one is 11.85% (i.e. who had comorbidity/complication) and whereas in non-exposed the death rate is 3.46% [28] was used to compute the required sample size .

n1=158, N=**316**

By adding 10% for loss & incomplete record, the final sample size became **348**.

ii. Sample size for second objective (predictors of mortality in SAM)

The sample size needed to identify predictors of mortality in SAM is calculated based on double population proportion of unexposed to exposed **1:2** and parameters: CI = 95%, power = 80%

P1- expected case fatality rate of SAM among exposed children

P2- expected case fatality rate of SAM among unexposed children

Table 1: Sample Size calculated based on some predictor variables of death from different studies done in different areas

Variables	Proportions (% of outcome)	Risk ratio	References	Sample size
Dehydration at admission - **Yes (P_1)** - **No (P_2)**	P_1 = 86.6% P_2 = 62.7%	0.72	**[35]**	**Exposed = 59** **Unexposed = 59** **Total = 118**
MUAC - **< 11.5 (P_1)** - **≥ 11.5 (P_2)**	P_1 = 14.8% P_2= 3.73%	0.25	**[27]**	**Exposed = 124** **Unexposed = 124** **Total = 248**
Routine antibiotics - **No (P_1)** - **Yes (P_2)**	**P_1 = 18.2%** **P_2= 8.1%**	**2.24**	**[26]**	**Exposed = 194** **Unexposed = 194** **Total = 388**

The highest sample size calculated for the second objective is **(388),** which is also larger than the first one.

4.7. Sampling Procedure

Three consecutive years, 2019, 2020, and 2021 was purposively selected for record reviews since they provide the latest information about the problem under investigation in the selected institution for the study. All cases of SAM will be obtained from the therapeutic feeding unit register book. Simple random sampling was employed to select a sufficient number of samples starting from the latest month backward, based on the sequence of their card number, until the required sample size is reached. The total sample size for each year was allocated proportionally from the sampling frame.

4.8. Data Collection Methods and Procedure

A structured data abstraction form was used for data collection. The data abstraction form was adopted from Ethiopian protocol for the management of severe acute malnutrition, the sphere standard for management of severe acute malnutrition and base line previous studies [42].

Data extraction format was include the children's socio-demographic data (age, sex, and residence), baseline anthropometric measurements (weight, height, wt/ht and MUAC), types of malnutrition (edematous and non-edematous), co-morbidity (anemia, malaria, and pneumonia), medication given and outcomes of the treatment. Besides, the data abstraction form will be pre-tested in 5% of the sample size in Teseka Hospital.

Three data collectors and one supervisor were recruited for the data collection. Two days training was given to ensure common understanding of the data collection process. They perform the data abstraction from the patient medical record and SAM treatment registry. Orientation was given for the supervisor separately on how to supervise the data collectors and how to check for the completeness of the data abstraction form.

4.9. Variables

4.10.1 Dependent variable

Survival status (died/alive) of under five children with SAM;

4.10.2. Independent variables

- Socio-demographic variables like age, sex, place of residence, occupational status of parent, and educational status of parent;
- Type of malnutrition like marasmus, kwashiorkor, Marasmic-kwashiorkor;
- Base line anthropometric measurements like MUAC, weight, and height;
- Immunization status like fully immunized, partially immunized and not immunized;
- Treatments, supplements and therapeutic feeding such as routine antibiotics, vitamin a, folic acid, F-100, F-75, RUTF, and special medication like IV medication, NGT feeding, blood transfusion and ReSomal;
- Comorbid medical conditions before or after admission like HIV, anemia, hypoglycemia, severe dehydration, altered temperature, congenital heart disease, diarrhea diseases, acute infection, and others;

4.11. Operational definitions

Severe Acute Malnutrition- if the wasting is severe, WFH < 70% median or <-3SD of the mean or MUAC less than 11.5 mm in children 6-59 months or there is bilateral pitting edema of nutritional origin [47].

Recovered- children free from medical complications, edema and have achieved and maintained sufficient weight gain (when they reach 85% weight for length) [48].

Died: Patient that has died while s/he was in the in-patient care and death report is recorded in patient card [48].

Defaulted- SAM cases that are sign against treatment to leave treatment before cure or lost for 2 consecutive days with unknown status.

Survive: It is being alive and not experiencing SAM related death during hospitalization period.

Co-morbidity- children with severe acute malnutrition, who have another medical problem like; TB, HIV, malaria, severe anemia or any co-infection at admission to SC.

Medical transfer: child is referred to higher health facilities for medical reasons.

New admission: Patients that are directly admitted to in-patient care to start the nutritional treatment.

Marasmus: non-edematous SAM

Kwashiorkor: edematous SAM

Marasmic-kwashiorkor: SAM cases with both edema and severe wasting.

4.12. Data quality control

Data quality was assured by using structured extraction format adopted from WHO protocol for the management of SAM and different literatures. To ensure the data quality, pre-test was carried on 5% of the sample to ensure the agreement of the data abstraction format with the need of the study. The tool was amended based on the pretest findings.

Two days training was given concerning the data abstraction tool and data collection process for both data collectors and supervisor. Completeness and consistency of the collected data was checked onsite daily basis during data collection and give prompt feedback by the supervisor and

the principal investigator. Whenever there appear incomplete, errors, and ambiguities of recording, the information formats were crosschecked with the source card on the spot.

4.13. Methods of Data Analysis

The data were crosscheck out, coded and entered into EpiData version 7 and will be exported into SPSS Version 27 software for analysis. The data were examined for missing; fulfillment of assumptions were inspected by using frequencies, and cross tabulations. Graphs and frequency tables were used to report the descriptive data.

Bivariate analysis was done to identify associations between dependent and independent variables. Bi-variate Cox regression was fitted and those independent variables having p value ≤ 0.25 level of significance were included in the multivariable analysis. Cox proportional hazard regression was fitted at 5% level of significance to determine the net effect of each explanatory variable on outcome variable (Hazard ratio with its 95% confidence interval and p values were used to measure the strength of association and identify statistically significance). P value < 0.05 was considered as statistically significant association. Finally, the Cox regression model for its fitness to the data and its adequacy was checked.

