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Original Article

Treatment outcomes and associated factors among infants under 6-Month-Old with severe acute malnutrition in Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia

Mohammed Nasir[1*], Ermias Abebaw[2], Muluken Ahmed [3], Bethlehem Birhanu[1], Muluken Berhanu[3]

[1]Pediatrics Department, Hawassa university, Hawassa, Ethiopia
[2]Pediatrics Department, ALERT comprehensive specialized hospital, Addis Ababa, Ethiopia
[3]Pediatrics Department, Arba Minch University, Arba Minch, Ethiopia

Corresponding author*::mn2572338@gmail.com

Abstract

Background*: Infants under the age of six months are considered to have severe acute malnutrition if their weight for length Z-score is below -3 standard deviations (SD) and/or they exhibit bilateral pitting edema. It is frequently diagnosed in infants under 6 months of age and is frequently associated with higher rates of morbidity and mortality in infants than in older children. The current study aimed to assess the treatment outcome of severe acute malnutrition and associated factors among infants under 6 months of age in Hawassa Comprehensive Specialized Hospital, southern Ethiopia*

Methods*: An institution-based cross-sectional study was carried out from September to November 2021. A total of 261 records were evaluated between September 2007 and October 2021. After the data were collected, they were subject to EPI-data version 31 and then exported to STATA version 16 for analysis. Before exporting anthropometry data to Stata, Z scores of anthropometric measurements were calculated using WHO Anthro V3.2.2 software.*

Results*: Our study included 261 infants with severe acute malnutrition who were admitted. The outcomes were cure, default, transfer out, non-respondent, death, and unknown with the rate of 57.2%,11.5%,9.2%, 4.2%, 14.2%, and 3.8%. respectively. Gestational age, pneumonia, Pre-lacteal feeding, and tuberculosis were significantly associated with mortality.*

Conclusions*: The mortality from malnutrition was high in this study. While administering treatment for severe acute malnutrition to infants younger than 6 months, attention should be paid to infants who have pneumonia and tuberculosis. Counseling on the risk of Pre-lacteal feeding through health education is necessary.*

Keywords: *under six months infant, malnutrition, treatment outcome, anthropometric characteristics*

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Introduction

Malnutrition is described by the World health organization (WHO) as a person's energy intake that is insufficient, excessive, or out of balance with their nutritional needs. Typically, straightforward anthropometry is used to define it(1). Stunting, also known as impeded linear development, wasting, a type of acute malnutrition brought on by recent weight loss or inability to gain weight, and underweight, which is defined as a child's weight is low compared to his/her age, are the classifications made based on anthropometric criteria.

A cutoff point of weight for age Z score less than -2, length for age Z score of -2, and weight for age Z score of -2 is used for the diagnosis of underweight, stunting, and wasting, respectively, according to the WHO 2013 malnutrition Guideline. A cut-off point of -3 Z score is used to diagnose severe underweight, severe stunting, and severe wasting. Although the data are of low quality in this age period, these cutoff points are also applied to children between the ages of 6 months and 5 years, as well as to infants under 6 months(U6M) of age(2).

About two-thirds of the world's wasted children live in Asia and Africa combined(3). Around 52 million children under the age of five are affected globally by wasting, which is responsible for 8% of all child fatalities(4). Severe wasting, which has an incidence of 2.9 percent worldwide, affects 19 million children. A child's risk of dying increases by 3 and 9.4 times for underweight and severely underweight children, respectively compared to children whose weight for height is greater than a Z score of -1 (3).
A significant decrease in the frequency of stunting and underweight was observed in Ethiopia, but the prevalence of wasting was less, which is 8% and 5% in riral and urban regions, respectively (5). In 2020, 1.2 million children in Ethiopia received services for moderate wasting, and 438,763 children with severe wasting were brought to care (6).Worldwide, there are roughly 4.7 million U6M infants who are moderately wasted and 3.8 million who are severely wasted. Evidence suggested that inadequate nutrition during the first 1000 days, a crucial time for a child's growth and brain development, is a substantial cause of morbidity and mortality (3).Anthropometry still has a high value despite absence of a gold standard for the diagnosis of malnutrition in infants, under 6 months of age (7).Severe wasting, bilateral leg pitting edema, or both are indicators of severe malnutrition (8).
The 2007 Ethiopian national malnutrition guideline recommends only inpatient treatment of malnutrition for infants U6M of age or less than 3 kilograms with SAM. According to the 2019 national guideline for the management of acute malnutrition, infants under 6 months with SAM will be admitted if they have recent weight loss or failure to gain weight, ineffective feeding, the presence of medical complications, or other medical or social issues needing more detailed assessment or intensive support. The priority of treatment is re-establishing effective exclusive breastfeeding (9,10).Even though guidelines recommend weight for length Z Score to identify wasting in infants, under 6 months of age, many are questioning its diagnostic ability and predicting mortality(11,12).

