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ORIGINAL ARTICLE

TREATMENT OUTCOME FROM SEVERE ACUTE MALNUTRITION AMONG CHILDREN 6 TO 59 MONTHS ADMITTED TO HAWASSA UNIVERSITY COMPREHENSIVE SPECIALIZED HOSPITAL, SOUTHERN ETHIOPIA

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ABSTRACT

Background: *: Malnutrition continues to be a long-term year-round phenomenon, threatening under 5 children unacceptably the most. It is responsible for 25,000 children's hospitalization per month and nearly 50% of all under-5 mortalities in Ethiopia. The national burden of SAM highlights the importance of addressing predictors of recovery rates.*

Methodology: *An institution-based retrospective cohort study was implemented from a period of august 2020- august 2021. Data were collected using a structured questionnaire and entered and analyzed using SPSS 25. The output of both bivariate and multivariate logistic regression analysis was presented using an odd ratio and 95% CI. A p-value of less than 0.05 was taken as statistically significant.*

Results*: Among the total study cases of 241 children, 192(79.7%) records were recovered, 15 (6.2%) died, and 20(8.3%) were defaulted. The majority of the children, 155(64.3%) had non-edematous malnutrition. The independent predictors of mortality were pneumonia (AOR=6.57), hypovolemic shock (AOR=0.05), presence of both pneumonia and gastroenteritis (AOR=4,463), getting third-line antibiotics (AOR=0.23), fourth-line antibiotics (AOR=0.15) and hospital stay more than 28 days (AOR=0.12).*

Conclusion*: The finding of this study attested that recovery and death rates are within the national standard. As many of the death occurred within the first week of admission, due attention should be given to SAM patients from the first minutes of arrival. Reduction in length of the hospital stays, and early recognition and management of complications have been unveiled to further upgrade the recovery rate.*

Keywords: Outcome, recovery, retrospective cohort study

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Background

Nutrition is a crucial factor for optimum child growth and development, especially throughout the first 1000 days of life, but also beyond. All children, no matter where they live or their circumstances, have the right to survive and thrive. An adequate well-balanced diet is the bedrock of child survival, health, and development. Undernutrition, by the same logic, is a devastating public health problem, particularly affecting under-5 children with major consequences like blunting the intellect, sapping productivity, and perpetuating poverty(1, 2).

Globally, malnutrition affects around 20 million children and contribute for more than 50% of under 5 mortalities signifying 3.5 million children death each year. Developing countries are home to 70 to 80% of undernourished children in the world(3). With an alarming figure of one million under 5 children deaths each year, SAM is among the deadliest forms of malnutrition in developing countries (4, 5). SAM as defined by WHO-UNICEF includes severe wasting and nutritional edema. Severe wasting (marasmus) is defined as weight-for-length (WFL) or weight for height (WFH) below −3 standard deviations (SD or Z-scores) or mid-upper arm circumference (MUAC) <115 mm (6-8).

According to the Global Hunger Index 2020, Chad was the most affected by hunger and malnutrition, with an index of 44.7. Approximately about 239 million of malnourished children live in Sub-Saharan Africa. Diarrhea, malaria, and HIV/AIDS are considered major causes of undernutrition (9). According to 2020 reports, the prevalence of wasting, stunting, and overweight in Ethiopia is 7.2%, 36.8%, and 2.1%. Ethiopia has found it hard to meet all targets for infant and young child nutrition with disappointing progress to increase the figure (10). Severe malnutrition is both a medical and a social disorder. That is the medical problems of the child result, in part, from the social problems of the home in which the child lives (11, 12). The provision of routine antibiotics for children with malnutrition irrespective of place of treatment improves the recovery rate (13, 14).

AIDS and TB are the two well-known infectious comorbidities to bring about secondary malnutrition, particularly in sub-Saharan Africa (15,16). Diarrhea with or without dehydration is credited for 67.3% to 71% of death among under 5 malnourished children, though septicemia, pneumonia, malaria, and hypothermia are also contributing (17-20).

Today, almost a quarter of all children under 5 years of age are stunted and the progress is not only too slow to meet global targets but also deeply unfair. Being underweight is a persisting issue for the poorest countries and can be ten times higher than in wealthier countries (21 -23). In Ethiopia, nearly 4 in 10 (38%) of children under five are stunted. Stunting is more common in Amhara (46%) and less common in Addis Ababa (15%). Overall, 10% of children are wasted, a sign of acute malnutrition.

