Recovery rate and treatment outcome in children aged 6-59 months with severe acute malnutrition admitted to outpatient therapeutic feeding, in Ethiopia

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Abstract

Different factors influence the recovery rate and treatment outcome of children with wasting using ready-to-use therapeutic food (OTP). Hence, our study aimed to assess determinants of the recovery rate among children with severe acute malnutrition (SAM) managed in OTP. A facility-based retrospective cohort study was conducted on 561 children treated in OTP. The proportion of recovery was 77.4%. The presence of edema, provision of Amoxicillin, Folic acid, and weight gain in the first three weeks were determinants of improved recovery rate. A better recovery rate could be achieved through improving the adherence to the proper administration of routine medications.

Keywords: Severe acute malnutrition, Outpatient therapeutic feeding, Recovery rate, and Children

Introduction

Acute undernutrition (wasting) is a condition in which a child becomes too thin for his or her height because of weight loss or failure to gain weight (1). Globally, 45.4 million children under five were suffered from wasting, and of this 13.6 million were affected by severe wasting (1). Severe acute malnutrition (SAM) lead to over one million children's death each year (2). Children suffering from SAM have a 5-20 times greater risk of death than well-nourished children. About 15 percent of children with SAM require admission to inpatient treatment in stabilization centers (2). In 2020, it was estimated that more than 12.1 million African children under the age of five were affected by wasting (1). According to the 2019 Mini Ethiopian Demographic and Health Survey (EDHS) report, 7.2 percent of children under five were wasted (3).

The World Health Organization (WHO) defines severe acute malnutrition (SAM) as a weight for height ratio (WFH) of less than -3 standard deviations (SD) or mid-upper arm circumference (MUAC) of less than 11.5 cm or presence of bilateral pitting edema (2). Children who are identified as having SAM should be examined for medical complication and their appetite. Children who have medical complications, severe bilateral pitting edema, or poor appetite, or present with one or more danger signs should be treated as inpatients.

According to Protocol for the Management of SAM (2007), OTP is a service treating patients with SAM without medical complications through the provision of routine medical treatment and nutrition rehabilitation with ready-to-use therapeutic foods (RUTF) (4). The children attend OTP every week until the discharge criteria are reached. In Ethiopia, OTP is now available in every health center and health post. The community-based therapeutic care programs for the management of SAM are primarily employed by community mobilization to engage the affected

population and maximize coverage and compliance. Other routine medications such as antibiotics, vitamin A, folic acid; and deworming. provide effective care to the majority of outpatient managed children with SAM (5).

Previous studies identified anemia at admission, maternal illiteracy, sharing of Ready-to-Use Therapeutic Food (RUTF), co-morbidity with diarrhea, and child age as predictors of time to recovery from SAM (6-8). However, the majority of previous studies were conducted in areas where SAM was less prevalent. Because determinants differ from setting to setting and recovery predictors in such a prevalent area would implicate a knowledge for interventions (9). Therefore, this study aimed to determine the factors that influence the recovery rate of children undergoing an OTP for severe acute malnutrition among children 6–59 months in West Hararghe, Ethiopia.

Materials and methods

Study design, site, and period

We conducted a facility-based retrospective cohort study in the inpatient unit of two health centers and seven health posts in West Hararghe, Ethiopia from March to May 2017. West Hararghe is located in the eastern part of Ethiopia, 401kms from the capital city of the country. Eastern part of Ethiopia is among areas prone to drought, conflict, and food insecurity, which have been among the key determinants of undernutrition in the country for several decades (10). The protocol for the management of acute malnutrition was used in all selected health facilities (4).

Source population: Records of all children aged 6-59 months who attended an outpatient therapeutic feeding program in the Habro district between September 1, 2014, and September 1, 2016.

Study population: A sample of children who received OTP treatment between September 1, 2014, and September 1, 2016.

Inclusion criteria: Records of children aged 6-59 months who were managed for severe acute malnutrition based on Federal Ministry of Health of Ethiopia admission criteria after treatment at an outpatient therapeutic feeding program in Habro district were included.

Exclusion criteria: Records of all Children who were transferred- out and lost to follow up with unknown outcomes were excluded due to lack of required information for the study

Sample size determination and population proportion

The sample size was calculated using a single population proportion formula.

$$n = \frac{Z_{\alpha/2}^2(p*(1-p))}{d^2}$$

n = Sample size

$Z_{\alpha/2}$ = 1.96 (is the critical value of the normal distribution at α/2)

p= is the sample proportion (taken from previously conducted study) and

d = an absolute precision (margin of error)

Assuming, a recovery rate prevalence of 67.7% (7), using a margin of error of 5%, the non-response rate of 10% and design effect of 1.5, the minimum sample size required to determine the treatment success rate of OTP is **561**.