For the care of severe acute malnutrition in infants under 6 months of age, the national and WHO guidelines advocate use of diluted F-100, F-75, and infant formula and encouraging breastfeeding along with standard drugs and appropriate follow-up. In babies who struggle to suckle, supplemental sucking techniques should be used(2,13).

Identification of the cause of malnutrition is crucial in the management of severe malnutrition; for instance, primary malnutrition is caused by lack of adequate food, for which parents should receive advice on feeding, whereas secondary malnutrition has a secondary cause that needs to be addressed (4).Treatment outcomes are measured by SPHERE key indicators. These Indicators are based on the percentage of discharges from targeted supplementary feeding programs that have died, recovered, or defaulted(14).

To the best of our knowledge, there is no research that has been done in our country regarding treatment outcomes and the factors associated with it in infants under the age of six months. Therefore, this study aimed to assess the treatment outcome of severe acute malnutrition and associated factors among U6M Infants in Hawassa University Comprehensive Specialized Hospital.

Methods

Study Design, Period, and population

A hospital-based cross-sectional study was conducted from September 1 to November 30, 2021. The study was carried out in the pediatric ward of the therapeutic feeding unit (TFU) of the comprehensive specialized hospital of Hawassa University (HUCSH). Hawassa is the seat of the Sidama region and is situated 275 kilometers south of Addis Ababa, the Ethiopian capital. HUCSH has been providing medical and surgical care to both adult and pediatric patients. The pediatric unit is divided into 4 sections: the surgical unit, critical ward, neonatal ICU, and TFU unit. There are 12 beds in 2 rooms at the TFU. The care of malnourished children is handled by 6 nurses, 6 physicians, and 6 pediatric residents and interns. Infants younger than six months are taken care for in the same wards as older children. F-75 is used to treat edematous infants under 6 months old while diluted F100 is used to treat non-edematous infants. Infants' weights were recorded by suspending scales, and their lengths by sliding measuring boards.

The source population was all records of Infants aged <6 months with SAM admitted to the therapeutic Feeding unit (TFU) at the Hawassa university comprehensive specialized hospital. The study population included infants aged <6 months with SAM admitted to the therapeutic Feeding Unit (TFU) who fulfilled the inclusion criteria at Hawassa university comprehensive specialized hospital from September 2007 to October 2021.

Eligibility criteria

Inclusion criteria

All infants <6 months of age with SAM that have been admitted and treated at the inpatient TFU of the hospital from September 2007 to October 2021were included in the study.

Exclusion criteria

Infants with incomplete medical records concerning variables of interest such as baseline sociodemographic characteristics were excluded. Patients with improperly labeled as having severe acute malnutrition and whose anthropometry was out of range were excluded.

Sample size determination and procedure
The therapeutic feeding center admission logbook was used to retrieve the medical record number (MRN) of infants under the age of six who had severe acute malnutrition. These admissions occurred between September 2007 and October 2021.The records of 261 under-six-month-old infants who met our eligibility criteria and had severe acute malnutrition were then extracted, and were reviewed.