In addition, 24% of children are underweight. About 472,000 Ethiopian children die each year before their fifth birthday, which places Ethiopia sixth among the countries in the world in terms of the absolute number of child deaths. The national Under-five Mortality Rate is about 49/1000, with variations among the regions from 114 to 233/1000. About 90% of mortality in under-fives is caused by pneumonia, neonatal causes (prematurity, asphyxia, and neonatal sepsis), malaria, diarrhea, and measles. Malnutrition is the fundamental cause of death in about 57% of these deaths, and 11% are associated with HIV infection (24).

A study was done in Southern Nations Nationalities and Peoples Regional (SNNPR) state to unravel 45% stunting, 42% underweight, and 12% wasting (25). comparably in Jimma town the prevalence of stunting, underweight, and wasting were 36%, 36%, and 9% respectively (23). 57% of children aged 6-59 months in Ethiopia are anemic. (20, 23). Young children are most vulnerable to the effects of undernutrition because of their rapid growth and development and smaller bodily reserves. (26). The age of a child, sex, weight of the child at birth, mother's BMI, and region of residence were significant determinants of malnutrition of children under five years in Ethiopia (27).

In Ethiopia there is a scarcity of hospital-based studies done to explicit predictors of recovery from malnutrition among 6 to 59 months children, Hence, this study will identify the gap, will be used to improve the outcome, and becomes a basis for a future large multicenter study. The study was aimed to determine the treatment outcome and predictors of recovery from SAM among children between 6 months to 5 years of age.

Material and methods

Study area and period

The study area was at Hawassa, a capital city of the Sidama region in Ethiopia, on the shores of Lake Hawassa in the great rift valley. It is located 270km south of Addis Ababa with a latitude and longitude of 70 3’ N380 28’E and an elevation of 1708 meters.

The city accompanies Hawassa University which encompasses the agricultural college, main campus, forestry campus, and medicine and health science college. The study was conducted in Hawassa university college of medicine and health sciences inside Hawassa University's comprehensive and specialized hospital pediatrics and child health department. The department has outpatient and inpatient units, one of the inpatient units is a therapeutic feeding unit (TFU) in which children with SAM are treated and stabilized. It has three subunits phase 1, transition, and phase 2 with an average of 15 malnourished children admitted per week. The study was conducted from august 2020 to august 2021.

Study design

The study design was an institution-based retrospective cohort study based on secondary records of children aged 6 to 59 months with SAM admitted at the HUCSH stabilization center during a specified study period.

Population

All children with SAM came to seek medical care at HUCSH during the study period. All children aged 6 to 59 months with SAM were admitted to the HUCSH stabilization center during the study period. Children with malnutrition aged 6 months to 5 years of age were included, but incomplete documentation was an exclusion.

Sample size determination

The double population proportion formula for cohort study was entertained to calculate the sample size using Epi info 7(Fleiss w/CC) by considering the following statistical assumptions: two-sided confidence level (95%), Odds ratio for inpatient complication (AHR=2.2), and power 80%. The AHRS were taken from the study where the maximum recovery rate was reported and the predictor gave the appropriate sample size (28). Accordingly, a total study sample size of 248 was obtained, including compensation of 10% type 1 error, and SAM children's records were recruited.

Sampling technique and procedures

Data was collected from the patient's chart after tracing it from card rooms. Patients with severe acute malnutrition who were discharged during the study period were also the other source of data collection. After counting the study population from the hospital pediatrics department ward and EOPD logbooks, a total of 862 children aged 6 to 60 months with SAM were admitted during the study periods. The sample size was 248, making a constant K value of approximately 3.5. Eligible cases were selected from the existing medical records using a simple random sampling technique. The sample frame was developed for all records of SAM patients aged 6 to 59 months admitted at the HUCSH stabilization center from august 2020 to august 2021 based on their unique SAM identification number. To improve the retrieval rate, incomplete medical records and incorrect data were replaced by the next patient's card. Subsequently, a total of 241 patient cards were correctly retrieved from the hospital card room.

Data collection tool and procedure

Data was collected from the patient's folder who fulfilled the inclusion criteria after ethical clearance from the responsible body was obtained. It was collected by the investigators using standardized survey tools after it was tested by pilot studies. Data were collected by trained personnel. Before the data collection, the collectors were given in-depth training on the objectives of the study, on how to collect the data and fill the questionnaires properly.

Data quality assurance

During the study, the quality and completeness of filled information were checked periodically by the principal investigator, and accordingly, the necessary amendments were made. To help ensure subject privacy and confidentiality, only a unique study identifier appeared on the data collection form for each subject. Any collected subject identifying information corresponding to the unique study

identifier was maintained on a linkage file, stored separately from the data. Data access was limited to study staff.