Sampling procedures: The study district, Habro district had seven health centers and 32 health posts. The district was chosen on purpose due to food-insecure with recurrent droughts and high prevalence of acute malnutrition in the district (10). As a result, two health centers and seven health posts were chosen through simple random sampling (lottery method) to ensure a sufficient sample size. The OTP protocol for SAM management was also applicable at the health center and health post levels. In total, a sampling frame of SAM-managed children from two health centers and seven health posts in the district was prepared. The probability proportional to size sampling method was used to assign samples to each health facility. Finally, the children were chosen at random from each facility using their unique identification number.

Data collection

The sources of data for the study were individual outpatient therapeutic record cards. The cards contained information recorded at admissions such as sex, place of residence (Urban, Rural), age of the child, Anthropometry measurements, admission medical history (medical problem), physical examinations, and medications prescribed on a routine basis was obtained from the

source of data. Cards with recorded follow-up anthropometry measurements, clinical features, routine medications, immunization status, and treatment outcome status were also used as data sources. All of the data were collected by three nurse professionals using a uniform extraction format developed from OTP cards.

Outpatient Therapeutic Program (OTP)

The OTP provides services to severely malnourished children aged 6–59 months. According to the SAM management protocol (4), children with MUAC less than 11.0 cm and/or weight for height Z-score less than -3 or presence of bilateral pitting edema and no medical complications are admitted to the OTP. The children admitted to the OTP receive a weekly Plumpy'Nut ration as well as routine medications based on their body weight. Antibiotics, de-worming tablets, vitamin A, folic acid tablets, and measles vaccine are among the routine medications. The discharge criteria for children admitted to OTP are reaching target weight and/or weight-for-height ratio greater than 85% for wasted and disappeared edema regardless of their body weight status for edematous children. The outcome of the treatment includes recovered, defaulter, non-respondent, medical transferred, and died. The treatment outcomes were compared with international Sphere standard requirements to evaluate the program effectiveness. The recovery, death, and default rates were considered as acceptable when >75, <10, and <15% respectively and alarming when <50, >15, and >25% respectively based on international Sphere standard (11).

Independent variables: Socio-demographic characteristics: age and sex of children, distance from home to health facility residence, and referred by (person referred the child to health facility).

The Baseline characteristics such as anthropometry measurements, admission medical history, intake of routine medication, the status of appetite test on admission with Plumy-Nut, and diagnosis on admission, admission status (new, readmission, or return after default).

Follow-up characteristics- follow-up anthropometry measurements, clinical features, routine medications, and outcome status. Type of health facility (health center, health post)

Dependent variable: Recovery rate

Data quality assurance

A structured and pretested data abstraction form on 5% of the sample size outside the study area was used for data collection. Data were abstracted within thirty days from outpatient therapeutic cards and registration for socio-demographic, baseline characteristics, follow-up, and outcome status by using three nurse professionals who trained on OTP as data collectors. The training was given by the principal investigator for 2 days before the data collection period about the objectives of the study, variables on the data abstraction sheet, OTP cards, and how to abstract data for this study. To ensure quality data collection, close supervision was carried out by the principal investigator and two supervisors during data abstraction. To ensure the completeness, accuracy, and consistency of information during data collection, the principal investigator and supervisors have made thorough checks before receiving the filled checklist from each data collector and in the meantime, they have selected the cards to crosscheck whether it is properly done or not.

Statistical analyses

Data were entered twice into EpiData version 1.2.2.0 (EpiData Association) to identify any errors or omissions. The EpiData database, which had been validated and cleaned, was converted to STATA format. The STATA version 16.1 (StataCorp LP) software was used to process and analyze the data. Categorical variables were summarized using frequency and percentage, whereas numerical variables were reported using median with interquartile range (IQR). The median time to recovery was estimated using Kaplan-Meier analysis. To determine whether the observed difference was significant, a log-rank test was used. Bi-variable and multivariable Cox-proportional hazard regression model was performed to identify predictors of time-to recovery. Variables with a P-value of 0.3 in the bivariate analysis were included in the multivariate cox regression analysis. Statistical significance was declared at a p-value less than 0.05.

