Time to Recovery and Determinants of Uncomplicated Severe Acute Malnutrition Among 6–59 Months Children From the Outpatient Therapeutic Feeding Program in North Shewa Zone of Oromia Region, Ethiopia. A Prospective Follow-Up Study.

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Keywords: Children, OTP, Time to recovery, Uncomplicated SAM

Posted Date: October 5th, 2021

DOI: <https://doi.org/10.21203/rs.3.rs-934196/v1>

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Abstract

Introduction: Community-based management of acute malnutrition is implementing in Ethiopia. But there is scarce information in our study set up regarding the time to recovery and its predictors of SAM among 6-59 months children, so this study aimed to assess the time to recovery and its predictors of uncomplicated SAM among 6-59 children managed at the OTP in north Shewa zone, Ethiopia.

Methods: A health post-based prospective follow-up study had conducted on 6-59 months children from November 20/2020 – February 20/2021. A total of 423 children had included in the study. A structured interviewer-administered questionnaire had used. The median time to recovery had calculated using the Kaplan Meier (KM) curve. The predictors of time to recovery were determined using both bi-variable and multi-variable Cox regression models with a 95% confidence interval (CI). Finally, the variable that had a p-value < 0.05 in the multi-variable analysis was declared as the predictors of time to recovery. Proportional hazard assumption was checked graphically and using Schoenfeld residual test.

Result: From the total 423 Children, 327 (77.3%) recovered. The median time to recovery was $42 \pm$ IQR of 14 days. Children from food secure households; AHR= 9.6 with 95% CI (8.1-18.5), mild food insecure; AHR= 6.5 with 95% CI (3.1, 13.8), moderate food insecure; AHR= 2.5 with 95% CI (1.2-5.3). Mothers who traveled less than 2 hours walking distance to the health post; AHR=2.6 with 95% CI (1.8-18.7). Children who received the correct dose of the RUTF AHR=1.6 with 95% CI (1.1-2.3), children who measured their weight weekly AHR= 1.5 with 95% CI (1.1-2.0), and children treated by health extension worker who took the Nutrition-related training AHR= 2.1 with 95% CI (1.0-4.5) were predictors of time to recovery.

Conclusion and recommendation: The median time to recovery was within the acceptable range of the Ethiopian protocol for the management of uncomplicated SAM in the Outpatient setup. Household food security status, the distance between home and health posts, the correct dose of RUTF, weekly weight measurement per protocol, and HEWs nutrition-related training status were the significant predictors of time to recovery. It is advisable to improve the household food security status, and the Health extension worker's (HEWs) nutrition-related training.

Introduction

Community-Based Management of Acute Malnutrition (CMAM) is a decentralized community-based approach to treating acute malnutrition (1). Uncomplicated Severe acute malnutrition (SAM) can be defined as; a weight-for-height measurement of $\leq 70\%$, weight for height Z score < 3 Standard deviations (SD), And/ Or amid-upper-arm circumference of < 110 mm (MUAC) in children age 6–59 months without any medical complications(1). Both macro and micronutrient malnutrition is a public health problem in under-five children in the world. Globally around 20 million children suffered from SAM yearly(1, 2). According to the Ethiopian demographic and health survey (EDHS, 2016), revealed that 38%, 24%, 10%, and 3% of children under the age of five years had stunting, underweight, wasted, and severe wasted respectively. In Ethiopia, malnutrition attributes about 53% of all under-five deaths (2).