Data collection procedure
Data were gathered using a checklist, which made it feasible to extract all relevant information from the patient's record. The format was divided into four sections: the patient's demographic characteristics wew covered in the first section, anthropometric measurements taken at admission were covered in the second section, child nutrition and treatment-related variables were covered in the third section, and co-morbidity and complication-related variables were covered in the fourth section. The checklist and data-collecting format were created in English. Four nurses who had received training in SAM management procedure and who would be overseen by two general practitioners who were working in the hospital collected the data. The principal investigator made constant monitoring and supervision during the data collection period.

Data processing and analysis
Data were subjected to EPI-data version 3.1 for cleaning after data collection and were afterward exported to STATA version 16 for analysis. Shapiro Wilk test was used to check normality for continuous variables. Tables and figures were used to summarize the results using descriptive statistics. The odds ratio was used in bivariate analysis to analyze the statistical relationship between the outcome variable and independent factors, and variables with values less than 0.25 were incorporated into a multivariate logistic regression to test the significance of the statistical association. To determine if the patient meets the anthropometric requirements for severe malnutrition, the anthropometry of the patient was calculated and checked using WHO anthro V3.2.2.

Operational Definition

The treatment outcome of SAM will be cure, death, defaulter, and medical transfer based on the criteria of SAM treatment protocol Ethiopian minster of health, 2014 (8).

Cured: - Patient that has reached the discharge criteria which are breastfeeding effectively or feeding well with replacement feeds, and have adequate weight gain, and having a weight-for-length ≥–2 Z-score
Death: - infant that has died while he/she was in the in-patient treatment program in a facility
Defaulter: - Patient that is absent for 2 consecutive weighing/2 days in an in-patient or who the caregiver sign to go against medical advice
Medical transfer: - Patient that is referred to a health facility/ hospital for medical reasons and this health facility will not continue the nutritional treatment or transfer the patient back to the program.
Non-responder: -patient who is in inpatient treatment and doesn't fulfill the discharge criteria even after 40 months of treatment.
Unknown: -a patient whose treatment outcome is not documented.

Results

Socio-demographic and anthropometric characteristics of infants

After excluding 39 U6M children due to incomplete and inaccurately documented charts, a total of 261 infants with SAM ages less than six months who were admitted to Hawassa referral hospital over the period from September 2007 to October 2021 were included in our study. This study showed that the age range of infants was 1-5 months, with a median age of 3 months and an IQR (2-5months) range. More than half of the infants were less than 3 months old; 146 (55.9%), were born at term, and 65.9 % came from rural regions. Females accounted for 154 (59%). The median length of hospital stay was 15 days, with an IQR (12-70 days) and a range of 3-140 days. Most infants were severely underweight and had normal lengths for their age (Table 1).

Nutritional status, treatment, complication, and comorbidity-related variables

This study showed that only 29.1% of infants were on exclusive breastfeeding, 48 (20.3%) had used supplemental suckling technique, and oral antibiotic was the common routine drug to be administered (37.5%). Diluted F-100 was used as therapeutic feeding in 87.7% of infants. The most common complication encountered was pneumonia 83 (31.8%) followed by sepsis 65 (24.9%). Only 16.1% of infants were edematous (table 2) .

Treatment outcomes and associated factors

Only slightly higher than half of the participants were cured (57.1 %). Others were dead, defaulted, transferred out, non-respondent, or had an unknown outcome in 14.2 %, 11.5 %, 9.5 %, 4.2 %, and 3.8 %, respectively (Figure 1).

Table 1: Sociodemographic and anthropometric characteristics of infants under 6 months old with severe acute malnutrition in Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia, 2021.