Results

The study included 561 children who were treated for severe acute malnutrition through an outpatient management program. The majority of the children, 66.7 % (n, 374), were admitted with severe wasting, while the remaining 33.3% (n, 187) were admitted with edema. Health posts were more decentralized than health centers, requiring an average of 1.64 hours on foot versus 1.24 hours from child's home. The most frequent medical problem was the failure to gain any weight for the first three weeks, 53.3% (n, 276). The severity of other medical problems: diarrhea, vomiting, cough, and fever were not concluded from extracted data. Amoxicillin was provided to 25.6% of the children, vitamin A to 17.2%, and folic acid to 24.9% (Table 1).

OTP program outcome

The prevalence of cure, death, defaulter, and length of stay in the OTP program compared with Sphere project reference value is displayed in Table 2. The overall recovery rate was 77.4 %, with 76.7 % and 78.6 % of children admitted with severe wasting and edema, respectively. About 4.5% of wasted and 5.3% of edematous children were not responded to the treatment. The recovery rate of children under two years were higher than the older children. The recovery rate for children under the age of two years was 78.8%, with 2.8% died, 14.7% defaulted, and 3.8% not responded to treatment (did not meet any of the discharge criteria). Likewise, the recovery rate of children 24-59 months of age was 75.5%, with 2.9% died, 15.4% defaulted and 6.2% not responded. The mortality rate was 14.2% (n, 16) in health posts and 0.0% in health Centers.

The median length of stay under the OTP treatment was 6 weeks (44-53 days). The OTP service providers in this study retained 15.7% of the children for more than 8 weeks (8-

18weeks) under the program. The length of stay for edema patients is less than severely wasted children in the program (i.e., median length stay of edematous patients was 41 with (IQR 30 -39) days while for severely wasted children was 46 with (IQR 34 -56) days.

The median (IQR) rate of weight gain among recovered children was 4.03 g/kg/day (IQR: 2.00, 6.00) in wasted and 2.84g/kg/day (IQR: 1.00, 4.00) in edematous children. The mean discharge MUAC value for recovered children was 11.30cm (IQR: 11.2; 11.4) for wasted and 11.26cm (IQR: 11.1, 11.4) for edematous children.

Determinants of recovery from OTP

All children were given ready-to-use therapeutic foods (RUTF) and routine medical treatment in accordance with the protocol for the management of SAM (2007). The determinants of improved recovery rate were children provided Amoxicillin (CHR=8.28, 95% CI: 4.28, 16.02), Folic Acid (CHR= 7.02, 95% CI: 3.95, 12.46), urban resident (CHR=1.38, 95% CI: 1.09, 1.73), admitted in health center (CHR = 1.37, 95% CI: 1.09, 1.72) and admitted with edema (CHR = 1.35, 95% CI: 1.10, 1.64). Children who were improperly managed had a lower rate of recovery. That is, children who had diarrhea cough, loss of appetite assessed using plumpy Nut, vomiting, and failure to gain weight for the first three weeks and those who did not receive routine drugs had a consistently lower recovery rate per week during the intervention period (Table 3).

A child admitted with edema had the higher probability of getting recovered from SAM compared to the children admitted with severe wasting (AHR=1.84, 95% CI: 1.49, 2.27). Similarly, the provision of Amoxicillin increased the recovery rate by 70% (AHR=0.3, 95%-CI:

0.11, 0.67), and the gain of weight during the first three weeks of admission increased the recovery rate by 70% (AHR=0.3, 95% CI: 0.23, 0.37).

Discussion

The study revealed that the proportion of recovery and death rates in under-five children admitted to OTP was 77.4% and 2.9 %, respectively. Children's length of stay on the programme for oedematous children was less than wasted children. We found 15.7% of children had retained for more than 8 weeks under the program. Recovery and non-respondent rates were different in the health centers and health posts, and the mortality rate showed only in health posts (100%) compared to health Centers (0.0%). Edematous children, provision of Amoxicillin, Folic acid, and increased weight gain in the first three weeks of treatment were the determinants of improved recovery.