Treatment is offered based on the nutritional and clinical needs of the child, with the majority of children receiving treatment at home using ready-to-use foods. Complicated severe acute malnutrition treatments are undergoing in the stabilization centers (SC). CMAM consists of four components: stabilization care for acute malnutrition with complications, outpatient therapeutic care for severe acute malnutrition without complications, supplementary feeding for moderate acute malnutrition, and community mobilization. It is an evidence-based model currently implemented in more than 70 countries worldwide and is the globally endorsed standard for the management of acute malnutrition. It is an appropriate model to address acute malnutrition, both in the development and humanitarian context(3). Timely diagnosis of cases, delivering effective treatment, and building local capacity (health system and community) in the identification and management of acute malnutrition are the main objectives of CMAM(4). Over the past 50 years, the case fatality rates for severe acute malnutrition treated in health facilities in most developmental settings have largely remained unchanged at 20–30% for marasmus and up to 50–60% for kwashiorkor. By contrast, for the past 30 years, management protocols implemented in specialist units have achieved case fatality rates on the order of 1–5%. Community therapeutic care is based upon the fundamental principle that all people whose lives are at risk from malnutrition should receive appropriate care and assistance (5). The provision of care should be impartial, targeted only based on need. It should be delivered without discriminating between or within affected populations and should not favor any particular side in conflicts or disputes. In practice, this principle translates into a commitment and obligation to provide the largest possible proportion of the acutely malnourished population with access to appropriate care in a timely fashion for as long as necessary. The core operating principles are thus the following: Although inpatient SAM management was successful in terms of the recovery of treated children, it failed to tackle SAM as a public health problem(6). The emergency setup demands a high workload and infrastructure. This was especially the case in open situations amongst dispersed communities living in chronic poverty where specialized inpatient feeding centers were not accessible. In their absence, children need to be referred to overcrowded pediatric or general wards ill-equipped to give adequate care to malnourished children. The new community-based approach is based upon proactive engagement with communities combined with a simple outpatient treatment model. Early presentation to the service will result from no admission into hospitals or clinics. The decision-making relied upon key individuals of the family and the community. This makes them understand and appreciate the care provided, early presentation and case finding increased dramatically. This model is easily implemented and resourced even in impoverished environments(6). The timely detection and improved access to standardized treatment reduced the case fatality rate to less than 5% (7). According to the World Health Organization (WHO) and the national guideline, children who have passed an appetite test and are clinically well had been treated through the Outpatient Therapeutic Program(8).

The acceptable level of recovery from SAM is about 75% and above. The minimum weight gain is about 8g/kg/day and above. The Antibiotic intake, vitamin A intake, admission Wt. /Ht and deworming status were some of the predictors of time to recovery. Despite some studies conducted at different parts of the

country, there is no adequate information regarding time to recovery and its predictors from USAM. In addition to this, no study had conducted in the North Shewa zone, Oromia, Ethiopia.

Material And Methods

Study design, setting, and period

A health post-based Prospective cohort study had performed from November 20/2020–February 20/2021 in the four districts of the North Shewa zone including; Dera, Abichu, Jida, and Kuyu districts. This zone has 13 woredas and 01 urban administration. Fiche town is the capital city of the Zone. It is located 112 km far from Addis Ababa in the Northwest direction. This zone has a total of 5 hospitals, 64 health centers, and 268 health posts. It has 1,690,403 population from these 274690(16.25%) are under five years, and 247689 children are 6-59 months.

Study participants and sampling procedures

All 6-59 months children in the north Shewa zone who have uncomplicated severe acute malnutrition and enrolled in the outpatient therapeutic feeding program were the source population. Whereas; every 6-59 months SAM children who were directly selected for the study and followed were the study units. Through multi-stage sampling, from 13 woredas, four were selected using simple random sampling techniques (Figure1). Through a simple random sampling technique, a total of 30 health posts from 89 had selected. The sample size was determined using both single and double population proportion formulas. A total sample size of 268 children was determined using a log-rank test by medcalc© setup 32 programs. The sampling uses the assumption of 95% confidence level, 80%power, 1.5adjusted hazard ratios to be detected as significant (equivalence of medium effect size) for the time-to-recovery outcome variable, 1.5 as the design effect, and 5% compensation for possible non-response.

Variables		Cured	Censored	% of outcome	AHR	Log - rank	P-value	Total event needed
Distance of HI from residence	<2 hours	196	46	72.9	1.48	19.3	<0.001	268
	>=2 hours	55	31	65.1	1			
Sex of child	Male	124	34	78.4	1.30	12.6	0.043	26
	Female	13	43	23.2	1			
Wt./Ht at admission	<60%	37	171	17.8	1	27.1	0.001	26
	>60%	218	60	78.4	1.87			

