ADDIS ABABA UNIVERSITY

COLLEGE OF HEALTH SCIENCES

SCHOOL OF PUBLIC HEALTH

SURVIVAL TO RECOVERY IN CHILDREN WITH SEVERE ACUTE MALNUTRITION TREATED AT OUTPATIENT THERAPEUTIC CARE PROGRAM IN SOUTHERN ETHIOPIA

A RETROSPECTIVE COHORT STUDY

BY

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Approved by the Examining Board

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List of Abbreviations / Acronyms

AHR	Adjusted Hazard Ratio
CHR	Crude Hazard Ratio
CMAM	Community-based Management of Acute Malnutrition
CTC	Community-based Therapeutic Care
CHW	Community Health Workers
EDHS	Ethiopian Demographic Health Survey
FMOH	Federal Ministry of Health
HR	Hazard Ratio
ID	Identification Number
IRB	Institutional Review Board
MOH	Ministry of Health
MUAC	Mid upper Arm Circumference
NGO	Non Governmental Organization
OTP	Outpatient Therapeutic Care
RUTF	Ready-To- Use Therapeutic Food
SAM	Severe Acute Malnutrition
SC	Stabilization Center
SNNPR	Southern Nation, Nationalities and Peoples Region
TFC	Therapeutic Feeding Center
WHM	Weight-for-Height percentage of Median

Abstract

Background: Community-based management of severe acute malnutrition has been widely rolled out and integrated to the existing health care system in Ethiopia. But there is a dearth of information concerning the survival to recovery of severely acutely malnourished children after rolling out of the program to a health post level in the country.

Objectives: To examine survival to recovery in children with severe acute malnutrition treated at outpatient therapeutic care program in Southern Ethiopia.

Method and materials: Institution based retrospective cohort study was conducted using a data available from Jan. 2011 to Jan. 2013 in twelve randomly selected health posts. A two population proportion formula was used to calculate a sample size of 374. Descriptive analysis was done using percentages for categorical data and mean/median for continuous variables. Chi-square was used to measure associations between categorical variables. The Mann-Whitney U test for the independent two samples test was used to compare the medians for non-normally distributed continuous variables. The outcome variable was time to recovery. The life table analysis and the Kaplan-Meier product limit were used to estimate the survival characteristics of the study subjects. And the log rank test was used to compare the survival curves. The Cox proportional-hazard regression model was used determine predictors of time to recovery.

Result: A total of 348 patient cards were reviewed. The median time to recovery was 35 days and 49 days for children with kwashiorkor and marasmus respectively. It was significantly different (Log Rank=46.93, df=1 P<0.001). There was a 1.2% decrease in the likelihood of recovery for one month increase in age (AHR=0.988, (0.977, 0.999)). Children with marasmus were also 48% less likely to recover (AHR=0.517, 95% CI (0.386, 0.691)). Children who had a weight gain of >=3.21gm/Kg/d were 2.43 times (AHR=2.434, (1.828, 3.241)) more likely to recover. For a MUAC gain (mm/day) of one unit increase there was a 2.33 times (AHR=2.326, (1.373, 3.942)) increase in the likelihood of recovery.

Conclusion: Being marasmic, age, weight and MUAC gain were identified as a predictor of recovery. Hence it needs special attention on counseling the care taker about the appropriate way of feeding the therapeutic diet to the sick child to improve weight and MUAC gain with due emphasis given to marasmic children.

1. Background

Severe acute malnutrition is defined by the presence of nutritional edema or mid-upper arm circumference of less than 110 mm in children aged 6–59 months. Globally, it is estimated that there are nearly 20 million children who are severely acutely malnourished. Most of them live in south Asia and in sub-Saharan Africa. Current estimates suggest that about 1 million children die every year from severe acute malnutrition. It can be a direct or indirect cause of child death (1).

The risk of mortality in acute malnutrition is directly related to severity (2). There were 1.5 million child deaths associated with severe wasting and 3.5 million with moderate wasting every year. These numbers did not include children who die of edematous malnutrition (kwashiorkor) (3). Results from the 2011 EDHS data showed a remarkable decline in under-five mortality but the prevalence of wasting in Ethiopia has remained constant over the last 11 years (4).