Our study showed an acceptable recovery rate according to the international standard minimum recovery rate (11). The reported recovery rate in our study was consistent with findings from different settings (12, 13). The higher recovery rates were reported in studies conducted in southern Ethiopia (14), in a cohort study evaluated outpatient therapeutic feeding program in southern Ethiopia (15), and in operational study done in rural southern Malawi (16) and Burkina Faso (17). The finding was slightly higher than the 2005 EFY annual OTP performance report of Kamba district (18), in the Tigray region (19) and Kenya (20). A discrepancy between our findings and discussed studies might be attributed to differences in the study setting and the types of health facilities, with children receiving treatment at health centers being more likely to have medical complications and thus receiving more attention, which may have contributed to a better recovery.

We discovered that the treatment outcome/response in boys was not significantly different from the treatment outcome in girls. However, a study done in Tigray found that boys had

better treatment outcomes than girls (19). This might be due to fewer numbers of boys admitted to OTP in our study compared to the Tigray study. According to our findings, the average length of stay following OTP intervention far exceeds the acceptable minimum international standard (21) and is well within the Ethiopian protocol for SAM management, which allows children to stay on treatment for up to eight weeks (4). The length of stay is comparable to a previous study evaluated the outcome of outpatient therapeutic feeding program in southern Ethiopia (22). However, there is a one-week delay in Outpatient Therapeutic Feeding Program treatment in this study when compared to a similar study on the evaluation of OTP in Jimma Ethiopia (23). Additionally, according to a study in Burkina Faso, the weight gain discharge criteria may have also contributed to the higher non-response noted in the present study by giving the studied children a shorter period to attain nutritional recovery.

Our study found a consistent mortality rate with the minimum international standard set for the management of severe acute malnutrition (11). In addition, our study found higher child mortality rate among children treated in health posts than health Centers. This finding was lower than the findings of studies from Kampala, Uganda (24), northwest Ethiopia (25), and Kenya (26). However, the present study found higher child mortality rate than in the meta-analysis study (27). The discrepancy between our findings and the discussed studies might be due to differences in patient load, patient profile, a management protocol, management team, and medical supplies. The difference in mortality rates between health posts and health centers could be explained by a presence of more qualified health professionals at health centers than at health posts. The mortality rate in older children was higher than that of younger children,

which might be due to stress of stopping breastfeeding and suffering from insufficient feeding practices.

The children admitted with severe wasting remained on SAM management for a longer period than edema children. This was consistent with some evidence found that non-edematous children had a slower response to the current SAM treatment as compared to the edematous counters (22, 28). The reason might be due to caregivers and health care providers providing relatively better care to edematous children. Study shows that caregivers are more concerned about edematous children than severely wasted children (29). In contrast, the OTP is currently facing challenges, such as the commonly practiced sharing of therapeutic foods with family members. On the other hand, OTP is currently facing challenges, such as the commonly practiced sharing of therapeutic foods with family members (21, 30). The reasons for sharing were related to the caregiver's perceptions of SAM and household food insecurity (30). Thus caregivers believe it will be difficult to treat edematous children (29) who might have less likelihood of sharing therapeutic foods provided to their children. As a result, we believe that better utilization of provided therapeutic foods may be a possible reason for edematous children taking the shorter length of stay on treatment.

Children provided with amoxicillin were more likely to recover compared to their counterparts. The finding was in line with the report from OTP in Tigray Region (19). The likely recovery of children provided with amoxicillin was explained by the supportive effect of antibiotics mainly amoxicillin in the treatment progress of SAM at OTP. The antibiotic provided for routine treatment must be active against bacterial pneumonia and small bowel bacterial overgrowth

causing dehydrating diarrhea (4). Thus, the finding possibly justified that amoxicillin was active bacterial pneumonia and small bowel bacterial overgrowth in SAM children.

The current study has some limitations, such as the use of retrospective study design and the fact that it relied on secondary data from patient follow-up cards, and that the following variables were missing: (1) information on treatment compliance at the home level, such as the existence of Plumpy Nut sharing among siblings; (2) proper treatment provision to the indexed child at home; and (3) the effect of maternal educational level on child care.

Conclusions

In conclusion, the children admitted to OTP intervention had a 6.6-week recovery rate, weight gain, and length of stay. Being enrolled with edema, not taking routine medication (Amoxicillin and folic acid) and failing to gain weight in the first three weeks were the strongest predictors of a low recovery rate. Sex, Age, referred by, residence, distance from the health facility, and medical comorbidity on the other hand does not affect the recovery rate of OTP patients. A better recovery rate could be achieved by improving the adherence to the proper administration of routine medications according to SAM management protocol.