Data collection methods and instruments

A structured pre-validated interviewer-administered questionnaire was developed in English. It was also translated to the local Affan Oromo language and re-translated back to the English version to check the consistency. The data were collected by four diploma nurse data collectors using structured interviewer-administered questionnaires. The anthropometric measurements and physical examination had used to collect data from study children. Initially, MUAC measurement for every child from the left mid-upper arm was taken using a MUAC tap meter and recorded to the nearest 0.1mm. Weight was measured using a calibrated 25 kg hanging spring BMI balance to the nearest 0.1 kg for children below the age of 3 years weekly. For children older than 2yrs, a calibrated Seca balance was used and recorded to the nearest 0.1kg. The Height and length were measured using the measuring board and stadiometer. For the children younger than 2yrs, the length measuring board was placed on the ground and read to the nearest 0.1 cm in the recumbent position. On the other hand, a child older than 2yrs height was measured using a measuring stadiometer with the Frankfurt position and reads to the nearest 0.1 cm. Any medical complications and development of bilateral pitting edema were screened at admission and recorded during a follow-up on a standard individual treatment card. The appetite test had done in a separate quiet room. Cases that passed the appetite test were recruited for the study and continued weekly. Children who failed the appetite test in any visit had transferred to inpatient care. At admission, the data collectors assessed the condition of every child using the OTP cards. Every participant recruited in the OTP had visited their health posts weekly to receive the diet and a medical assessment. During the weekly visit, every child was examined and given a weekly RUTF.

Variables of the Study

The dependent variable was time to recovery. The independent variables were; socio-demographic characteristics (mothers age, educational status, age of the child, Sex of the child, Parental educational status, and household food security status); Child Healthcare-related factors (type of malnutrition at admission, Comorbidity, Admission weight, Antibiotic intake status, Vitamin A intake status, Vaccination status, The correct dose of RUTF, Deworming status, and folic acid intake status), other factors (Distance b/n residence and health post, Children food preparation way, and Water treatment status), and the **health extension worker-related factors**(Age of HEW, service year, educational status, Nutrition-related training status, supportive supervision, support from none governmental organization, and ICCM utilization status).

Measurements and study variables

Time to recovery means a time from admission to discharge date while the child is cured (Federal Ministry of Health Ethiopia, 2018).

The average length of stay was defined as the sum of the number of days for each recovered patient per total number of patients in a program (Federal Ministry of Health Ethiopia, 2018).

Weight gain (g/kg/day): was defined as an average weight (in gram) increase for every Kg of body weight of the child per day (Federal Ministry of Health Ethiopia, 2018)

Cured: A patient that has reached the discharge criteria (Federal Ministry of Health Ethiopia, 2018).

Death: The patient died while he was in the Programme at your facility or in transition to another component of the Program, but had not yet been admitted to that facility. For the outpatient Program, the death has to be confirmed by a home visit (Federal Ministry of Health Ethiopia, 2018).

Unknown- Patient that is absent for three consecutive weightings in out-patient care(21 days) but the outcome (actual defaulting or death) is not confirmed/ verified by a home visit (Federal Ministry of Health Ethiopia, 2018).

Defaulter- Patient that was absent for two consecutive weighing's (14 days in outpatient), confirmed by a home visit for the outpatient component of the program (Federal Ministry of Health Ethiopia, 2018).

Non-responder: Patient that did not reach the discharge criteria after two months in the OTP (Federal Ministry of Health Ethiopia, 2018).

Medical transfer - Patient that was 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 (Federal Ministry of Health Ethiopia, 2018).

Transfer Out - this is not a discharge. The “transfers out” from an OTP program who do not return can be considered to be a discharge with an UNKNOWN outcome unless the outcome is otherwise determined and Patient that has started the nutritional treatment in your TFU/OTP and is referred to another site to continue the treatment

Recovery rate - Number of patients discharged for recovery / Total No of exits (Federal Ministry of Health Ethiopia, 2018).

Mean length of stay for wasted cured children- The sum of (Number of days for each recovered case) / number of recovered patients (Federal Ministry of Health Ethiopia, 2018).

Average weight gain (g/kg/day) = Total individual weight gains/Total No of individuals (Federal Ministry of Health Ethiopia, 2018).

Mean rate weight gain for wasted cured children- the discharge weight minus the minimum weight multiplied by 1000 to convert the weight gain to grams again divided by the admission weight to give grams of weight gained per kilo body weight. Lastly, this total weight gain is divided by the number of days from the date of minimum weight to the date of discharge, to give g/kg/day.