Community-based therapeutic care (CTC), a new model for treating malnourished children in their communities and homes, was developed in 2004 by Valid International (5). Several studies have documented the effectiveness of the CTC program (3, 6, 7). It exceeded the minimum SPHERE standards for treatment outcome measures except for weight gain and length of stay (8).

Community based management of severe acute malnutrition was integrated to the existing health care system and has been rolled out to a health post level in Ethiopia since 2008/09 (9). Central to the home-based care of the severely acutely malnourished children is the provision of appropriate therapeutic foods containing the right mix of nutrients that will aid in treatment and rehabilitation (10).

But there is a dearth of information concerning the outcome of outpatient therapeutic care programs (OTP) and factors which affect the recovery of SAM children after rolling out of the program to health post level in the country.

So this study was aimed to come up with findings pertaining to the survival to recovery and related factors of children with severe acute malnutrition treated at outpatient therapeutic care program. And it will help as an additional input to the existing body of knowledge and in the design of strategies for the treatment and prevention of malnutrition and accelerate the momentum to the achievement of the millennium development goal on child health.

2. Literature Review

2.1. The Community-based Therapeutic Care (CTC) program

The CTC model treats people suffering from severe acute malnutrition by using a combination of three treatment modalities—inpatient therapy, outpatient therapy, and supplementary feeding—according to the clinical and anthropometric characteristics at presentation. Children with severe acute uncomplicated malnutrition are treated in an outpatient therapeutic program (OTP). The patient attends an OTP site weekly or fortnightly to receive ready-to-use therapeutic food (RUTF) to eat at home and a course of routine medications. A two-stage screening method using WHM and MUAC has been changed now and the use of MUAC is recommended as the only criterion for referral and admission to OTP (11).

2.2. Community health workers and severe acute malnutrition

Community health workers or volunteers can easily identify the children affected by severe acute malnutrition using simple colored plastic strips that are designed to measure mid-upper arm circumference (MUAC). They can also be trained to recognize nutritional edema of the feet. A MUAC value < 110mm or the presence of nutritional edema in children aged 6-59 months is used to define children as having severe acute malnutrition (1). A study done in Bangladesh on quality of services delivered by community health workers indicated that when SAM is diagnosed and treated by community health workers (CHWs), a very high proportion of malnourished children can access care and they are very likely to recover. The main outcome measures including the high recovery rate (92%) and low mortality and default rates (0.1% and 7.5% respectively) are all considerably better than the SPHERE international standards (12).

The study in Malawi indicated that for severely malnourished children, there were no differences in recovery based on the organization or formal medical training of the staff; 955/1101 (87%) of children cared by medical professionals recovered, 670/738 (91%) referred by medical professionals but cared for by community health aids recovered, and 264/292 (90%) cared for by community health aids recovered (13).

2.3. Results of CTC programs

2.3.1. Outcome of CTC program in emergency setting

A large retrospective study conducted with the aim of assessing treatment outcomes of CTC among 12,316 patients with severe acute malnutrition from 2003 to 2005 in SNNP region indicated that the average cure and death rates were 9871(91%) and 217(2.5%) and the average weight gain was 5.3 and 5.8 grams /kg/day and the average length of stay was 49 and 42 days for cases of Marasmus and Kwashiorkor, respectively. Except for weight gain and length of stay, the findings exceeded the minimum sphere standards for treatment outcome measures (8).

A retrospective cohort study conducted in Bedawacho, Ethiopia, documented that 86 (81 %) of marasmic children and 48(96%) of kwashiorkor children treated at outpatient therapeutic care recovered with 85% overall rate of recovery. The median time of recovery was 42 days (28–56). Overall, median rate of weight gain was 3.2 g kg^{-1} day^{-1} (1.9–5.6). In patients who recovered, median rates of weight gain were 4.8 g kg^{-1} day^{-1} (3.0–8.1) in marasmic, 2.7 g kg^{-1} day^{-1} (0–4.8) in kwashiorkor patient (14).