Data processing and analysis

Data obtained from the study was cleared, entered, and analyzed using SPSS- Version 25 (computer software). Data were summarized using mean and standard deviation for quantitative variables, and percentage for qualitative variables. Data analysis involved calculation for indicators like recovery, death, and defaulter rate. The association between the recovery rate and type of malnutrition, age of a child, presence of diarrhea, pneumonia, shock (septic and hypovolemic), Length of hospital stay, and presence of TB controlling confounding factors for each was analyzed by using bivariate and multivariate logistics regression analysis. A P-value of less than 0.05 was considered statistically significant at a confidence interval of 95%.

Variables

The dependent variables for this study is a treeatment outcome which is classified as good Vs poor) The independent variable included age, type of malnutrition, length of hospital stay, the presence of complications like gastroenteritis, pneumonia, shock, lines of antibiotics received, severe anemia, HIV/AIDS, and Tuberculosis.

Measurements

Outcome comprises good outcome (recovered) and bad outcome (death, defaulter, and non-respondent).

Recovered/cure: a patient who fulfills WHO discharge criteria within 42 days of admission.

Death is a patient who died while he/she was being treated in the program in a facility, and a **defaulter** is a SAM patient that was absent for two consecutive weighing's.

A patient who could not meet the discharge criteria after six weeks of inpatient management is considered a **nonrespondent.**

Result

Demographic characteristics

From a total of 248 randomly selected records of children admitted with a diagnosis of SAM during a study period, 241 patients had complete medical records with a retrieval rate of 97.2%. Both sexes were evenly distributed, with a male-to-female ratio of 1.07. The majority of children 234(95.03%) were newly admitted cases, whereas 7(4.97%) cases had one previous admission with the same diagnosis. More than half of all children 154(63.9%) were aged less than 2 years age and 6 to 18 months represented the highest 129(53.5%). The mean age of study participants was 22.85±7.03months

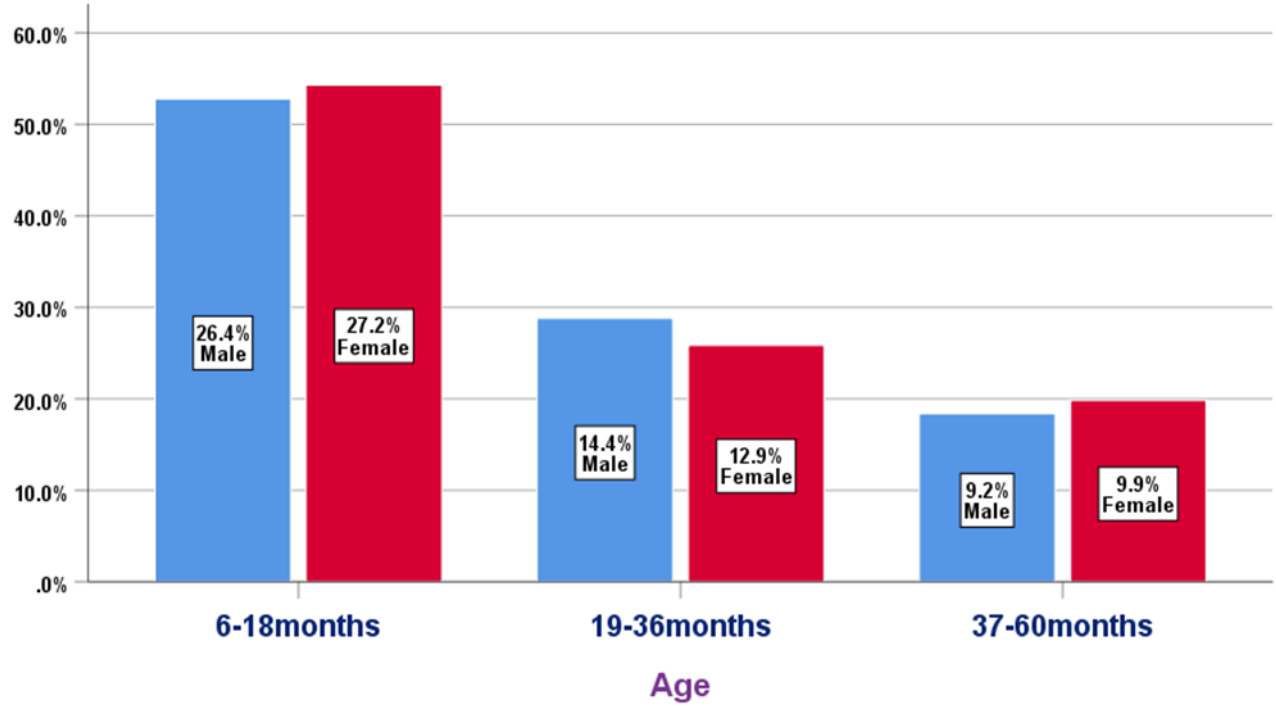

Figure 1: Distribution of age of the children with respect to their gender

Among 241 admitted cases, 126(52.3%) were from the Oromia region, particularly around Shashemene zone were 67(53.17%). Kebele 2 accounted for 30(44.78%), and 103(42.6%) were from the Sidama region. The rest 11 (4.5%) were from the south region. One hundred six (44%) children were completely vaccinated according to the schedule and 60 (24.9%) were vaccinated for their age whereas 27(11.2%) were not vaccinated at all.