A food-secure household experiences none of the food insecurity (access) conditions or just experiences worry, but rarely (FAO, 1996)

A mild food insecure (access) household worries about not having enough food sometimes or often, and or is unable to eat preferred foods, and or eats a more monotonous diet than desired (FAO, 1996)

A moderate food-insecure household sacrifices quality more repeated, by eating a monotonous diet or undesirable foods sometimes or often, and or has started to cut back on quantity by reducing the meal (FAO, 1996)

A severe food-insecure household has graduated to cutting back on meal size or number of meals often and or experiences any of the three most severe conditions (running out of food, going to bed hungry, or going a whole day and night without eating), even as infrequently as rarely or in other words, any household that experiences one of these three conditions even once in the last four weeks (30days)

Data quality control

Four data collectors (Diploma nurses) had trained on the content of the question and the aim of the study for 03 days. A pre-test was done at 5% of the sample size at another district before the actual data collection. A structured interviewer-administered questionnaire had used for the data collection. The supervisor and the investigator were checked the data for completeness, missing, and unwanted filling daily. Epi data manager version 4.6.0.4 had used for data entry. For the analysis STATA version, 16 had used.

Data analysis and processing

During the data collection, the completeness, missing, and the unwanted filling was assessed daily by the investigators and supervisors. The data were entered to Epi data manager version 4.6.0.4 and exported to STATA version 16 for the analysis. The descriptive statistics, percentage, and median uses to describe the categorical and continuous variables orderly. Proportional Hazard Assumption (PHA) was checked both graphically and using Schoenfeld residual tests. Cox regression model had computed for both bi-variable and multivariate analysis, and finally, results had taken as significant at a 5% level of significance. Adjusted hazard ratio (AHR) with its respective 95% confidence interval (CI) had reported showing the strength of association.

Result

Socio-demographic characteristics

A total of 423 study subjects had registered for this study with a response rate of 100%. At enrolment, 345 (81.6%), 183 (43.2%) of children were below 24 months and 12 months orderly. The female-to-male ratio was 01 to 1.2. The median age of the mother/ caretaker and the children were $35 \pm$ IQR of 11 years and $14 \pm$ IQR of 8 months respectively, (Figure 1). More than half of the mothers/caretakers (59.1%) did not read and write in their educational status (Figure 2). Most 239 (56.5%) households were food secured in their FSS (**Table 1**).

Table 1: Sociodemographic characteristics of the study participants in north Shewa zone, Oromia Ethiopia June 2021

Variables (n=423)		Frequency	Percent (%)
Parental educational status	Unable to read and write	241	56.9
	Able to read and write	100	23.6
	Elementary school (grade 1-8)	50	11.8
	Secondary school (grade 9-12)	29	6.9
	Diploma and above	3	0.7
Sex of the child	Male	193	45.6
	Female	230	54.4
Household food security status	Food secured	239	56.5
	Mild food insecure	95	22.5
	Moderate food insecure	53	12.5
	Severe food insecure	36	8.5
The age group of children in months	6-11	129	30.5
	12-23	216	51.1
	24-35	58	13.7
	36-47	18	4.3
	48-60	2	0.5

Health extension worker related factor

The mean age of the health extension worker in the study area was 29.8, in (± 3.7 SD) with a minimum age of 20 years and a maximum age of 38 years. More than half, 269(63.6%) of them were level four diplomas, and the rest 154(36.4%) were level three in their educational status. Regarding Nutrition training, about 321(75.9%) of health extension workers took the training. Around 76% of the HEW got supportive supervision with feedback from the woredas health office, and 38% of health posts had supported by NGOs (Table2).

Table 2: The Health extension worker-related factors of the study participants in north Shewa zone, Oromia Ethiopia June 2021.

Variables		Frequency	Percent (%)
The age group of HEW	<=29 years	32	53.0
	>29 years	28	47.0
Service years of the HEW	< 9 years	28	46.0
	>9 years	32	54.0
HEW educational status	Level 3 diploma	22	36.0
	Level 4 diploma	38	64.0
HEW nutrition training status	Trained	46	76.0
	Not trained	14	24.0
Health post support from woredas health office and others with feedback	Yes	28	46.0
	No	32	54.0
Health post support by none governmental organizations support	Yes	23	38.3
	No	37	61.7
ICCM utilization by HEW	Yes	46	76.6
	No	14	23.4

Child healthcare-related factor

The majority, 305 (72.1%) children, were Marasmic type malnutrition at admission, and the rest were kwashiorkor. About 310 (73.3%) children had taken routine antibiotics (Amoxicillin) during the treatment period, and 309 (73%) children had taken a vitamin. Most of the children (74.7%) had fully vaccinated (**Table 3**).