Outcome of the first 7,400 severely malnourished patients treated in CTCs conducted in Ethiopia, Sudan and Malawi were substantially better than the Sphere indicators for recovery, death and default. Death rates were 4.7%, under half the Sphere standard of 10%; cure rates were 76.8%, better than the Sphere standard of 75%, whilst default rates were 10.6%, compared with Sphere's 15%. In CTC the average length of stay is approximately 40–50 days; depending on the context, up to 20% of children recover very slowly in the community and stay in the program for several months. Average rates of weight gain are approximately 5g/kg/day. This gives a recovery period significantly longer than the 30 days in the Sphere standards or the 28 days reported in the TFC centers described above. It is also worse than the 8g/kg/day in Sphere and the 12–14g/kg/day reported in the TFC centers (6).

2.3.2. Outcomes of CTC programs in non-emergency setting

For long-term improvements in the treatment of SAM, community-based management of SAM need to be implemented from the existing MoH structures as a standard part of primary health care package. The first two large CTC programs implemented in stable situations were in Dowa district of Malawi and in South Wollo of Ethiopia. From May/04-May/05 a total of 1573 cases of severe acute malnourished cases were seen in the CTC program run by the ministry of health in South Wollo. The recovery rate, mortality, defaults and non-recovery was 82%, 5%, 5% and 8% respectively. In Malawi too, program outcomes exceeded international standards for therapeutic feeding programs with a 75.7% recovery rate and 5.9% mortality rate overall (15).

A trial conducted in Malawi assessed the effectiveness in terms of recovery among children treated with 10 % milk RUTF compared with 25% milk RUTF. Treatment with 25% milk RUTF is the standard therapy for home-based treatment of children with severe acute malnutrition. The study finding indicated that recovery among children receiving 25% milk RUTF was greater than children receiving 10% milk RUTF. Having no edema (HR= 0.802, 95% CI (0.685, 0.939)) and female sex (HR= 0.852, 95% CI (0.764, 0.951)) were identified as a risk factor for recovery. The same study also showed that age (HR= 0.999, 95% CI (0.993, 1.006)) and having malnutrition previously (HR= 1.060, 95% CI (0.919, 1.224)) were not affecting the recovery of children with severe acute malnutrition (16).

3. Objectives

3.1. General objective

To examine survival to recovery in children with severe acute malnutrition treated at outpatient therapeutic care program in Southern Ethiopia from Jan. 2011-2013.

3.2. Specific objectives

1. To estimate the median recovery time of children with severe acute malnutrition
2. To compare the survival of children with severe acute malnutrition to recovery
3. To identify the factors affecting the recovery of children with severe acute malnutrition

4. Methods and materials

4.1. Study area and period

The study was conducted in Shebedido woreda of sidama zone in SNNP region. Shebedino is one of the 21 woredas found in Sidama zone. It is located 27 km away from the capital city of the SNNP region, Hawassa. The woreda had a total of 7 health centers and one hospital. Among the 35 kebeles found in Shebedino woreda, 3 were found in Leku town which was the center of Shebedino and in which OTP service was not delivered. Under each health centers there were heath posts per kebele staffed by two or three health extension workers. The health extension workers were trained to manage children with severe acute malnutrition without additional complication in the outpatient therapeutic care program in addition to the other duties they were running. A non-governmental international organization, GOAL Ethiopia, was supporting the outpatient therapeutic care program running in Shebedino and Boricha.

The study period was from Jan. 2011-2013.

4.2. Study design

Institution based retrospective cohort study design was used

4.3. Populations

4.3.1. Source population

All children aged 6-59 months classified as having severe acute uncomplicated malnutrition presented to all the health posts during the period from Jan. 2011 to Jan. 2013 in Shebedino woreda were our source population.

4.3.2. Study population

All Severe acutely malnourished children admitted to the selected OTP centers at the health posts in Shebedino woreda fulfilling the following criteria were our study population.