4.14. Ethical consideration

This study was carried out after getting approval from the ethical review committee of Zemen Post Graduate College, department of public health. Then, the data were collected after getting permission from Zonal Health Department and Sekota General Hospital. Since the study was conducted through review of medical records, there was no direct contact with children/care givers, informed consent was not mandatory.

Nevertheless, all the necessary measures were taken to keep and assure the privacy, confidentiality and benefits of patient. To keep the confidentiality names and unique numbers were included in the data abstraction format and the data will not disclosed to any person or organization other than principal investigator.

4.15. Dissemination of the research findings

This study upon completion will serve as resource material for researchers, managers, and policy makers. To reach these targets, the result of the study will be submitted and presented to Zemen Post Graduate College, School of Public Health as a partial fulfillment of masters in GMPH.

On top of that, it will also be submitted to Sekota General Hospital. Along with this, it will be given to Waghimera Zonal Health bureau, and NGOs working around malnutrition in the city. Finally, it will be published in nationally or internationally recognized journals.

5. RESULT

5.1. Socio-demographic characteristics and anthropometry

In this study, Out of the total **388** randomly selected medical records, **376[97%]** records were retrieved and the remaining **12[3%]** charts were discarded due to inappropriately recorded and others were lost from the card room. Out of the total 376 selected record with SAM, more than half **199[53%]** were males. Majority of the children **256[68%]** were rural residents and **210[56%]** of the study participants were between the age of **12 to 24** months. (Table 5.1).

Table 5. 1: Comparison of children by different age category during admission and their distribution pattern based on their residence

Age on date of admission in months	clients distribution pattern by residence and sex					
	frequency	percent	rural	urban	male	female
0-6 months	23	6.0%	15	7	12	11
6-12 months	34.00	9.0%	23	11	18	16
12-24 months	109.00	29.0%	74	35	58	51
>24moths	210.00	56.0%	143	68	111	99
Total	**376**	**100.0%**	**255**	**121**	**199**	**177**

5.2. Anthropometry characteristics at Admission

From the total 376 reviewed records, 131[34.8%] children were having history of bottle-feeding during admission. Greater than two-third of children at admission, 289[76.9], had a WFH Z score of <-3 and the rest 87[23.1%] of them had a WFH Z score of above and equal to [-3]. On the hand, of all children at admission 270[75.8%] of them were MUAC below < 11.5mm.Whereas, 85(23.9%) of them were MUAC 11.5mm and above and the remaining 21[5.6%] of participants were not eligible for MUAC, due to the reason behind that their age during admission was below six month. Along with this, 141[38.8%] of admitted children were diagnosed with edematous type of malnutrition (kwashiorkor or Marasmic-kwash) (Table 5.2).

Table 5. 2: Anthropometry characteristics of SAM children that are admitted in Sekota Hospital

Characteristics		Frequency	Percent[%]
Appetite test	Passed Appetite	313	87.92
	Failed Appetite	42	11.80
MUAC	<11.5	270	75.84
	≥11.5	85	23.88
WFH	z score < -3	289	76.86
	z score ≥ -3	87	23.14
Has history of bottle feeding	Yes	131	34.84
	No	245	65.16
Edema	No Edema	230	61.17
	Grade I Pitting edema[Mild]	105	27.93
	Grade II Pitting edema[Moderate]	33	8.78
	Grade III Pitting edema[Severe]	8	2.13

5.3. Admission Status and SAM diagnosis

Majority of the children 348[92.5%] were identified as newly admitted children and the rest 28[7.4%] of them were readmitted to SC unit.

Out of a total of 376 SAM clients that are admitted under SC unit of Sekota hospital, Majority of children's 263[70%] were diagnoses as Marasmus type of malnutrition. The remaining clients 63[17%] and 50[13.3%] of them diagnosed as Kwashiorkor and Marasmic-Kwashiorkor respectively. Out of total marasmus cases diagnosed 192[73%] of them were came from rural districts. Under Kwashiorkor diagnosed clients 26[41.2] of them were history of using bottle-feeding during their past. Whereas, from the total Marasmic-Kwashiorkor diagnosed children's 20[40%] of them were presented with edema [includes Grade I, II and III forms of it] (Figure 5.3).

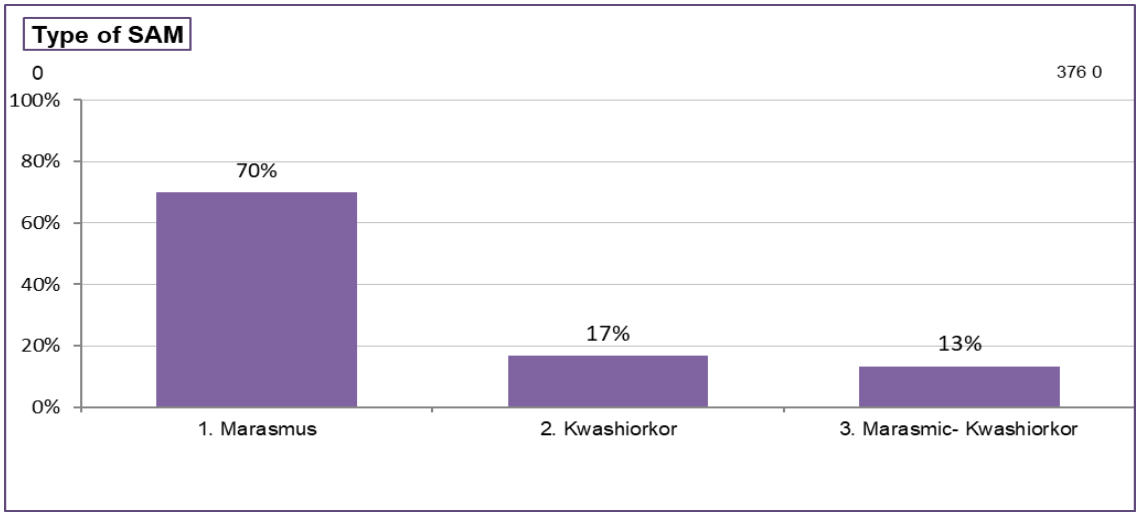

Figure 5. 1: Admission Types of severe acute malnutrition among under five children admitted to a stabilization center in Sekota Hospital from Jan 2019 to Dec 2021 G.C.