Table 3: Child healthcare-related factors of study mothers/caretakers in north Shewa zone, Oromia Ethiopia June 2021.

Variable's name		Frequency	Percent (%)
Type of malnutrition at admission	Marasmus	305	72.1
	Kwashiorkor	118	27.9
Child vaccination status	Fully vaccinated	316	74.7
	Not fully vaccinated	107	25.3
Routine antibiotic (Amoxicillin) intake status	Given	310	73.3
	Not given	113	26.7
Vitamin A intake status	Given	309	73.0
	Not given	114	27.0
Deworming during the treatment	Given	124	29.3
	Not given	299	70.7
Folic acid during the treatment	Given	79	18.7
	Not given	344	81.3
Weekly weight measurement	Measured	338	79.9
	Not measured	85	20.1
MUAC measurement as the protocol	Yes	364	86.0
	No	59	14.0

Other factors

The mother/ caretaker who traveled less than 2 hours to receive OTP was 339(80.1%) (Table4).

Table 4: The other factors for time to recovery among study participants in North Shewa Zone, Ethiopia, June 2021

Variables		Frequency	Percent (%)
Distance b/n residence and health post	Less than 2 hours	339	80.1
	Two hours and more	84	19.9
Children food preparation ways	Together with other family members	298	70.5
	Prepared for their own	125	29.5
Water treatment habit with aqua safe/chlorine in their home.	Yes	96	22.7
	No	327	77.3

The time-to-recovery and treatment outcomes of children with SAM

From the total recruited subjects, 327 (77.3%) at (95% CI: 73.05–81.06) successfully recovered, and hence they developed the event of interest. On the contrary, 22.7% of children have not developed the event. The reason for failure, 42(9.9%), 33(7.8%), 18(4.3%), and 3(0.7%), was none responder, defaulter, medical transfer, and transfer out orderly.

The mean weight gain of the recovered children is 5.7gm/Kg/day. The median time to response (recovery) was 42 ± IQR of 14 days (6weeks) as determined by the Kaplan-Meier survival estimate (Figure 4).

Determinants of time to recovery from uncomplicated severe acute malnutrition enrolled children in the OTP.

Among the socio-demographic factors, household food security was identified as a predictor for time to recovery among children with SAM. As a result, cases from mild food insecure recovered 6.5 times faster than cases from food-insecure HHS (AHR= 6.5; 95%CI: 3.1-13.8); whereas, Cases from moderate food insecure HHs recover at a rate of 2.5 times faster than cases from severe food insecure HHs (AHR= 2.5; 95%:1.2-5.3). The rate of time to recover among children from food secure HHs was 9.6 times faster than cases of severe food insecure HHs (AHR= 9.60; 95%CI:8.1-18.5). Children whose residence was at less than 2 hours walking distance from the nearby health post recovered 2.6 times faster than those who lived at a distance taking 2hours or more walking distance (AHR= 2.6; 95%: 1.8-18.7). Taking the correct dose of RUTF enabled the recovery time to be 1.6 faster than those who did not take the appropriate one (AHR= 1.6; 95%: 1.1-2.3). The rate of time to recovery among children who had weekly weight measurements was 50% faster than those who were not measured (AHR= 1.5; 95%CI: 1.1-2.0). Having SAM management service by HEWs who had nutritional-related training enabled the recovery time of cases to be two times faster (AHR= 2.1; 95%: (1.0 4.5) (Table5).

Table 5: Outputs of the Cox-proportional hazard model analyses on the predictors of time-to-recovery from severe acute malnutrition in north Shewa zone, Oromia Ethiopia June 2021.