<u>Inclusion criteria:</u>

- Children with MUAC< 11 cm.
- Children with bilateral pitting edema
- Children who passed the appetite test and free from additional medical complications
- Children who were directly admitted to OTP
- Children who relapsed after being declared cured and fulfill the criteria of admission

Exclusion criteria:

- Children referred to OTP due to the care taker refusing inpatient admission
- Children being stabilized and referred from TFC to OTP
- Children with marasmic kwashiorkor

4.4. Sample size determination

Open-epi for windows version 2.3 was used to calculate the sample size for two population proportions. The proportion of children recovered in the exposed (children with marasmus, 81%) and children recovered in the non-exposed (children with kwashiorkor, 96%) was taken from a retrospective cohort study done in Ethiopia (14). The following were the assumptions used in calculating the sample size:

P1= proportion recovered among the exposed, 81%

P2= proportion recovered among the non-exposed, 96%

α= level of significance, $Z\alpha/2=1.96$ at 95% CL

Power= 80% =1-β, $Z_{\beta}=0.84$

n=the minimum required sample size in each group

r= the ratio of non-exposed to exposed=1

Accordingly the minimum sample size in the two groups was 85 both in the exposed and non-exposed. To compensate for missing of potential sources in the random selection of health posts a design effect of 2 was used. And hence the sample size becomes, 2*170=340. By adding 10 % for incomplete or missing records, the final sample size was 374.

4.5. Sampling procedure

From the 32 health posts in the woreda, 12 health posts were selected randomly. The health posts were similar on the supervisions made, materials and trainings provided, professional and educational level of the health post staff. Subjects fulfilling the eligibility criteria were extracted from the registration book independently for the specific type of SAM (kwashiorkor vs. marasmus). Sampling frame was formed per OTP site. The unique SAM number, age, sex and type of SAM were used to create the sampling frame. The total sample size was then proportionally distributed independently for the type of SAM per each OTP site. Finally eligible study subjects were selected independently for the type of SAM using systematic random sampling from each health posts.

4.6. Data collection procedures

4.6.1. Variables

4.6.1.1. Independent variables

The independent variables included age, sex, kebele/OTP site, seasonal variation, type of admission, breast feeding, admission weight, MUAC on admission, weight gain (gm/Kg/day), MUAC gain (mm/day), edema, and routine medication.

4.6.1.2. Dependent variables

Time to recovery was the dependent outcome variable.

4.6.2. Instruments

The data collection instruments were developed using the OTP patient card and it included:

- Demographic characteristics
- Baseline patient information
- Information on follow up visits

4.6.3. Data collection

The data was collected by the health extension workers using structured questionnaire to abstract information from the patient card. The 12 selected OTP sites were clustered in to three zones. The first zone was including Dobetoga, Howolso, Gonawo gabalo, and Gobo hebisha; the second zone was including Medre genet, Diramo aferera, Kontore ano, and Bonoya miride; the third clusted zone was including Fura, Morocho shondolo, Morocho negasha, and Dila gunbe. The OTP sites were clustered in to zones based on their proximity to make the data collection and supervision easier.

4.6.4. Quality control

Pretesting was done on five percent of the sample before the actual data collection. One day training was given to both the data collectors and the supervisor. Completed questionnaire and the corresponding patient card were collected on daily basis and checked for completeness and consistency. Cleaning was done on daily basis and timely feedback was communicated to the data collectors. The data collection sites were reached by the supervisor and the principal investigator using motor bicycle.

4.7. Measurement of variables

A health extension worker in charge of the respective OTP site obtained basic information on admission characteristics of a child with severe acute malnutrition. It included kebele, age, sex, date of admission, type of admission in to the program, type of referral, baseline anthropometry, presence of edema, breast feeding, admission medication, history of diarrhea, physical examination of the skin, the respiratory rate and body temperature; baseline anthropometries including admission weight and MUAC measurement.

Weight was measured using a digital weighting scale or by a 25-Kg hanging spring scale graduated by 0.1 Kg for children below the age of 3 years.

MUAC was measured on the left upper arm of a child while the arm was hanging down the side of the body and relaxed. The MUAC value was recorded to the nearest of 1mm.

The appetite test was conducted in a quit environment and a child was said to be passed the appetite test when he/she was able to consume the amount shown in **annex 2**.

Measurements like weight, MUAC, body temperature, appetite test, checking of edema, diarrhea, vomiting were done on each week of the follow up visit. The child also received RUTF (plumpy'nut, 500Kcal/sacket) based on his/her weight on each week of follow up visits.