Anthropometric information on severely malnourished children

Non-edematous acute malnutrition (severe wasting) was the topmost cause of admission 155(64.3%), followed by edematous acute malnutrition 86(35.7%), with marasmic-kwashiorkor and kwashiorkor representing 50 (20.7%) and 38(14.9%) respectively. The mean age of non-edematous malnutrition (21.75 months) was younger than that of edematous malnutrition (31.95months), 33.33 months for kwashiorkor, and 30.96 months for marasmic-kwashiorkor.

Of all admitted cases, 238(98.8%) were breastfed at least till admission. Of which, 174 (72.2%) children were on exclusive breastfeeding (EBF) for 6 months, 64(26.6%) were not on EBF, and 3(1.2%) did not breastfeed at all because of different reasons like a maternal loss. Two hundred one (83.4%) children were breastfed for less than 2 years with 115 (47.7%) breastfeeding upon admission. The mean age of breastfeeding was 14.3 months. The main source of income for their parents was farming 123(51%), and a majority of the children live with family members of 4 to 8 individuals 132(54.8%).

Table 1: Characteristics of children aged 6 - 59 months admitted with SAM to stabilization center at HUCSH, August 2020 to August 2021

Characteristics(n=241)	Category	Frequency	Percent
Gender	Male	125	51.9
	Female	116	48.1
Age	6 to 18 months	129	53.5
	19 to 36 months	66	27.4
	37 to 60 months	46	19.1
Breastfeeding	Still BF	115	47.7
	Below 2 years	86	35.7
	Above 2years	36	16.2
Region of residence	Oromia	126	52.3
	Sidama	102	42.3
	South	13	5.4
Admission stattus	New	134	95.03
	Readmission	7	4.97
Admission criteria	Marasmic	155	64.3
	Marasmic kwashiorkor	50	20.7
	Kwashiorkor	36	14.9
Vaccination status	Complete	106	44.0
	Vaccinated for age	60	24.9
	Incomplete	48	19.9
	Unvaccinated	27	11.2
Birth order	First	50	20.7
	Second	54	22.4
	Third	61	25.3
	Fourth and above	76	31.5
Admission diagnosis	Non-edematous SAM	155	64.3
	Edematous SAM	86	35.7

Medical comorbidities

Of all admitted patients, 229 (95.0%) had 1 or more malnutrition-related complications during admission. Anemia was the most common complication, accounting for 129(53.5%). of which, 121(50.2%) were moderately anemic and 8(3.3%) were severely anemic, requiring blood transfusion with the mean (±SD) hemoglobin (Hb) level of 8.1 (±1.86) g/dL. Pneumonia was the second most common complication 75 (31.1%), followed by both gastroenteritis and pneumonia 65 (27.0%) and gastroenteritis alone 58(24.1%). Septic and hypovolemic shock were seen in 10(4.1%) and 5 (2.1%) respectively. Septic shock 9(60%) and pneumonia 3(20%) were the 2 most common causes of death in this study.