Independent variables (n=423)		CHR(95% CI)	AHR(95% CI)
Maternal educational status	Unable to read and write	1	1
	Grade 1-8	1.22(0.90-1.66)	-
Parental educational status	Unable to read and write	1	1
	Grade 1-8	1.47(1.05-2.05)	-
	Grade 9-12	1.63(1.05-2.52)	-
Child vaccination status	Not vaccinated	1	1
	Fully vaccinated	1.22(0.95-1.57)	-
Household food insecurity status	Food secure	17.9(17.1-24.9)	9.6(8.1-18.5)
	Mild food insecure	10.1(5.1-19.9)	6.5(3.1-13.8)
	Moderate food insecure	2.9(1.4-6.2)	2.5(1.2-5.3)
	Severe food insecure	1	1
Distance b/n residence and health post	< 2 hours	13.9(10.8-95.4)	2.6(1.8-18.7)
	>= 2 hours	1	1
Health extension workers educational status	Level 3 diploma	1	1
	Level 4 diploma	2.56(1.97-3.33)	-
Supportive supervision with feedback	Given	17(8.74-33.06)	
	Not given	1	1
NGO support	Yes	1.26(1.01-1.58)	-
	No	1	1
HEW ICCM utilization	Yes	11.49(6.58-20.06)	-
	No	1	1
Type of malnutrition at admission	Marasmus	1.73(1.34-2.24)	-
	Kwashiorkor	1	1
Routine amoxicillin	Given	1.86(1.43-2.43)	-

	Not given	1	1
Vitamin A supplementation	Yes	1.86(1.43-2.43)	-
	No	1	1
Deworming status	Yes	1.34(1.07-1.69)	-
	No	1	1
The correct dose of RUTF intake	Given	4.6(3.2-6.7)	1.6(1.1-2.3)
	Not given	1	1
Weekly weight measurement	Yes	1.7(1.3-2.3)	1.5(1.1-2.0)
	No	1	
Nutrition-related training status	Trained	19.9(9.8-40.2)	2.1(1.0-4.5)
	Not trained	1	1
MUAC measurement per-protocol	Taken	1.85(1.29-2.64)	-
	Not taken	1	1

Discussion

The median time to recover from this study was $42 \pm$ IQR of 14 days(6weeks) as determined by the Kaplan-Meier survival estimate. The significant predictors of the time to recovery were household food insecurity status, the distance between home and health posts, the correct dose of RUTF, weekly weight measurement of the children per protocol, and health extension worker's nutrition-related training status. The recovery rate reported in this study (77.3%) was in line with the minimum 75% threshold set by the SPHERE standard(9) and the facility-based prospective cohort study done at shebedino, southern Ethiopia that was 79.6%(10). However, this was lower than a prospective cohort study done in the Afar region that was 83.2 %(11). This deviation may be due to many NGO involvements in the Afar region than this study area. Whereas; it was higher than the prospective cohort study done at north Gondar that was 65.3% (12). The reason behind this may be the study period difference and walking distance between their home and the nearby health posts. It was also higher than the retrospective cohort study done in Tigray that was 61.8%(13) Kamba district, southwest Ethiopia that was 67.7%(14), and the retrospective cross-sectional study conducted in Wolaita that was 64.9%(15). The possible reason for this may be the study period difference and the study design.

The mean rate of weight gain for this study was 5.98gm/kg/day with 95 % (CI: 5.61, 6.36). That was almost in line with the expected mean weight gain as determined by the SPHERE standard that recommends meaning weight gain should be from 6gm/kg/day to 8gm/kg/day(9). This finding was higher than the study done at shebedino, southern Ethiopia that was 5.4gm/Kg/Day(10). A retrospective study had done at Tigray that was 5.23gm/Kg/Day(13), and a retrospective cross-sectional study had