Characteristics	Category	Frequency	Percentage
Sex	Female	154	59.0
	Male	107	41.0
Age group of infants	Less than 3 months	146	55.9
	Greater than 3 months	115	44.1
Gestational age of the infants at birth	Preterm	66	25.3
	Term	175	67.0
	post term	20	7.7
Residence	Urban	89	34.1
	Rural	172	65.9
Marital status of parents	Married	102	39.1
	Single	43	16.5
	Widowed	45	17.2
	Divorced	35	13.4
	Unknown	35	13.8
Infant's caretaker	Mother	205	78.5
	Father	28	10.7
	Grandparents	28	10.7
Birth order of the infant	First	97	37.2
	Second	54	20.7
	Third and above	110	42.2
Weight for age Z score	Less than -3	143	54.8
	Between -2 and -3	57	21.8
	Above -2	61	23.4
Length for age Z score	Less than-3	30	11.5
	Between -2 and -3	55	21.1
	Above -2	176	67.4
Combination anthropometry	Severely underweight and severely stunted	30	11.5
	Severely underweight and stunted	55	21.1
	Severely underweight and normal length for age	58	22.2
	Underweight and normal length for age	57	21.8
	Normal weight for age and normal length for age	61	23.4

Infants with severely underweight had a higher proportion of deaths, and infants with stunting had a higher proportion of deaths in terms of length for age group. From the combined anthropometry group, the category of infants with severe wasting and severe stunting had the highest death rate (Figure 2). Bivariate and multivariate logistic regression analysis was done to identify factors associated with bad treatment outcomes of severely malnourished hospitalized U6M infant patients.

On the bivariate analysis, residence, infant caretaker, gestational age, birth order, supplementary suckling, feeding at admission, Prelacteal feeding, pneumonia, dehydration, and tuberculosis showed a p-value of <0.2 and became a candidate for multivariate analysis.

Table 2: Nutritional status, treatment, and complication/comorbidity variables of infants under 6 months old with severe acute malnutrition in Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia, 2021

Characteristics	Category	Frequency	Percentage
Feeding at admission	Exclusive breast feeding	76	29.1
	Cow's milk	40	15.3
	Infant formula	59	22.6
	Mixed feeding	86	32.9
Supplementary suckling technique	Yes	53	20.8
	No	208	79.7
Prelacteal feeding	Yes	124	47.5
	No	137	52.5
Therapeutic feeding started at admission	Diluted F-100	229	87.7
	F-75	32	12.3
Iron supplementation	Yes	45	17.2
	No	216	82.8
Folic acid supplementation	Yes	47	18
	No	214	82
Vitamin A supplementation	Yes	64	24.5
	No	197	75.5
Po Antibiotics given	Yes	98	37.5
	No	163	62.5
IV Antibiotics given	Yes	75	28.5
	No	186	71.5
Pneumonia	Yes	83	31.8
	No	178	68.2
Sepsis	Yes	65	24.9
	No	196	75.1
Dehydration	Yes	47	18
	No	214	82
Shock	Yes	29	11.1
	No	232	88.9
Anemia	Yes	64	24.5
	No	197	75.5
Tuberculosis	Yes	17	6.5
	No	244	93.5
HIV exposed	Yes	24	9.2
	No	237	90.8
Congenital heart disease	Yes	12	4.6
	No	249	95.4
Infantile pyloric stenosis	Yes	32	12.3
	No	229	87.7
Edema	Yes	42	16.1
	No	219	83.9

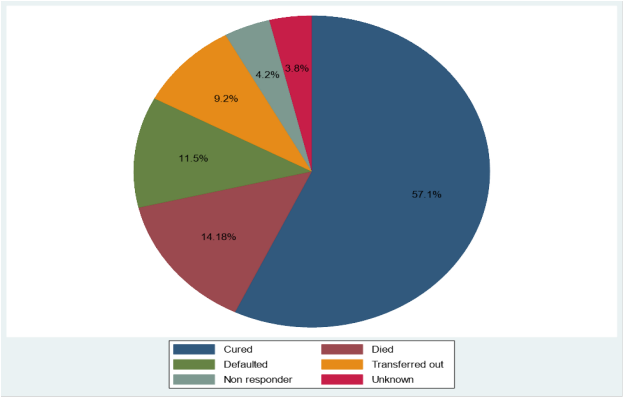

Figure 1: proportion of treatment outcomes in infants under 6 months old with severe acute malnutrition in Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia, 2021