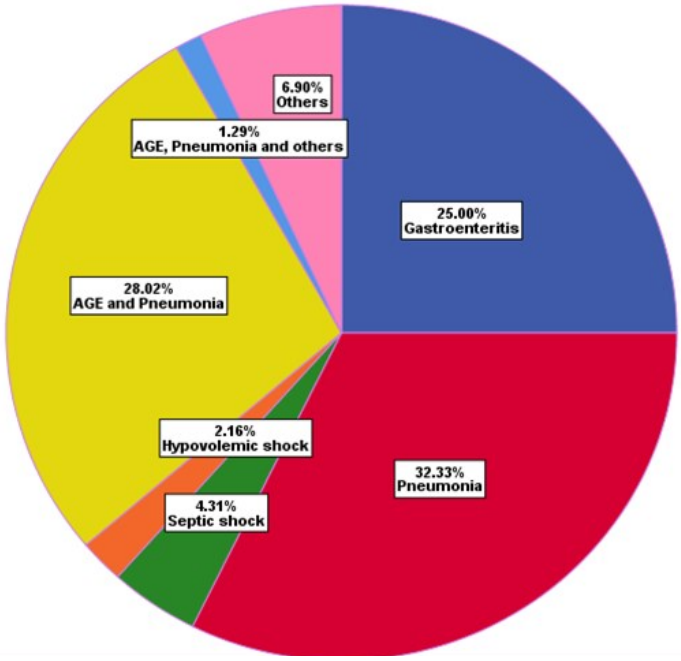

Figure 2: Distribution of complication of SAM patients at admission

None of the study cases had either a positive HIV test or started on ART. Tuberculosis was diagnosed in nearly 1 in 6 patients 39 (16.2%), with disseminated TB responsible for 27 (69.2%), succeeded by pulmonary tuberculosis (PTB) 8 (20.5%) and Extra-pulmonary tuberculosis (EPTB) 4 (10.3%). In the majority of study cases, 228- (94.6%) had received intravenous (IV) antibiotics, with 90 (37.3%) children receiving the second-line antibiotics (Ampicillin and gentamicin) and 99 (41.1%) third-line antibiotics (Ceftriaxone with oral ciprofloxacin) during their hospital stay. The remaining 39 (16.2%) study participants had received fourth-line antibiotics (Vancomycin and ceftazidime) and more potent antibiotics during admission. Those cases who received the third and fourth line of antibiotics had a higher rate to die with a statistically significant P-value of <0.05 (.00).

All 241 study cases were retrospectively followed for a minimum of 2 and a maximum of 55 days during the study period once admitted to the stabilization center of the hospital. The overall proportion of recovery was 192 (79.7%), death 15 (6.2%), and a defaulter rate of 20 (8.3%). According to the national minimum standards for the performance indicators, a recovery rate of >75%, a Death rate of < 10%, and a defaulter rate of <15% are acceptable figures as developed by the SPHERE project. Thus, the outcome figure is consistent with the national standard. The remaining 12 (5.0%) and 2(0.8%) represented the transfer out and the non-respondent rate during the study periods. The overall proportion of death among non-edematous and edematous malnourished patients was (11) 9.24% and (4) 5.55% using total respective admitted cases as denominators.

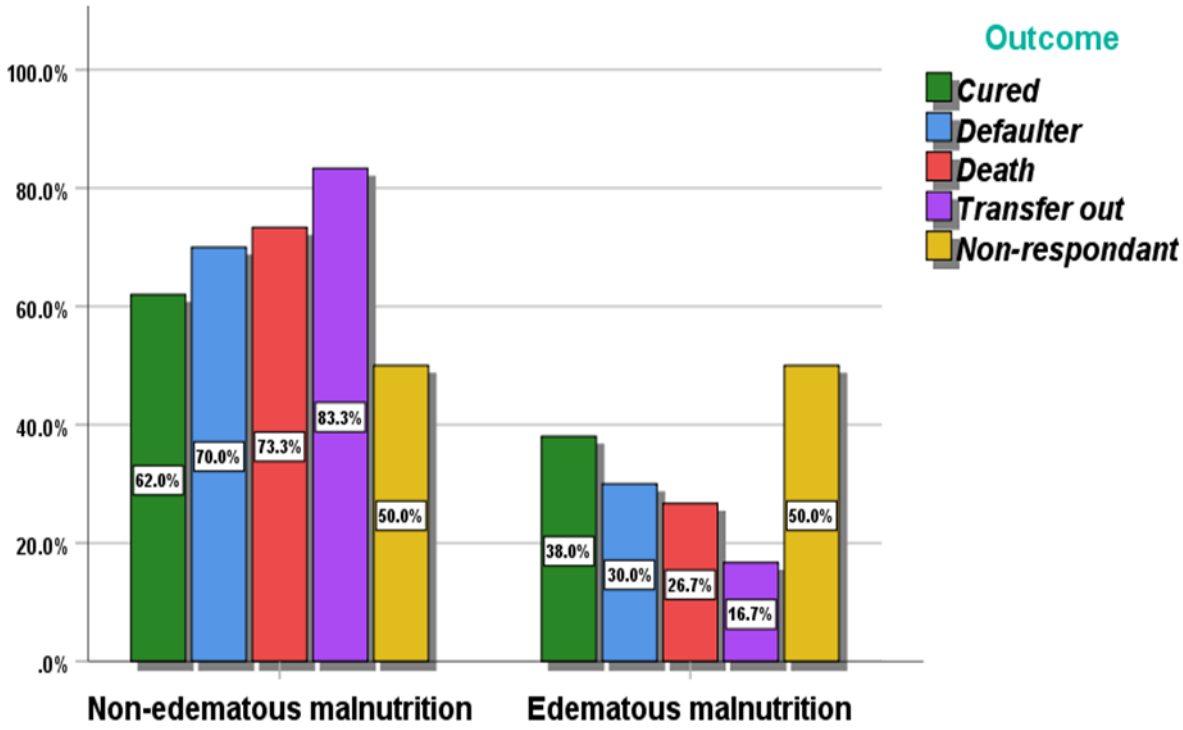

Figure 3: Treatment outcomes of studied cases according to the status of malnutrition