Declarations

Ethical Approval and Consent to participate: Ethical approval was obtained from the Addis Continental Institute of Public Health the ethical review board. Permission letters were obtained from Habro district Health Office to use the OTP cards for research purposes. Confidentiality to information was maintained by not using any personal identifiers on the checklists for data collection and the recorded data were kept away from access to a third person but for the team of investigators. Since we extracted secondary data from patient cards, we have not obtained participant consent.

Consent for publication: Not applicable.

Availability of data and materials: The dataset for the present study is available from the corresponding author upon reasonable request.

Competing interests: The authors declared there were no financial or non-financial relationships in this study that could be viewed as a potential conflict of interest.

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Authors' contributions: Birhanu G and AWT conceptualized the study. Birhanu G recruited the participants and collected the data. BR analyzed the results and drafted the manuscript. AWW supervised in drafting the manuscript. Binyam G and AWT assisted in improving the presentation of the manuscript. All authors have read and approved the final manuscript.

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Table 1: Baseline admission characteristics of children admitted to the selected Health facilities from 2014 to 2016, Ethiopia

Characteristics	Frequency (N= 561)	Percentages
Child age (month)		
6-23	320	57
24-59	241	43
Sex of child		
Male	152	27.1
Female	409	72.9
Place of residence		
urban	110	19.6
Rural	451	80.4
Distance travel to health facility		
<2hrs.	475	84.7
≥2 hrs.	86	15.3
Admission type		
new admission	484	86.3
Re-admission	57	10.2
Relapse	20	3.6
Admission criteria		
Edema	187	33.3
Severe wasting	374	66.7
Child referred by		
Community volunteer	286	51
Neighbor	57	10.2
Self	211	37.6
Medical comorbidity		
Failed appetite test	13	2.5
Fever	29	5.5

Cough	38	7.3
Diarrhea	87	16.6
Vomiting	75	14.3
Anemia	6	1.1
Failed to gain weight in the first three weeks	276	52.7
Routine medication received		
Amoxicillin	556	25.6
Deworming	194	10.9
Vitamin A	307	17.2
Folic Acid	444	24.9
Measles immunization	381	21.4

Table 2: Performance Indicator values of the OTP Program compared to the Sphere Project reference values.

Performance indicators	**Study outcomes**	**The Sphere Project reference values**	
		Acceptable	Alarming
Cure rate	77.4%	>75 %	<50 %
Death rate	0.9%	<10%	>15%
Defaulter rate	15%	<15%	>25%
Length of stay	44.53	28 days	>6weeks

Sphere: international standard to evaluate the program effectiveness

Table 3: Predictors of time to recovery in the multivariate Cox Regression in children with SAM treated at OTP in West Hararghe, Ethiopia, from September 2014 to September 2016

variable	characteristics	Treatment outcome		CHR	AHR
		Recovered	Censored		
Residence	Urban	100	10	1.38(1.09,1.73)	1.42 (0.19,10.18)
	Rural	334	117	Reference	
Health Facility	HC	101	11	1.37(1.09,1.72)	0.56 (0.07,4.04)
	HP	333	116	Reference	
Average distance from child's home	≥2 hrs.	8	78	0.29(0.14,0.58)	1.09 (0.53,2.27)
	<1 hrs.	426	49	reference	
Admission criteria	Edema	147	40	1.35(1.10,1.64)	1.84 (1.5,2.3)
	MUAC <11cm	287	374	Reference	
Had cough at admission/on follow up	Yes	21	17	0.54(0.35,0.84)	0.69(0.44,1.08)
	No	413	110	reference	
Had vomiting at admission/on follow up	Yes	21	54	0.39(0.25,0.60)	0.99 (0.61,1.61)
	No	413	73	reference	

Had diarrhea at admission or on the course of treatment	Yes	32	55	0.68(0.47,0.97)	0.74(0.51,1.07)
	No	402	72	reference	
	Yes	425	31	8.28(0.47,0.97)	0.3(0.11,0.67)
Had taken Amoxicillin	No	9	96	reference	
	Yes	422	22	7.02(3.95,12.46)	0.56(0.24,1.29)
Had taken folic acid	No	12	105	reference	
Increased weight in the 1st three weeks	Yes	281	4	0.3(0.24,0.36)	0.3(0.23,0.37)
	No	153	123	reference	

CHR: crude hazard ratio; CI: confidence interval; AHR: adjusted hazard ratio; SAM: severe acute malnutrition; OTP: outpatient therapeutic care program.