Admission medication included amoxicillin given on admission and for seven consecutive days, vitamin-A given on admission and on the 4th visit, measles vaccine on the 4th visit, and deworming on the 2nd visit. Vitamin-A was not given on admission for children with edema and for those who received vitamin-A in the past six months.

We created a new variable called season of the year from the date of admission. And similarly we calculated MUAC gain (mm/day) and weight gain (gm/Kg/day) for the malnourished children. The formula used to calculate MUAC gain (mm/day) and weight gain (gm/Kg/day) for children with marasmus and children with kwashiorkor was as follows:

Weight gain in marasmic patients

$$\frac{\text{(Discharge weight (Kg) - admission weight (Kg))}}{\text{(Admission weight in Kg*total length of stay in days)}} * 1000\ \text{gm/Kg} \ldots\ldots\ldots\ldots\ldots\ldots\ldots..(14).$$

Weight gain in kwashiorkor patients

$$\frac{\text{(Discharge weight (Kg) – weight (Kg) when edema resolved)}}{\text{(Weight (Kg) when edema resolved * length of stay in days after edema resolved)}} * 1000\ \text{gm/Kg} \ldots\ldots..(14).$$

MUAC gain in marasmic patients:

$$\frac{\text{(Discharge MUAC (cm)-admission MUAC (cm))}}{\text{(Length of stay in days)}} * 10\ \text{mm/cm}$$

MUAC gain in kwashiorkor patients:

$$\frac{\text{(Discharge MUAC (cm)-MUAC after edema resolved (cm))}}{\text{(Length of stay in days after edema resolved)}} * 10\ \text{mm/cm}$$

4.8. Operational definition

Admission: Refers to admission in to the OTP program.

- ✓ **New admission:** children who directly referred from the community; and those re-presenting after being discharged cured before two months.

- ✓ **Readmission:** Children who were previously discharged cured and admitted to the program within two months after discharge fulfilling the criteria of admission.

Breast feeding: Breast feeding of a child on admission to the program.

Discharge: children with SAM exit the program through the following ways.

- ✓ **Recovered:** a child is said to be recovered when he/she attains 15% weight gain (target weight) if marasmic on admission and no edema for two consecutive weeks/visits if he/she had kwashiorkor on admission.
- ✓ **Non-response:** Failing to recover at the end of the eighth week of treatment in the program.
- ✓ **Death**: Refers to the death of the malnourished child while he/she was in treatment and confirmed by home visit.
- ✓ **Defaulter:** When a child was absent for three consecutive follow-up visits from the outpatient therapeutic care program and confirmed by home visit.

Health post: The lowest level in the health care provision system in Ethiopia.

Health Extension Workers: These were health care providers at the health post level. They were grade 10 completed and had a certificate of one year training in health care.

RUTF: An oil-based ready to use therapeutic diet containing the right-mix of vitamins and minerals and is given for the treatment of a malnourished child during the follow-up visits.

Referral: refers to who sent the malnourished child to the program.

Care taker: usually the mother of the sick child.

4.9. Data management and analysis

Completed data was coded as needed using numbers. Data were entered into Epi-Data for windows version 3.1 in which built-in parameters like range, jumps, must enter, and repeat commands made data entry easy and minimized errors. Data cleaning and editing were done by simple frequencies and cross tabulation, and SPSS version 16.0 and STATA version 11 for windows were used for analysis.

Descriptive analysis was done using percentages for categorical data and mean/median for continuous variables. Chi-square was used to see associations between categorical variables. The Mann-Whitney U test for the independent two samples test was used to compare the medians. Kolmogrov-Smirnov test of normality was used to check normality of distributions for continuous variables. The outcome variable was time to recovery. Individuals lost to follow up, defaulted, classified as non-response and those who did not have event of interest (i.e. recovery) at the end of the study or those died were censored. Treatment outcome was dichotomized in to censored and recovered.