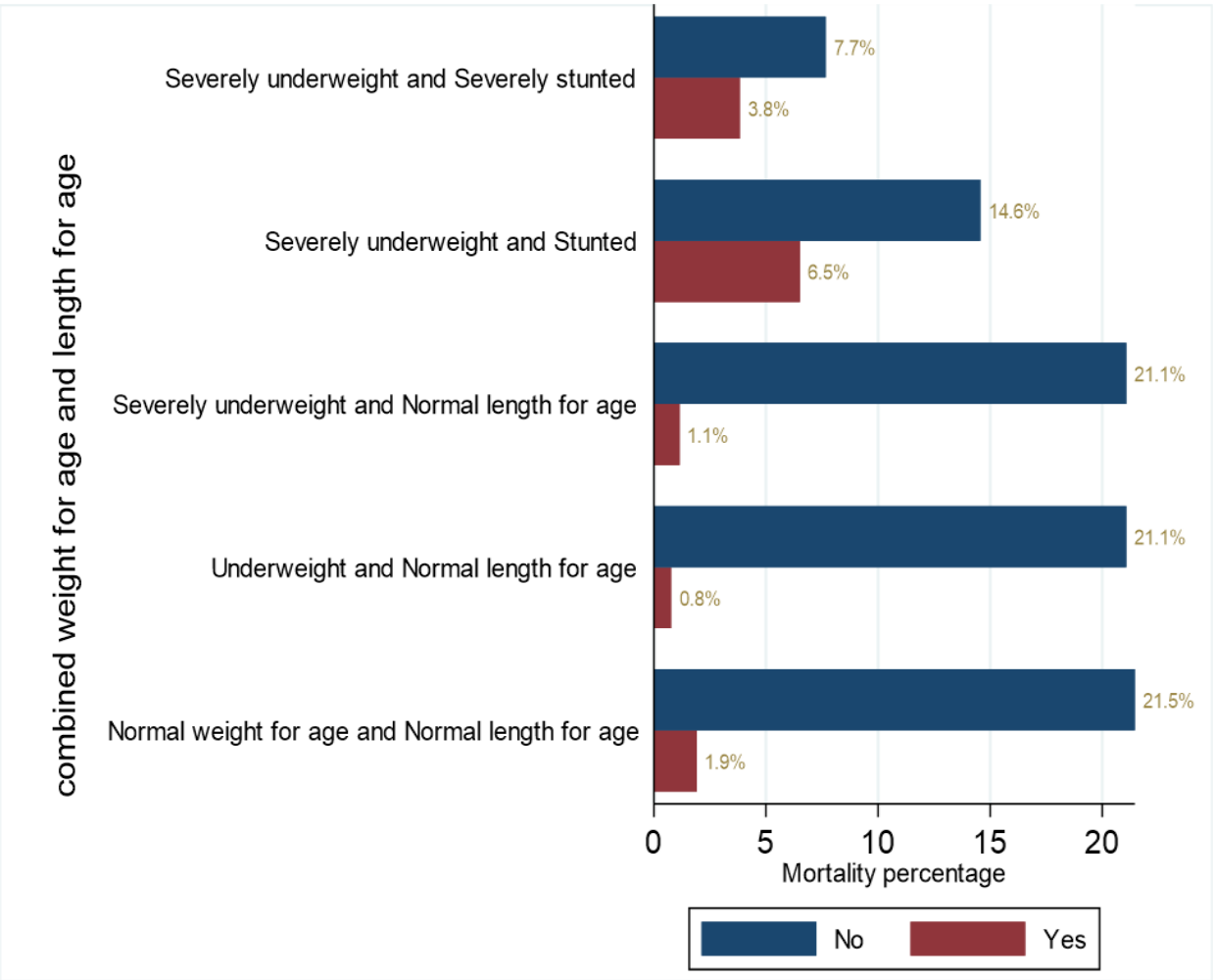

Figure 2: Proportion of mortality in the combined weight and length for infants under 6-Month-Old with SAM in Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia, 2021