5.4. Clinical Condition and Medical Co-morbidities during Admission

A significant proportion of children had deranged vital signs during admission. Altered respiration [fast breathing or respiratory failure], altered pulse rate [bradycardia or tachycardia] and altered body temperature [hypothermia or hyperpyrexia] had been appeared in most situations. Accordingly, 158[42%] of children presented with altered respiration. Similarly, 80[21.3%], 10[2.7%] and 101[26.9] children's appeared with altered pulse rate, hypothermia and having extensive skin lesions throughout their body respectively.

Among all under-5 children selected for the study, 317[95.7%] of them had at least one form of comorbid disease. The most common medical comorbidities of under-5 children accompanied with SAM were diarrheal diseases 263[69.9%], followed by pneumonia 155[41.2%] (Table 5.3).

Table 5. 3: Distribution of comorbid diseases among admitted SAM cases in TFU

Variables	Category	Frequency	Percent[%]
Hypothermia	Present	10	2.66
	Absent	366	97.34
Respiratory Rate	Altered	158	42.02
	Normal	218	57.98
Pulse Rate	Altered	80	21.28
	Normal	296	78.72
Extensive Skin Lesion	Present	101	26.86
	Absent	275	73.14
TB	Present	19	5.05
	Absent	357	94.95
Pneumonia	Present	155	41.22
	Absent	221	58.78
Diahrea	Present	263	69.95
	Absent	113	30.05
Malaria	Present	53	14.10
	Absent	323	85.90
Anemia	Present	96	25.53
	Absent	280	74.47
Dehydration	Present	77	20.48
	Absent	299	79.52
Shock	Present	27	7.18
	Absent	349	92.82

5.5. Feeding and Medications

In Phase I F-75 given for about 319[84.8%], diluted F-100 were given for 15[4%] children's and RUTF for 34[9%]. Whereas, in a transition phase F-75 for 4[1.1%], diluted F-100 for 18[4.8%], F-100 for 281[74.73%] and RUTF for 66[17.5%]. In Phase II diluted F-100 17[4.5%], F-100 278 [73.9%] and RUTF were given for 73[19.4%].

From the total reviewed cases, Most of the client's 349[95%] eat family meal as an additional food and the others 20[5%] of them used porridge as additional food (Figure 5.4).

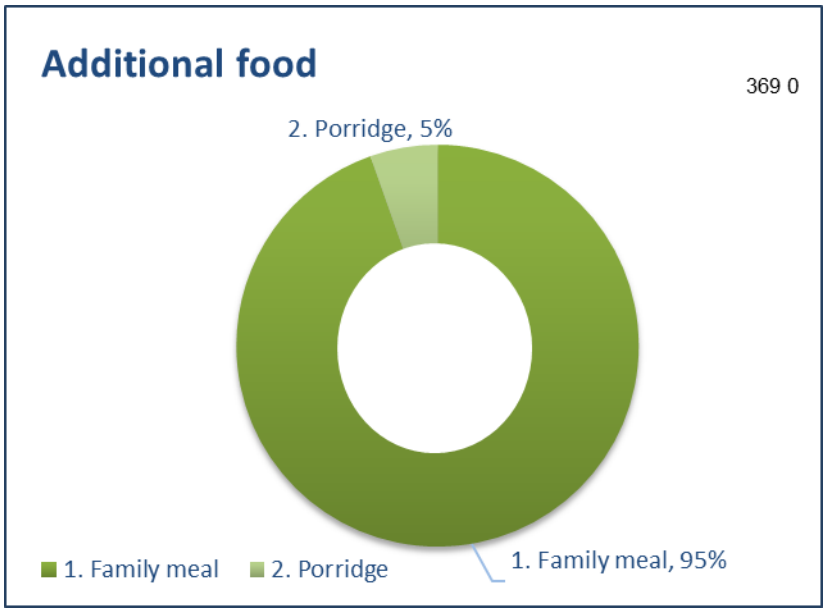

Figure 5. 2: Illustration of additional food taken by clients

5.6. Treatment and supplements

Different treatments and supplements were given for the children enrolled in the study based on acute malnutrition treatment guidelines. Majority 309[82.1%] of children received amoxicillin and 53[14.1%] of them were treated with anti-malarial. In addition, nearly one third of clients 129[34%] had vitamin A supplementation, 89[23.7%] of them took folic acid, 60[16%] took iron supplements and 34[9%] of children were dewormed.

Different medications were given and procedures were done based on the standard guideline. From the total children enrolled, more than half of children's 213[57%] were treated with IV medication. While 207[55%], 93[24.7%] and 56[14.9%] of children at SC were given ReSoMal, NG tube insertion and blood transfusion [whole blood] respectively.

Similarly, some medications that national SAM management guideline recommends to supply or treat complicated SAM were not implemented for some of the cases. Thus, this may also be due to irregular of supply or adherence to treat SAM may not supervised by external bodies (Table 5.4).