The Kaplan Meier product limit was used to estimate the survival time of a malnourished to recovery. And the log rank test was used to compare the survival curves. Life table analysis was used to estimate cumulative proportion surviving in a given interval and to look into other details. The Cox proportional-hazards regression was used to calculate the crude and adjusted hazard ratio to determine predictors of time to recovery.

Co-linearity was checked for the covariates in the final model and the proportional hazards assumption was checked by obtaining the Schoenfeld residuals for each of the covariates using STATA for windows version 11. We dropped the independent variable type of referral from analysis as there were missing values for more than half of the study subjects in the sample.

4.10. Ethical considerations

Ethical approval was obtained from the Institutional Review Board (IRB) of Addis Ababa University, faculty of medicine, following submission of the proposal for ethical review. After obtaining the ethical approval, the school of public health wrote a letter of support to concerned bodies to help in running of the data collection. As the study was conducted through review of records, the individual participant in the study was not subjected to any harm as far as the confidentiality is kept. The unique SAM ID of the malnourished child was used for identification and no name of the patient or the care taker was used to keep the confidentiality of the data. The recorded data would not be accessed by any third person except the principal investigator, and will be kept confidentially.

4.11. Dissemination of result

Result of the study will be communicated to Sidama zone health department and Shebedino woreda health office where the study was conducted and to school of public health through hard copy and presentation. The findings will be presented in scientific conferences and published to be accessible for scientific communities in general.

5. Result

5.1 Socio-demographic characteristics

A total of 1354 severe acutely malnourished children were admitted in the selected health posts during the period from Jan.09/2011 to Jan. 09/2013. Excluding 22 transfer-in severe acutely malnourished children from stabilization centers we found 1332 malnourished children eligible for this study. Out of the total eligible 468 were children with kwashiorkor while 864 were children with marasmus. We found 165 (88.2%) patient card among the selected patient card from the kwashiorkor group and 183 (97.9%) patient card from the marasmic group each being out of 187 minimum sample sizes. 22 patient cards in the kwashiorkor group and 4 patient cards in the marasmic group were lost.

Most of the study subjects 185 (55.4%) were females. The overall median (IQR) age of the study subjects was 36 (24-48) months. The median ages among the kwashiorkor and marasmic groups were statistically different (Mann-Whitney U= 8374, P<0.001) (**Table 1**).

Table 1: sex and age distribution of severe acutely malnourished children admitted to the selected health posts in Southern Ethiopia from Jan. 2011 to Jan. 2013.

Variables		**Group**		**X^2(df)**	**P-value**
		Kwashiorkor	**Marasmus**		
		n (%)	**n (%)**		
Sex (N=334)	Female	84 (54.9)	101(55.8)	0.027(1)	0.869
	Male	69 (45.1)	80 (44.2)		
Age (N=348)	Median (IQR)	48 (36-48)	36 (12-48)	8374.00†	**< 0.001***
	Overall	Mean (±)	36.34 (±16.28)		
		Median (IQR)	36 (24-48)		

† The Mann-Whitney U test of two independent samples test was used,*Significant at α=0.05

5.2. Patients baseline information

Most of the severe acutely malnourished children were admitted to the outpatient therapeutic care program in the spring 131 (37.6%) and summer 128 (36.8%) seasons of the year. Both in the kwashiorkor and marasmic group a high number of children were admitted to the program during these seasons of the year than others. The distribution of severe acutely malnourished children in both groups across the seasons of year was significantly different (X^2 (df) = 9.51(3), p-value = 0.023 at α=0.05) (**Table 2**).

There was no significant difference on admission type between the kwashiorkor and marasmic group. Most of the severe acutely malnourished children were newly admitted in both the kwashiorkor and marasmic group with a count of 114 (78.6%) and 134 (77.5%) respectively (**Table 2**).

Admission MUAC value was taken only for marasmic patients (n=183). The median (IQR) MUAC value on admission for the marasmic patients was 10.60 (10.5-10.8). The median (IQR) admission weight in marasmic group (n=183) was 7.30 (6-10). And the median (IQR) admission weight in children with kwashiorkor (n=165) was 10.4 (9-12.1).

The distribution of breastfeeding among the groups of children with marasmus and kwashiorkor stratified by age group was not statistically significant. In the age group of 6-23 months 56 (82.35%) of children with marasmus were breastfed (**Table 2**).