On multivariate analysis, preterm infants, and infants with pneumonia, tuberculosis and Pre-lacteal feeding were significantly associated with bad outcomes (death) of malnourished infants. By taking other variables constant, preterm infants were 3 times more likely to die than the term ones [AOR=2.984; 95%CI (1.270, 7.010)]. Infants with a history of Pre-lacteal feeding were 2.6 times more likely to die than infants without a history of Pre-lacteal feeding [AOR=2.659; 95 % CI (1.145, 6.173)], infants with tuberculosis were 4 times more likely to die than infants without tuberculosis [AOR=4.096;95 % CI (1.072,15.659)], and infants with pneumonia were 2.5 times more likely to die than infants without pneumonia [AOR=2.543;95 % CI (1.072,6.022)] (Table 3).

Discussion

Compared to other anthropometric subcategories, U6M infants who were severely wasted had a larger proportion of severely underweight. In contrast to studies conducted in Bangladesh and Kenya as well as collected demographic survey data reports from 20 countries, the majority of patients in the present study were females, as was the case in studies conducted in Nigeria and Malawi(7,15–18).

In many studies, it was explored how breastfeeding could reduce malnutrition and lower its mortality(19,20,21). One of the parameters for assessing proper breast feeding is the rate of exclusive breastfeeding rate. In our study, the exclusive breastfeeding rate was 29.1%.

Table 3: Multivariate analysis showing factors associated with mortality of infants under 6 months old with severe acute malnutrition in Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia, 2021**.**

Characteristics	Category	Crude OR	Adjusted OR	p-value	[95% Confidence Interval]
Place of residence	Urban	1	0.491	0.126	0.197-1.221
	Rural	1.73(0.78-3.84	1	0.1	1
Classification based on gestational age	Preterm	2.85(1.37-5.9)	2.984	0.012	1.270-7.010
	Term	1	1	0.665	1
	Post term	0.43(0.05-3.41)	0.617	.	.069-5.482.
Birth order of infants	First	1	1	0.1	1
	Second	1.3(0.46-3.63)	1.165	0.797	.363-3.740
	Third and	1.93(0.86-4.4)	1.372	0.52	.524-3.590
Infant's caregiver	Mother	1	1	0.1	1
	Father	1.1(0.35-3.41)	0.87	0.848	.209-3.618
	Grandparents	1.8(0.67-4.83)	1.112	0.863	.333-3.712
Maternal marital status	Married	1	1	1	
	Single	2(0.7-5.8)	1.481	0.55	.409-5.359
	Widowed	1.9(0.66-5.5)	1.417	0.579	.413-4.855
	Divorced	3.1(1.1-8.7)	1.824	0.359	.505-6.583
	Unknown	2.1(0.68-0.19)	0.982	0.978	.262-3.681
Infants feeding at admission	Breast feeding	1	1	0.1	1
	Cow's milk	1.5(0.48-4.7)	1.272	0.72	.341-4.744
	Infant formula	1.33(0.47-3.8)	0.918	0.89	.274-3.080
	Mixed	1.8(0.72-4.51)	1.771	0.314	.583-5.378
Prelacteal feeding	No	1	1	1	1
	Yes	2.63(1.26-5.5)	2.659	0.023	1.145-6.173
Supplemental suckling technique	No	1	1	1	1
	Yes	0.43(0.15-1.28)	0.359	0.099	.106-1.214
Pneumonia	No	1	1	1	1
	Yes	2.7(1.4-5.6)	2.543	0.034	1.074-6.022
Dehydration	No	1	1	.	1
	Yes	1.87(0.84-4.2)	1.436	0.456	.554-3.724
Tuberculosis	No	1	1	0.1	1
	Yes	4.1(1.51-11.3)	4.096	0.039	1.072-15.659

Compared to findings from the Gondar research, which showed only 72 percent of the infants had evidence of breastfeeding practices, and only 39.1% were the exclusively breastfed, the exclusive breastfeeding rate was lower in our study(22)**.**However, the proportion of exclusive breastfeeding was higher than that found in the Nigerian studies(18)**.**The mothers' employment in recent years and traditional beliefs may be the factors in the nonexclusive breastfeeding pattern, which contributes to poor breastfeeding behaviors.