Table.5.4: Distribution of treatment & supplements for U5 children admitted to SC

Variables		Frequency	Percent
Amoxicillin	Yes	309	82.18
	No	67	17.82
Vitamin A	Yes	129	34.31
	No	247	65.69
Anti-Malaria	Yes	53	14.10
	No	323	85.90
Folic Acid	Yes	89	23.67
	No	287	76.33
Mebendazole	Yes	34	9.04
	No	342	90.96
Iron	Yes	60	15.96
	No	316	84.04
IV Medication	Yes	213	56.65
	No	163	43.35
Blood Transfusion	Yes	56	14.89
	No	320	85.11
NG Tube feeding	Yes	93	24.73
	No	283	75.27
ReSoMal	Yes	207	55.05
	No	169	44.95

5.7. Treatment Outcome

Among 376 children whose records were reviewed, 215[57.18%] were recovered from their diseases, while the rest 161[26.6%] of them were censored. Out of censored, 80 [21.3%] of them were end up dead, 63[9.6%] were defaulted their treatment and the remaining 18[4.8%] were transferred to other health facility (Table 5.5)

Table 5. 5: Treatment outcome of inpatient SAM children in Sekota Hospital

Variables		Frequency	Percent[%]	Sphere Standard	
				Acceptable	Alarming
Outcome of Treatment	Cured/Recovery	215	57.18	>75%	<50%
	Death	80	21.28	<10%	>15%
	Defaulter	63	16.76	<15%	>25%
	Transferred	18	4.79		

Out of a total selected SAM clients, Majority of the children's were died with Marasmus type of malnutrition 51[63%] followed by kwashiorkor with 15[18.8%] of them were recorded as dead. The rest of clients 14[17.5%] end up by death with Marasmic-kwashiorkor type of malnutrition. Along with this, the highest rate of defaulter was recorded under the marasmus category of SAM with 39[61.8%] of clients were registered as drop out from the TFU programme (Figure 5.5).

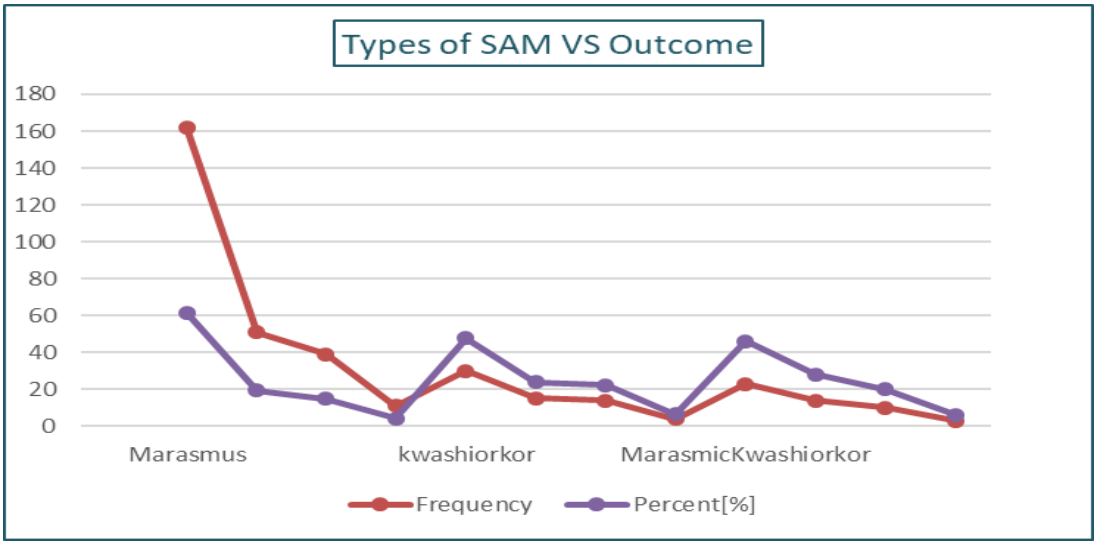

Figure 5. 3: Treatment outcome of [SAM] by types of Malnutrition, among under five children admitted to a stabilization center in SH from Jan 2019 to Dec 2021 G.C. Sekota, Amhara

5.8. Factors Associated with Treatment Outcome`

The association of independent variables with the dependent variable was investigated using both bivariate and multivariate logistic regression technique. In bivariate logistic regression analysis; sex, residence of the client, age, presence of edema, hypothermia, Fast breathing, diarrhea, pneumonia, malaria, TB, HIV/AIDS, shock, anemia, history of bottle feeding, and routine

medication like vitamin A, amoxicillin, Folic acid showed association with recovery rate [P - value less than 0.25] and hence we were used in multivariate analysis.

As a result, in bivariable regression analysis the presence of ++ edema [COR: 0.21, 95%CI: 0.01, 0.91] TB [COR: 2.88, 95%CI: 1.12, 7.42], Malaria [COR: 2.94, 95%CI: 1.12, 5.45], DHN [COR: 0.49, 95%CI: 0.24, 1.00] and diarrhea [COR: 0.33, 95%CI: 0.20, 0.55] and others were found to be significantly associated with mortality. During this regression, death was considered as failure and other outcomes were censored. (Table 5.6)

Table 5. 6: Treatment Results of Binary logistic regression analysis of factors associated with treatment outcomes under-five children admitted with SAM to TFU at Sekota Hospital

Variables		Recovered[%]	Dead[%]	COR[95% CI]	P-Value
Sex	Male	154[77.4]	45[22.6]	1.16[0.7-1.91]	0.561
	Feamale	142[80.2]	35[19.8]	1	
Resident	Rural	197[77.2]	58[22.8]	1.31[0.75-2.26]	0.341
	Urban	99[81.8]	22[18.2]	1	
Age	< 6 months	15[68.2]	7[31.8]	0.53[0.34-0.92]	0.002
	6-12 months	84[75.7]	27[24.3]	0.56[0.29-1.12]	0.032
	12-24 months	173[83.1]	35[16.9]	0.60[0.25-1.28]	0.04
	>24 months	24[68.6]	11[31.4]	1	
History of B.feeding	Yes	197[80.4]	48[19.6]	0.75[0.45-1.25]	0.276
	no	99[75.6]	32[24.4]	1	
Edema	No edma	180[78.2]	50[21.8]	1	0.197
	Grade + edema	87[76.1]	18[23.9]	0.28[0.07-1.15]	0.077
	Grade ++ edema	24[72.7]	9[27.3]	0.21[0.01-0.91]	0.036
	Grade +++ edema	5[62.5]	3[37.5]	0.32[0.06-1.58]	0.162
Respiratory rate	Altered	136[86]	22[14]	0.45[0.26-0.77]	0.003
	Normal	160[73.4]	58[26.6]	1	
Hypothermia	Present	6[60]	4[40]	2.54[0.70-9.24]	0.156
	Absent	290[79.2]	76[20.8]	1	
Pulse rate	Altered	67[84]	13[16]	0.66[0.35-1.27]	0.218
	Normal	229[77.3]	67[22.7]	1	
Type of SAM	Marasmus	212[80]	51[20]	1	0.345