Severe acutely malnourished children received routine medications on admission. The routine medications involved amoxicillin, vitamin A, measles vaccine and deworming (albendazole/mebendazole). These were categorized to those received amoxicillin only and amoxicillin plus. Out of 156 children with kwashiorkor, 131(84%) and 146 (79.8%) out of 183 children with marasmus received additional medications to amoxicillin. Overall only 62(18.3%) received amoxicillin only on admission. The distribution of routine medications among the groups of severe acutely malnourished children was not significantly different (**Table 2**).

Table 2: Baseline admission characteristics of severe acutely malnourished children admitted to the selected health posts in Southern Ethiopia from Jan. 2011 to Jan. 2013.

Variables		**Group**		**X^2(df)**	**P-value**
		Kwashiorkor	**Marasmus**		
		n (%)	**n (%)**		
Season (N= 348)	Summer	57 (34.5)	71 (38.8)		
	Autumn	25 (15.2)	40 (21.9)	9.51(3)	**0.023***
	Winter	8 (4.8)	16 (8.7)		
	Spring	75 (45.5)	56 (30.6)		
Admission (n= 318)	New	114 (78.6)	134 (77.5)	0.062 (1)	0.803
	Readmission	31 (21.4)	39 (22.5)		
Medication	Amoxplus*	131 (84)	146 (79.8)	0.99 (1)	0.320
	Amoxicillin	25 (16)	37 (20.2)		
Breast feeding (n=341)	No†	5	12 (17.65)	4.34(1)	0.05*†
	Yes†	6	56 (82.35)		
	No†*	133 (89.3)	95 (84.1)	1.53(1)	0.22
	Yes†*	16 (10.7)	56 (82.4)		

† Breast feeding stratified by age group (in months) of 6-23, †* >=24months

*Significant at α=0.05 *† Fisher's exact test P-value (2-sided) was used

*amoxplus= amoxicillin, vitamin A, measles vaccine, deworming

5.3. Patient follow-up information

The overall median (IQR) weight gain (gm/kg/day) was 3.72 (2.75-5.41).There was a statistically significant difference among the groups on their median weight gain (Mann-Whitney U=10998.5, P=0.001). The overall median (IQR) MUAC gain (mm/day) was 0.25 mm/day (0.16-0.41) (**Table 3**).

The distribution of outcome among the groups showed significant difference (X^2 (df) = 44.17 (2), P-value < 0.001). Out of 165 children with kwashiorkor 147 (89.1%) and only 127 (69.4%) out of 183 children with marasmus discharged cured. In malnourished children who recovered, median (IQR) rates of weight gain were 3.85 gm/Kg/day (3.29-4.66) in children with marasmus and 4.45 gm/Kg/day (2.74-6.22) in children with kwashiorkor. The median MUAC and weight on discharge were significantly different among the groups of malnourished children (**Table 3**).

52 (28.4%) of children with marasmus did not respond to treatment. There was no reported death and default in this study. Overall 274 (78.74%) out of 348 children with severe acute malnutrition in this study were discharged cured (**Table 3**).

For the majority 259 (78.5%) of severe acutely malnourished children no change was made on the quantity of plumpynut provided during the follow-up visits.

A change to the quantity of plumpy nut received was made only to 71 (21.5%) of the total severe acutely malnourished children. The distribution of plumpynut dose change did not show significant difference among the groups.

Table 3: The distribution of patient follow-up characteristics among children with severe acute malnutrition admitted to outpatient therapeutic care program in Southern Ethiopia from Jan. 2011 to Jan. 2013.