Even though the use of supplementary sucking technique has improved the outcome of underweight infants with lactation failure, the practice was only 21.5% in this study(23)**.** Compared to a study done in Niger, its use was lower(24)**.**

Based on cure, default, transfer out, non-respondent, and death rates, the treatment outcome was 57.1%, 11.5%, 9.2%, 4.2%, and 14.18%, respectively.

This study demonstrated a death rate higher than that in Bangladesh (3.9 %), Niger (6%) and Kenya (9%) without considering deaths that might have occurred in cases with defaulted and transferred out (15,16,24)**.**The death rate was also greater than what is recommended by the national guidelines and SPHERE standards, which consider values of < 10% and <3 %, respectively to be good indicators of care **(**13**,**14**).** The recovery rate in our study was significantly lower(17,25) compared to those of the Malawian studies (17, 25) on uncomplicated SAM in U6M (75.4%) and on inpatient in rural setting (83.3%)**,.**The significant increase in SAM treatment-related deaths and decline in cure rates in our study might be attributed to the fact that the majority of the infants were transferred from other treatment facilities due to being critically ill, resistant to conventional management, or experienced complications. The default rate was below the cut-off point of both the national guideline and SPHERE recommendations**(**13**,**14**).**
Infection is one of the causes that contribute to the death of malnourished infants. Similar to the Niger study, pneumonia was identified as one of the factors associated with the death of malnourished infants (24)**.** Pneumonia may associate with dehydration and also predispose the patient to hypoxemia(26)**.**The presence of severity features is predictor for mortality as reported by the Bangladesh study(27)**.** Malnutrition's immune-suppressing effects caused infections to become more severe. This might also explain the association of tuberculosis with death in u6m infants with SAM. Despite WHO and national guidelines recommending oral antibiotics for uncomplicated cases and iv antibiotics for complicated ones, only 35% of patients, i.e.,27.5% with oral antibiotics and 28.7% with iv antibiotics—were put on antibiotics treatment **(**2**).** This might also contribute to the high mortality of infants due to infection by not addressing it properly. Prematurity was also associated with mortality in our study, also supported by a Kenyan study which reported being small at birth was associated with mortality in u6m infants with SAM(15)**.** Because prematurity is linked to numerous medical issues, preterm infant mortality is high. Therefore, it might be challenging to determine if a preterm infant's death was brought on by an underlying medical condition or a nutritional shortage.

The association of Pre-lacteal feeding with mortality observed in this study was supported by other studies. Pre-lacteal feeding is one of the factors that predispose to wasting, according to a study from Bangladesh and northern India (16,28)**.** It was also associated with neonatal mortality (29)**.** This study explored 47.5% of mothers practiced Pre-lacteal feeding which is much higher than that of a study done in Gondar which showed that 23.5% of mothers in their study practiced pre-lacteal feeding with butter being a prevalent diet provided.

Exclusive Breastfeeding is recommended for the first 4-6 months with no pre-lacteal feeding to avoid the risk of infection(25)**.**

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Consent and ethical clearance

The study complied with the Declaration of Helsinki. A letter of ethical clearance was obtained from Hawassa University, College of Health Sciences, Institutional Review Board (protocol number =IRB/1007/2021). Written informed consent was obtained from each patient to participate in the interview and to extract data from their medical charts. Privacy and confidentiality were ensured during patient interview and medical chart review.

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Conflict of interest
The authors declare that there is no conflict of interest regarding the publication of this article
Data sharing statement
The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.
Author contributions
All authors made substantial contributions to conception, design, analysis and interpretation of data, reviewed the manuscript critically for important intellectual content, gave final approval of the version to be published and agreed to be accountable for all aspects of the work.

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