	Kwashiorkor	48[76.1]	15[23.9]	0.62[0.31-1.23]	0.623
	Marasmic-Kwashiorkor	36[72]	14[28]	0.80[0.34-0.87]	0.172
TB	Yes	11[57.9]	8[42.1]	2.88[1.12-7.42]	0.029
	No	285[75.8]	72[24.2]	1	
Malaria	Yes	32[60.4]	21[39.6]	2.94[1.12-5.45]	0.001
	No	205[77.6]	59[22.4]	1	
Diarrhea	Yes	224[85.2]	39[14.8]	0.33[0.20-0.55]	0.000
	No	72[63.7]	41[36.3]	1	
DHN	Yes	49[63.6]	28[36.4]	0.49[0.24-1.00]	0.049
	No	247[82.6]	52[17.4]	1	
Pneumonia	Yes	122[78.7]	33[21.3]	1.00[0.61-1.65]	0.996
	No	174[78.8]	47[21.2]	1	
Anemia	Yes	41[72]	16[28]	0.65[0.31-1.40]	0.275
	No	255[80]	64[20]	1	
Shock	Yes	16[59.9]	11[40.1]	2.79[1.24-6.28]	0.013
	No	280[80.2]	69[19.8]	1	
IV fluid given	Yes	37[71.2]	15[28.8]	0.62[]0.32-1.20]	0.154
	No	259[79.9]	65[20.1]	1	
Blood Transfusuion	Yes	25[69.4]	11[30.6]	0.58[0.27-1.23]	0.157
	No	271[79.7]	69[20.3]	1	
ResoMal	Yes	176[85]	31[15]	2.32[1.40-3.85]	0.001
	No	120[71]	49[29]	1	
Amoxcillin	Yes	243[78.6]	66[21.4]	0.97[0.51-1.86]	0.933
	No	53[79.1]	14[20.9]	1	
Vitamin A	Yes	103[79.8]	26[20.2]	1.11[0.66-1.87]	0.701
	No	193[78.1]	54[21.9]	1	
Anti-Malaria	Yes	37[69.81]	16[30.19]	0.57[0.30-1.09]	0.090
	No	259[80.2]	64[19.8]	1	
Folic Acid	Yes	77[87.5]	11[12.5]	2.21[1.11-4.39]	0.024
	No	219[76]	69[24]	1	
Deworming [Mebendazole or Albendazole]	Yes	145[80.9]	38[19.1]	1.06[0.65-1.74]	0.813
	No	151[78.2]	42[21.8]	1	

In order to reveal the effect level of independent variables to survival [death] due to complicated severe acute malnutrition, multivariate Cox-regression was computed over the age group, appeared clinical conditions[Hypothermia, edema, respiratory rate, pulse rate, and type of SAM], CO-Morbidities [malaria, TB, diarrhea, shock, DHN], Medication [routine antibiotic, folic acid, Vit. A, blood transfusion, ResoMal, IV fluid given and Anti malaria] which have a P value of < 0.25 in the bivariate cox and they were eligible for multivariate Cox- regression. As the final multivariate Cox-regression analysis table shows variables that have significant level at 95% CI and p value < 0.05 were considered in predicting mortality of children aged 0-59 months with complicated severe acute malnutrition admitted to stabilization center.

As the analysis indicates that children's with comorbidities like TB [AOR: 3.04, 95%CI: 0.50, 4.25], Malaria [AOR: 2.51, 95%CI: 1.02, 4.88], DHN [AOR: 3.97, 95%CI: 1.28, 12.30], shock [AOR: 2.45, 95%CI: 1.08, 5.12] and among the medications part [Folic acid, IV fluid given & ResoMal] had effect on child mortality. Similarly, clients Age [<6months], type of SAM, and hypothermia during admission were statistically significant and predictors of mortality for children's with SAM cases. (Table 5.7)

Table 5. 7: Treatment Results of Binary logistic regression analysis of factors associated with treatment outcomes under-five children admitted with SAM to TFU at Sekota Hospital

Variables		COR[95% CI]	AOR[95% CI]	P-Value
Age	< 6 months	0.53[0.34-0.92]	1.37[0.34-2.84]	0.031 [*]
	6-12 months	0.56[0.29-1.12]	0.72[0.22-1.18]	0.086
	12-24 months	0.60[0.25-1.28]	0.83[0.31-1.46]	0.127
	>24 months	1	1	1
Edema	No edma	1	1	1
	Grade + edema	0.28[0.07-1.15]	0.33[0.14-1.46]	0.097
	Grade ++ edema	0.21[0.01-0.91]	0.79[0.11-2.05]	0.162
	Grade +++ edema	0.32[0.06-1.58]	1.67[0.05-2.92]	0.041 [*]
Respiratoryrate	Altered	0.45[0.26-0.77]	1.27[0.52-2.31]	0.435
	Normal	1	1	
Hypothermia	Present	2.54[0.70-9.24]	2.71[0.92-10.13]	0.071 [*]