Most of the patients were hospitalized for the first 28 days 232(96.3%), with a mean length of hospital stay 0f 17.8(±4.87) days, which is still an acceptable range according to the SPHERE project. The mean length of hospital stay was higher for patients with marasmic kwashiorkor (25.57days). of the total cured cases 191, 119 (62.3%) were marasmic, 42 (21.9%) marasmic kwashiorkor, and 30 (15.7%) kwashiorkor. This figure might be proportionated with a higher number of admissions of marasmic patients.

Predictors of mortality of children from complicated SAM

On binary logistic regression analysis had been attempted considering a dependent variable(poor outcome) and the following independent variables, Age, gender, vaccination status, hospital stay, breastfeeding, admission criteria, admission diagnosis, presence of complication, types of complications, HCT at admission, place of residency, tuberculosis, and family size. Subsequently, longer hospital stays (p-value=0.003, COR=0.12), line of antibiotics received (p-value=.000, COR=0.146), types of tuberculosis (p-value=0.059, COR=0.09), presence of TB (p-value=0.186, COR=1.69, 95% CI=0.776-3.71), presence of complications (p-value=0.004, COR=8.10), admission diagnosis (non-edematous Vs edematous SAM) (COR=0.14, COR=0.59) was statistically significant, at p-value<0.2.

Moreover, duration of breast feeding (p-value=0.191, COR=0.50), age (p-value=0,106, COR=0.52), vaccination status (p-value=0.25, COR=1.88), gender (p-value=0.16, (male to

female) COR =1.58, 95% CI=0.837-2.99), and source of income (p-value=0.018, COR=2.38) were also demonstrated statistical significance. Whereas being EBF for the first 6 months, region of residency, family size, admission criteria, birth order, and age of the child was not shown statistical significance as their p-value is greater than 0.2.

Table 2: Product of binary logistic regression analysis of severely malnourished children hospitalized at HUCSH, August 2021.

Variables	Category	Recovery status			
		Recovered	Censored	COR	p-value
Gender	Male	104	21	1	1
	Female	88	28	1.58	0.158
Age	6-18months	107	22	1	1
	19-36months	52	14	0.52	0.105
	37-60months	33	13	0.68	0.392
Duration of breastfeeding	Still BF	87	28	1	1
	Below 2 yrs.	70	15	0.50	0.191
	Above 2 years	31	5	0.71	0.531
Source of income	Farming	105	18	1	1
	Laborer	27	9	2.38	0.018*
	Employee	8	2	1.22	0.665
	Pauper	3	0	1.63	0.557
Admission diagnosis	Non-edematous SAM	119	36	1	1
	Edematous SAM	73	13	0.59	0.137
Types of complications	Gastroenteritis	54	4	1	1
	Pneumonia	60	15	8.10	0.004
	Septic shock	1	9	2.40	0.139
	Hypovolemic shock	3	2	0.07	0.021
	AGE and pneumonia	58	7	0.90	0.920
	AGE, pneumonia, and others	2	1	4.97	0.014
	Others	10	6	1.20	0.891
Tuberculosis	Yes	164	38	1	1
	No	28	11	1.70	0.186
Types of TB	PTB	6	2	1	1
	EPTB	1	3	0.86	0.870
	Disseminated TB	21	6	0.10	0.059
Line of antibiotics	First line	8	5	1	1
	Second line	75	15	0.73	0.629
	Third line	88	11	0.23	0.001
	Fourth and higher	21	18	0.15	0.000
Hospital stays	<9 days	73	27	1	1
	9-28 days	115	17	0.29	0.082
	>28 days	4	5	0.12	0.003

Sequentially, multivariate logistic regression analysis was then carried out for those independent variables with a p-value <0.20 obtained from binary logistic regression analysis. Accordingly, the following outcome was entertained. Those children who were hospitalized for more than 28 days were 88.1% less likely to recover than those admitted for <9 days (p-value=0.003, AOR=0.12, 95% CI=0.290-0.490). Similarly, children admitted with a complication of pneumonia alone and pneumonia with AGE had a higher chance of recovery compared to those with gastroenteritis alone (p-value-0.012, 0.024, AOR-6.565, 4.463, 95% CI=1.508-28.90, 1.219-16.34, respectively).