done at Wolaita that was 4.29gm/Kg/Day(15). The reason behind this may be the study period and the treatment waiting time difference. The median time to recovery of this study was $42 \pm$ IQR of 14 days (6weeks). That was within the acceptable range of the Ethiopian protocol for the management of uncomplicated SAM in the OTP that allows the children can stay up to 8 weeks on the treatment (Federal Ministry of Health Ethiopia, 2007), and in line with the prospective study done at north Gondar that was $38.5 \pm$ IQR of 14 days(12). However, the recovery time in this study was a little longer day than the international standard that recommends below six weeks(16), and the study at shebedino, Ethiopia that was 36 days(10). These may be due to none- adherence of the health extension workers to the management protocol and the HFIAS difference of the study areas. However, This was shorter days than the prospective cohort study at the Afar region. that was $44.15(\pm 8.77)$ days(11), the retrospective study done in Kamba district southwest Ethiopia that was 7.14 weeks IQR 5.28-8.1(14), and the retrospective cross-sectional study done at Wolaita that was 6.8 weeks (15)respectively. The possible reason for this discrepancy may be the study period and monitoring and evaluation system differences. From socio-demographic factors household, food security status was the predictor of time to recovery. Cases from food secured HHs (AHR = 9.6), mild food insecure (AHR = 6.5), and moderate food insecure (AHR= 2.5) recovered faster than cases from severe food insecure HHs. This finding had supported by the result at shebedino, southern Ethiopia(10). The distance between the residence and the health post had significantly associated with the time to recovery. Those cases who traveled less than 2 hours were 2.6 times recover faster than their counterparts. This finding was in line with the study conducted in the Afar region(11). Taking the correct dose of RUTF enabled the recovery time to be faster than those who didn't. The children that had in the OTP program should get the correct caloric dose to respond faster. The rate of time to recovery among children who weekly measured their weight was 50% faster than those who didn't. It may improve the monitoring of cases and intervene on the finding early. The other factor had significantly associated with the time to recovery was health extension workers' nutrition-related training status. Those who had nutrition-related training were two times improved time to recover than those who did not take the training. Giving the updated nutrition-related training for the health extension workers can improve the quality of treatment and adherence to the management guideline. The type of malnutrition at admission, the age of the children, Amoxicillin intake, vitamin A supplementation, and deworming were not the predictors in this study. That were predictors in other studies for the time to recovery (17). These may be due to adherence to the treatment, shortage of supplies, and inadequate management quality of health extension workers as indicated by the protocol, study area, and study period difference.

Conclusion

The median time to response (recovery) of this study was $42 \pm$ IQR of 14 days (6weeks) as determined by the Kaplan-Meier survival estimate that was within the acceptable range of the Ethiopian protocol for the management of uncomplicated SAM in the OTP. The significant predictors of the time to recovery were household food insecurity status, the distance between home and health posts, the correct dose of RUTF, weekly weight measurement of the children per protocol, and health extension workers' nutrition-related training status.

Abbreviations

CBN, community-based Nutrition; CMAM, community management of acute malnutrition; CSA, central statistical agency; CTC, community-based Therapeutic care; EDHS, Ethiopian demographic and health survey; FAO, food agriculture organizations, Food security; FSS, Food security status; HEW, health extension worker; HHs, Households; HFIAS, HFIAS; ICCM, integrated community case management; IQR, Inter Quartile range; MAM, moderate acute malnutrition; MUAC, mid-upper arm circumference; OTP, OTP; SAM, severe acute malnutrition; RUTF, ready to use therapeutic feeding; UNICEF, united nation cultural education fund; WFH, Weight for Height; WHO, world health organization;

Declarations

Ethics Approval and consent to participate

The study approval had obtained from the institutional ethical review Committee of Salale University. An official letter of cooperation had written from the selected districts, and each respective health office gave a permission letter. Oral consent had taken from every mother before the interview started after explaining the objective of the study. The study participants did not get any incentives as compensation. The confidentiality of the respondent had kept by avoiding the name and household numbers of the respondents. The questionnaire had also kept in a secured locked cabinet and the database with a secured strong password.

Consent for publication

Not applicable

Availability of Data and Materials

The data sets used and analyzed in this study are available from the corresponding author. Data will not be shared to preserve the participant anonymity.

Competing interests

The author reports no financial and non -financial competing interest in this work.

Funding

This study had funded by Salale University.

Author contribution

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Acknowledgments

First, we would like to say thanks more to North Shewa zonal health department staff for their provision of valuable information. Secondly, we want to extend our thanks to Salale University's department of Public Health for giving us the chance to conduct research. Lastly, we would like to extend our deep gratitude to study Woredas health offices, health centers, and health posts staff members for their friendly support.

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Figures

Figure 1

Schematic presentation of sampling procedure of time to recover and determinants of recovery among 6–59 months children enrolled at the outpatient therapeutic feeding Program in north Shewa zone, Oromia region, Ethiopia 2020/2021.

Figure 2

Age of the mothers/ caretakers in north Shewa zone, Oromia region, Ethiopia, June 2021

Figure 3

Mothers/ caretakers' educational status in north Shewa zone, Oromia region, Ethiopia, June 2021.

Figure 4

Kaplan- Meier survival estimate of the enrolled children in the OTP program in north Shewa zone, Oromia Ethiopia June 2021