	Absent	1	1	
Pulse rate	Altered	0.66[0.35-1.27]	1.27[0.69-2.31]	0.435
	Normal	1	1	
Type of SAM	Marasmus	1	1	
	Kwashiorkor	0.62[0.31-1.23]	0.79[0.36-1.69]	0.122
	Marasmic-Kwashiorkor	0.80[0.34-0.87]	1.91[0.39-2.83]	0.079 [*]
TB	Yes	2.88[1.12-7.42]	3.40[0.50-14.25]	0.001 [*]
	No	1	1	
Malaria	Yes	2.94[1.12-5.45]	2.51[1.02-4.88]	0.027 [*]
	No	1	1	
Diarrhea	Yes	0.33[0.20-0.55]	1.27[0.52-2.31]	0.135
	No	1	1	
DHN	Yes	0.49[0.24-1.00]	3.97[1.28-12.30]	0.017 [*]
	No	1	1	
Shock	Yes	2.79[1.24-6.28]	2.45[1.08-5.12]	0.000 [*]
	No	1	1	
IV fluid given	Yes	0.62[0.32-1.20]	0.163[0.031-0.857]	0.032 [*]
	No	1	1	
Blood Transfusuion	Yes	0.58[0.27-1.23]	1.312[0.141-1.76]	0.215
	No	1	1	
ResoMal	Yes	2.32[1.40-3.85]	0.497[0.177-1.395]	0.007 [*]
	No	1	1	
Anti-Malaria	Yes	0.57[0.30-1.09]	1.975[0.724-5.309]	0.184
	No	1	1	
Folic Acid	Yes	2.21[1.11-4.39]	0.411[0.209-0.807]	0.010 [*]
	No	1	1	
[*] show statistically significant association between predictors and mortality [P < 0.05]				

6. DISCUSSIONS

This study aimed at identifying predictors of mortality and investigating possible factors that are associated with treatment outcome among under five children [0-59 months] with severe acute malnutrition admitted to stabilization center in Sekota hospital. The recovery rate of SAM in this study was found to be 57.18%, 21.28% death, 16.76%, defaulter and 4.79% medical transfer. While, the acceptable reference value that has been developed by SPHERE standard has > 75% recovery, < 15% defaulter and < 10% death rates. This showed that none of the outcome indicators in this study was within the recommended standard set of sphere project values/international standards **[23].**

In this study the percentage of recovered children, 57.18% were less than the minimum SPHERE standard and national management protocol for severe acute malnutrition managed at stabilization centers [>75%]. Similarly, the proportion of recovery in this study is lower than the finding from Woldiya hospital [85%], Felege Hiwot referral hospital [58.4%], Gondar university tertiary hospital [68.5%], Walaita General Hospital [64%] and Uganda [66.9%] **[49, 45, 50, 51 &52].** However, the recovery rate in this study comparatively higher when compared to the percentage in a prospective cohort conducted at Zambia [53.7%] and previously done in Sekota hospital, which showed [47%] recovery rate**[53, 9].**

This study also found that high proportion of death encountered 21.28% and this is much higher than the study conducted in Mekele [12.8%] of mortality, Malawi [7.7%],Woldiya hospital [6%], in Jimma university specialized hospital [9.3 %] and Dilchora referral hospital 7.6%**[55, 54, 49, 28, 34].** On the other hand, the present finding is lower than study previously done in Sekota hospital [29%] and Zambia [40.5%] **[9, 53].**

The proportion of defaulted children was 16.76%. It is comparable with a reported indicated from Sudan [15%] and Gonder [19.8%] **[56, 50].** This outcome is below acceptable range of sphere standard, it is also lower than another studies conducted in Yirgalem hospital [22%] **[57, 50,].**

The possible explanation for the low recovery, high death and defaulter rate might be due to late presentation to the stabilization center after developing severe complications, Mismanagement [not adhering with the updated SAM management protocol], especially on the first day of admission. Additionally, most of clients 256[68%] were rural residents which is too far from available hospitals and parents had been discontinuing their children treatment due to financial constraint to buy drugs and foods.

Along with this, poor health seeking behavior, inaccessibility of therapeutic foods and medications and also different taboos that are practicing within the catchment population are might be the possible reasons for the concurred variance.

In this particular study, the median age of the children at admission was 17 months [IQR=12-24] months. The reason for the high number of cases of SAM to be among the age group 12 to 24 months might be due to the likely reasons of low rate of continued breast feeding and poor complementary feeding practices among children of this age. Regarding the type of severe acute malnutrition, Marasmus was the most prevalent 263[70%] type of severe acute malnutrition, which is in line with the study done in Gondar [66.2%] and Dhaka city of Bangladesh [61%] **[59, 58]**. However, the finding was different from study conducted at southern Ethiopia [47%] and Zambia [27.3%] **[60, 61].** This variation may be explained by the fact that different factors of malnutrition across various settings. For example, social, cultural and environmental factors are the few reasons for the cause of SAM.

Non-edematous was the most common type of SAM [severe acute malnutrition] and identified in 61.17% followed by edematous 38.83%. Similar findings were also observed in Felege Hiwot and Gondar university tertiary hospitals **[45, 50].** The percentage of Edematous SAM in this study is higher than the study done in Niger [15%] **[62]**. Nevertheless, it is lower than in the study done in Southern Ethiopia [53%] **[60]**. Along with this, children with +++edema were 1.67 times more likely to die than non-edematous children. This might be due to the effect of edematous children are prone to fluid overload and metabolic complication however, no related result reported from previous studies.

As per the findings of this study, there was no relationship between type of Malnutrition and treatment outcome which is in line with the finding of Jimma university specialized hospital, Debre Markos and Finote Selam hospitals **[28, 63].**

Adjusting for other variables, children with age less than 6 months were 1.83 times more likely to die earlier than children with age 24 and above months. This finding was also supported by different studies done in Jimma and southern region but in others, age was not a predictor of mortality **[28, 36].** Younger children may be more vulnerable because of depressed immunity, increased risk of infection and insufficient feeding practices including discontinuing breast-feeding.