On the contrary, those children complicated with hypovolemic shock were 94.6% less likely to recover and be discharged from the SC than those with gastroenteritis. (p-value=0.014, AOR=0.054, 95% CI=0.005-0.559). Furthermore, children who received third and fourth lines of IV antibiotics during their hospitalization were 76.5% and 84.8% less likely to recover and be discharged than their counterparts. (p-value=0.000, 0.001, AOR=0.24, 0.15, 95% CI=0.101-0.54, 0.06-0.37, respectively).

Table 3: Output of multivariate logistic regression analysis of children admitted with SAM at HUCSH, August 2021.

Variables	**Category**	**Status of recovery**		**p-value**	**AOR**	**95% CI**	
		Recovered	Censored			Lower	Upper
Types of complication	Gastroenteritis	54	4	1	1	1	1
	Pneumonia	60	15	0.012	6.57*	1.51	28.90
	Hypovolemic shock	3	2	0.014	0.05	0.01	0.56
	Pneumonia, AGE, and others together	2	1	0.024	4.46*	1.22	16.34
Lines of antibiotics	First	8	5	1	1	1	1
	Third	88	11	0.001	0.23*	0.10	0.54
	Fourth	21	18	0.000	0.15*	0.06	0.33
Hospital stays	<9 days	73	27	1	1	1	1
	9-28 days	115	17	0.082	0.29	0.72	1.17
	>28 days	4	5	0.003	0.12*	0.29	0.49

***- Significant at p-value 0.005**

Discussion

This study unravels the recovery, death, and default rate of 79.7%), 6.2% and 8.3% among children with SAM admitted to the stabilization center of HUCSH. The two most common complications identified were pneumonia and anemia, followed by acute gastroenteritis. Tuberculosis was identified as one of the complications that guard the recovery. 66.7% of the death occurred within the first week of admission and 78.1% discharged improved within the first four weeks of admission. The majority of the children, 64.3% had non-edematous malnutrition. The mean age of children with SAM was 22.85±7.03 months, which was inconsistent with similar studies conducted in Zambia(12-24months) and Zomba (29-31).

The finding of the study disclosed that the good treatment outcome (recovery) of SAM children admitted at the HUCSH stabilization center was within a range of the national minimum standards for performance indicators of recovery rate greater than 75 % (29, 32). This result is supported by studies done in Bangladesh (cure rate of 88%), the Sidama zone (93.36%), Southern Ethiopia (87%), Woldia (85%), and Jimma (77.8%) (33-37). This recovery rate was better than studies conducted in Africa (cure rate of 73 %), Hindawi (33.6%), Gedeo (76%), and selected hospitals in Ethiopia (55.9%) (38-41). This might be accountable to the difference in settings, case flow, number of trained health professionals, and the severity of complications they had. This study also uncovered that the death rate among study participants was below the national minimum standard of less than 10 % [29]. This finding antagonized studies carried out in other parts of Ethiopia (42, 43) However, most of the deaths occurred within the first week of admission, so this might be related to stabilization center factors such as excess case -load and failure to recognize complications earlier.

This study revealed that children who defaulted (8.3%) were considerably below the national and international minimum standards of cut -off point (< 15%) (44, 45). A similar finding with a defaulter rate of 5.3 to 12.9% was also obtained in different studies conducted in Ethiopia (39, 41-43, 46), but a higher defaulter rate was seen in other studies (38, 47, 48). Although this study showed that anemia and pneumonia were the two common complications encountered, anemia had no statistically significant relationship with the recovery rate of SAM, but a study done in Sekota, northern Ethiopia has shown severe anemia related to a higher mortality rate (AHR=6.71) (49), while those children who had pneumonia at admission had a higher recovery rate (AOR=6.565). This finding is inconsistent with the study done in southwest Ethiopia (50).

Despite the high burden of TB disease in this study (1 in 6), there was no statistically significant relationship between TB and recovery from SAM. This is in favor of a similar study conducted in Zambia Lusaka (30), Woldia (36), and Jimma (37). However, the result of

this study was out of favor with a study done at Jimma University (AHR=0.54) (42), Bahirdar Felege Hiwot Hospital (43), and Sekota Hospital (AHR=2.88) (49), where TB affected the cure rate negatively. The possible argument underlying this result would probably be because the study area was a comprehensive specialized hospital with early recognition and treatment of TB. The average length of stay under the stabilization center was 20.1 days. This is in line with the acceptable minimum international standard according to the SPHERE project (45) and the Ethiopian national guideline for the management of SAM which recommends a mean length of hospital stay less than 4 weeks as benchmarks against which to interpret the quality and effectiveness of functioning under average conditions (44) This result was better than studies done on Yemeni children (48) but in Zomba, Malawi where the median recovery day was 12 days (31).