Altered body temperature [hypothermia and hyperpyrexia] significantly increased the risk of mortality among children with SAM. The risk of earlier death was 2.7 times higher for children who had altered body temperature than children who had normal temperature. Hypothermia increased the hazard of mortality by threefold in another study **[28],** while in contrast to these findings, a study conducted in South Africa showed no association **[64].** Since hypothermia and hyperpyrexia affect the biochemical reactions of the body, and are indicators of altered metabolism, sepsis and serious infections, the mortality ascribed to such alteration is high **[14, 65].**

SAM Children with TB co-infection were 3.4 times more likely to die than their counterpart [AHR= 3.40; 95% CI: 0.50, 14.25]. The study conducted in Yergalem hospital reported that the risk of death due to TB co-morbidity among SAM was about three times as compared to children with no TB **[66].** The similarity of the study finding may be due to similar pattern of TB distribution in Ethiopia.

In this study, children with malaria were 2.5 [AHR] times more likely to die than their counterpart. Similarly, researches done at Dilchora Hospitals, Ethiopia showed children with malaria were eleven times more likely to die compared with children not diagnosed malaria **[34].** Another study conducted in Dilla University Referral Hospital, Ethiopia showed malaria was not predictor of mortality **[35].** This variation in findings might be related with differences in epidemiology of malaria, adherence to management protocol and medical supplies.

Dehydrated children were 3.9 times more likely to die earlier than children who were not dehydrated [AHR= 3.97; 95% CI: 1.28, 12.30]. The study conducted in Jimma university specialized hospital also support this finding in which dehydrated children were found to be 2.3 [AHR=2.3; 95% CI: 1.3, 3.9] times more likely to die than children without dehydration **[28].** This might be because of misdiagnosis and mistreatment of dehydration in severely malnourished children who can quickly develop fluid overload and cardiac failure during fluid repletion **[2].**

Regarding children with impaired consciousness level [lethargy or coma] were 2.4 times more likely to die earlier than conscious children. This was similar to the finding of study conducted in Jimma University specialized hospital, yekatit hospital addis ababa and Kenya **[28, 67, 68]**. This is because of the fact that children with SAM are highly at risk of shock secondary to severe infections and diarrheal diseases which can cause either hypovolemic or septic shocks. Besides, severe sepsis and diarrheal diseases in malnourished children might be associated with low cardiac reserves leading to shock which leads to death **[69]**. Unless it is prevented and detected, early shock could compromise many vital organs including brain, heart and kidney especially when children were under starvation of cellular energy **[39]**. However, shock was not a significant associated factor for recovery from SAM in a study done in two hospitals of Wolaita **[51].**

Treatment related factors like infusion and transfusion were not independent predictors of death in severely malnourished children admitted to Sekota hospital. This was in contrast to a study conducted in Uganda where transfusion and infusion were predictors of mortality **[70]**. A study conducted in South Africa also found that transfusion was associated with death **[67]**. This could be the result of fluid overload from inappropriate use of transfusions and infusions or from differences in study settings **[2, 70].**

According to this study, there was a significant difference in hazard of death among children who were treated by Folic acid and ResoMal compared to clients who are not given. Those who were treated 59% less likely to die than children not treated by folic acid. Whereas those who were given resomal 51% less likely to die than children were not treated by resomal. This might be due to the effect of resomal to reduce stool output, the duration of diarrhea, and the need for unscheduled intravenous fluids and rehydrate the children adequately. However, no related result reported from previous studies.

In this study also diarrheal diseases, anemia, pneumonia and altered pulse rate were not significantly associated with the death and this is in contrast with the findings of the other studies that were conducted prior to this study **[72, 45, 35, 71]**. The difference might be also resulted from differences recording system as well as due to variations in the geospatial distribution of co-morbidities. The other possible rationale may be the fact that the intermediate effect of the treatment given could obscure the true effects of those variables with death. Incompleteness of records and absence confirmatory tests for co-morbidities were limitations of this study. Besides, selection bias might affect the true estimates.

6.1. Strength and limitation of the study

6.1.1 Strength of the study

The strengths of this study include:

- Using a 3-year record to increase representativeness,
- Incorporating more covariates like resomal and shock that were not included in other retrospective studies.

6.1.2 Limitation of the study

The study was merely based on secondary data, so analysis of associated factors for nutritional recovery was limited by the information that could be obtained from the patients' charts. Other limitations of this study include:

- Lack of comparison group from other healthcare facilities in the city;
- Children's immunization status, additional family meal and appetite test were inadequately recorded and were not included in the analysis;
- The reliability of the recorded data could not be verified, and there was a potential bias associated with discarded records and the unknown status of absconders.
- Since the study was analyzed using logistic regression model rather than cox-regression model it does not show the time effect of factors on the outcome of the study.

7. CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the finding of this study, the overall status of children aged 0-59 months with complicated severe acute malnutrition that were managed at sekota stabilization center was less than the minimum SPHERE standard and national management protocol for SAM. The mortality rate was higher than the acceptable level, which is less than 10% at stabilization centers. Having malaria, hypothermia, DHN, shock and tuberculosis [TB] as co-infection with severe acute malnutrition were found to be independent predictors of mortality. Provision of medications like folic acid and resomal for that in need have also paramount effect in saving the life of children with severe acute malnutrition in the stabilization center.

Recommendation

Based on the above finding the following recommendations are forwarded for the concerned bodies:

For Sekota referral health care providers:

- ☐ Children admitted to stabilization center in this hospital are not recovering well. So proper diagnosis and management of cases in accordance to the protocol permits should strictly follow. Treatment of complication like DHN, shock, Malaria, hypothermia and TB needs focus.
- ☐ Proper monitoring and documentation of records needs improvement.

For Sekota zonal health office and concerned bodies

- ☐ There is need for programmed supervision and monitoring in managing SAM in line with the national management protocol.
- ☐ Screening, case identification and follow up of cases of children with severe acute malnutrition and promote feeding practices at the community level by strengthening health extension workers should be given an attention. These may be the most effective way to reduce complicated SAM, mortality at hospital and rehabilitation center.

- The most affected children with severe acute malnutrition in this study was aged below 6 months. Therefore, implementation and integration of child survival policy including infant and young child feeding [IYCF] should be improved Screening, case identification, management, referral and follow up of cases of children with severe acute malnutrition at the community level should be given an attention.

For future researchers

- The finding of this paper may serve as baseline data, so all concerned bodies should investigate with prospective cohort study design farther for the improvement of child survival.

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ANNEXS

Annex-I: Data Abstraction Format

This data abstraction format is prepared for collecting information on mortality and morbidity trends and predictors of mortality among under-5 children with SAM admitted to stabilization center at Sekota Hospital from January 2019 to December 2021.

Date of review __/___/_____

Name of the reviewer _____Signature _____

Supervisor Name _____

Signature _____ Date __/____/_____

Total number of records reviewed _____

Reviewed Patient's card No. from _____to_____

Available Data: I. Complete____ II. Incomplete_____ III. Excluded____

Card No: _____ Unique SAM No: _____ institutions name: _____

S.no	Admission Characteristics	Response	Remark
Socio-demographic characteristics			
	Sex	1. Male 2. Female	
	Residence	1. Urban 2. Rural	
	Age on date of admission in months	_____ months	
	Residence	1. urban 2. rural	
Anthropometry Chx at Admission			
	MUAC (for 6–59 months)	_____ mms	

	Wight	_____ kg	
	Height	_____ cm	
	WFH[WFL] Z Score	1. Z score < -3 2. Z score > -3 to < -2	
	Appetite at admission	1. Failed appetite 2. Passed appetite	
	Has history of Bottle Feeding?	1. yes 2. no	
	Edema	0. No 1. + 2. ++ 3. +++	
Clinical conditions at admissions			
	Major complain at admission	1. _____ 2. _____ 3. _____	
	Hypothermia (axillary To ≤ 35 °C)	1. Present 2. Absent	
	Respiratory rate	1. Altered 2. Normal	
	Pulse rate	1. Altered 2. Normal	
	Extensive skin lesions/ infection	1. Present 2. Absent	
Admission status and SAM diagnosis			
	Type of SAM	1. Marasmus 2. Kwashiorkor 3. Marasmic-kwashiorkor	
	Type of admission	1. New admission 2. Relapse (readmission)	
Co-morbidity/complication on admission		1. Present 2. Absent	
	Major Comorbidities	1. TB 2. HIV	

		3. Malaria 4. Diarrhea 5. Pneumonia 6. Heart failure 7. Other(specify)_____	
	Complication	1. Dehydration 2. Shock 3. Skin lesion 4. Pale-conjunctiva 4. Others(specify)_____	
Therapeutic Diet			
	Phases	1. Phase 1/ Stabilization Phase 2. Transition Phase 3. Phase 2/Rehabilitation Phase	
	Diet name	1. F -75 2. F-100 3. Diluted F-100 4. RUTF	
	Additional food	1. Porridge 2. Family meal	
	Feed by	1. Orally 2. By naso-gastric tube(NG –tube)	
Routine and special medications			
	IV infusion/Medication	1. Yes 2. No	
	Blood Transfusion	1. Yes 2. No	
	NG tube feeding	1. Yes 2. No	
	ReSoMal	1. Yes 2. No	
Treatment and supplement			
	Amoxicillin	1. Yes 2. No	

	Vitamin A	1. Yes 2. No	
	Anti-malarial	1. Yes 2. No	
	Folic acid	1. Yes 2. No	
	Mebendazole	1. Yes 2. No	
	Iron	1. Yes 2. No	

Discharge and outcome			
	Date of discharge	_____/_____/_____(EC/GC)	
	Discharge wt.	_____ kg	
	Target weight achieved	1. Yes 2. No	
	End result /outcome/	1. Cured/discharged 2. Dead 3. Defaulter 4. Transferred	

NB: (0) no edema, (+): grade one edema (++): grade two edema (moderate) and (+++): grade three edema (generalized edema).

Checked by supervisor: Name_____, Signature_____

Annex II. Information sheet and Consent

Title of the research project: Mortality and Morbidity trends and predictors of mortality among under five children with severely acutely malnourished admitted to stabilization centers in Sekota, Wag Zone, North Ethiopia from January 2019 to December 2021.

Name of principal investigator: Barkot Tamiru

Name of the organization: Zemen Post Graduate College, Department of Public Health

Name of the sponsor: principal investigator

Introduction: this information sheet is prepared for Sekota Zone health bureo, Ziquala woreda health office and for Hospital Admin Staffs. The aim of the form is to make the above concerned offices clear about the purpose of the research work, data collection procedure and get permission to undertake the research.

Purpose of the Research thesis: to assess and determine the predictors of mortality and morbidity among under five children with severe acute malnutrition admitted to stabilization center in Sekota Hospital from January 2019 to December 2021.

Procedure: In order to achieve the above objective, information, which is necessary for the study, will be taken from patient charts. In order to come up with the objective of the study, selected charts of patients enrolled from January 1, 2019 to December 30, 2021 will be reviewed to access the required information from the records using a pre-prepared data abstraction format.

Risk and /or Discomfort: Since the study will be conducted by taking appropriate information from medical chart, it will not inflict any harm on the patients. The name or any other identifying information will not be recorded on the data abstraction form and all information taken from the chart will be kept strictly confidential and in a safe place. The information extracted will be kept secured by locked in to locker by key. After the data will be entered in to the computer, it will be protected by a computer password. The information retrieved will only be used for the study purpose.

Benefits: the research has no direct benefit for those whose document/ record is included in this research. However, the indirect benefit of the research for the participant and other clients in the program is clear. This is because if program planners are preparing predicted plan there is a benefit for clients in the program of getting appropriate care and treatment services for children with severe acute malnutrition.

Confidentiality: To ensure confidentiality the data on the chart will be collected without the name and medical record number of the clients. The information collected for this research project will be kept confidential and will be stored in a file. In addition, it will not be revealed to anyone except the investigator.