As inferred from this study children who were remained in the stabilization center for more than 28 days were less likely to recover and discharged (AOR=0.119), which disagreed with a study done in Bahirdar where children who stayed longer had a higher recovery rate (43). This finding might robust the concept that the longer they stayed in the hospital, the more likely they to have or develop serious medical complications, which decreased the recovery rate. In this study, age was not an independent predictor of nutritional recovery rate. This finding was in line with a study done in Kenya and India (51, 52). however, it was the opposite of a study conducted in southern Ethiopia and Hindawi (31, 38). This difference might be due to the reference age range included in the studies. This study also discovered that children who received third (ceftriaxone and PO ciprofloxacin) and Fourth (Vancomycin, ceftazidime, and more potent antibiotics) lines of antibiotics were less likely to be discharged improved. (AOR=0.235, AOR=0.146, respectively). This finding is encouraged by a study conducted in Malawi (51) although the association was done for amoxicillin and cefdinir but against a study done in Althea, Indonesia (53), where the types of antibiotics were not specified. This finding is also antagonized by a study done in the Sekota Wagehmera zone (49) where children not managed by intravenous antibiotics had a higher mortality rate (AHR= 2.73). This difference is explained by the that those children who required more potent antibiotics likely to have severe complications that demand longer hospital stays, which in turn negatively affect the nutritional cure rate.

As this study suggested that the status of malnutrition was not a statistically significant independent variable, this finding was contrary to a study done in southern Ethiopia and Hindawi (29, 38), where edematous malnourished children were associated with a better recovery rate. This might be a higher number of admission due to severe wasting. Furthermore, the vaccination status of studied children was not statically associated with the

recovery rate unlike the study conducted by Viramitha K (53) suggested that complete vaccination history increased the recovery rate. The average weight gain among recovered cases, in this study, was 10.9(±3.4) g/kg/d, which was much lower than the study done in Hindawi (38). This difference might result from the duration of hospital stay and the weight scale used for study participants.

As indicated in this study the presence of complications like pneumonia alone (AOR=6.565) and pneumonia with AGE (AOR=4.463) was statically associated with a higher rate of recovery when compared to those children with gastroenteritis. However, Study done by Karunaratne R (AHR=1.89) (54) showed that the presence of pneumonia is rather associated with a higher rate of mortality. Moreover, a study done in Zomba Malawi revealed that those children who had pneumonia (AOR=0.71) were 29% less likely to recover (31). This might be owing to the difference in independent variables, HIV serostatus, and reference category, because 95.0% of study participants were admitted with 1 or more complications, thus the comparision was brought in amongst malnourished children with gastroenteritis and those with other complications like pneumonia, On contrary, those children complicated with hypovolemic shock had 94.6% less likely to recover and be discharged (AOR=0.054), which agreed with a study done by Karunaratne R. (54) and done in Jimma (AOR=0.18) (50).

The findings of this study might suffer from the fact that the study used secondary data from records. As the outcome was dichotomized into a good and bad outcome, the outcome of the transfer out and defaulter cases was unknown, which might affect the interpretation of the result. Adherence and practice of health professionals according to the standard protocol cannot be identified from records

Conclusion

The study revealed that recovery rate, defaulters' rate, death rate, and length of hospital stay has met the accepted minimum national and international standard for malnourished children which is the cure rate of more than 75 %, defaulter rate of less than 15%, a death rate of less than 10 % and the average length of stay of fewer than 28 days. Reducing the length of hospital stay has improved the nutritional recovery rate significantly. Children who had pneumonia and gastroenteritis were more likely to recover than those who had a hypovolemic shock. Most deaths occurred within the first weeks. Children who required 3rd or 4th line antibiotics had a lesser recovery rate. Therefore, early discharge, early recognition, and treatment of malnutrition-related complications have paramount importance to maximizing recovery rate and minimizing defaulter and death rate.

Declaration

Ethical consideration: Ethical approval was received from Institutional Review Board (IRB). In this study, there was no direct

contact with patients, and secondary data was used anonymously by using identity numbers instead of names to protect patient identity. As this was a retrospective cohort study, there was minimal risk to involve participants physically. All protected health information (PHI) was de-identified before data analysis and publication; subject identities were known only to the study staff. No reference to any individual participant was made in the study reports.

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