Variables		Group		X^2(df)	p-value
		Kwashiorkor n (%)	**Marasmus n (%)**		
Outcome (N= 348)	Cured	147 (89.1)	127 (69.4)	44.17(2)	**<0.001***
	Non-response	5 (3)	52 (28.4)		
	Transfer out	13 (7.9)	4 (2.2)		
Plumpy nut dose change (N= 330)	No	126 (82.9)	133 (74.7)	3.25 (1)	0.072
	Yes	26 (17.1)	45 (25.3)		
Weight gain (gm/Kg/day) (N= 336)	Median (IQR)	4.45(2.68-6.22)	3.46(2.83-4.35)	10998.5†	**0.001***
	Overall	Median (IQR)=3.72 (2.75-5.41)			
Discharge MUAC (n=343)	Median (IQR)	12.5 (11.5-13)	11.7 (11.5-12.0)	6755†	**<0.001***
	Overall	Median(IQR)=12(11.9-13.0)			
Discharge weight (n=337)	Median (IQR)	11(9.7-12.7)	8.5(6.7-11.5)	7915†	**<0.001***
	Overall	Median(IQR)=10.3(7.8-12)			
MUAC gain (mm/day) (n=328)	Median (IQR)	0.24 (0.14-0.43)	0.26 (0.18-0.38)	12649.5†	0.432
	Overall	Median (IQR)= 0.25 (0.16-0.41)			

* Significant at α =0.05 † The Mann-Whitney U test of two independent samples test was used

The mean weight (±SD) when edema resolved in children with kwashiorkor was 10.2 (9.1-11.8). Similarly the median MUAC value when edema resolved in children with kwashiorkor was 12 (11.5-12.98).

The median (IQR) time edema resolved in children with kwashiorkor was 3.0 (3-4) weeks. Majority 67 (43.5%) and 54 (35.1%) out of 154 children with kwashiorkor get resolved of edema on the 3th and 4thof treatment respectively (**figure 1**).

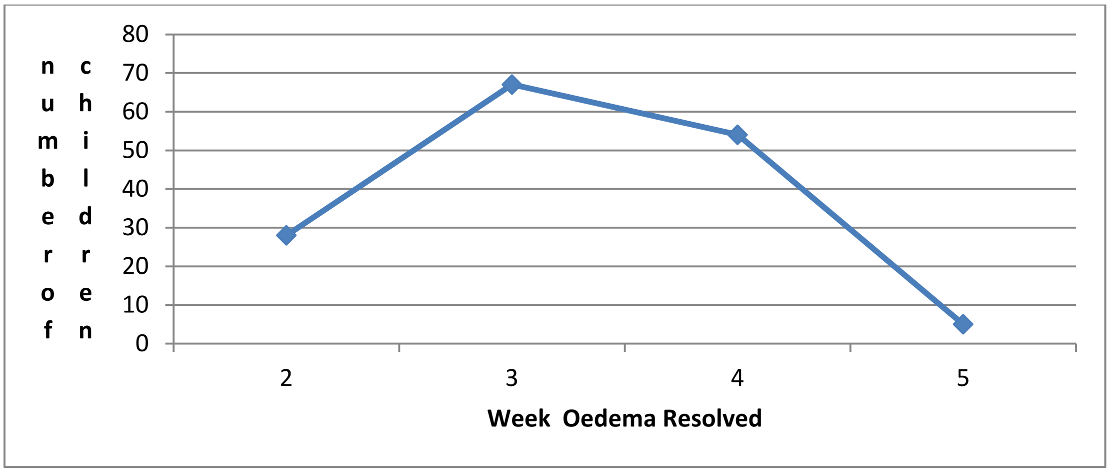

FIGURE 1: Time measured in weeks for edema to resolve among children with kwashiorkor treated at outpatient therapeutic care program in Southern Ethiopia from Jan. 2011 to Jan. 2013.

Comparison of survival time to recovery among study subjects

During the treatment in the program children with severe acute malnutrition had contributed a total of 1836 person weeks of follow up. The follow up time contributed by children with kwashiorkor and children with marasmus was 793 and 1043 person weeks respectively. The Kaplan-Meier estimate of the median time of recovery was 35 days for children with kwashiorkor and 49 days for children with marasmus. The overall median time of recovery was 42 days. The cumulative proportion of children surviving recovery up to the end of the interval 42-49 days in the kwashiorkor group and in the marasmic group was 39 (23%) and 100 (55%) cases respectively (**Table 4**). The overall incidence rate of recovery was 14.92 per 100 person weeks, 95 % CI (13.21, 16.8). The rate of recovery among children with kwashiorkor and children with marasmus with 95% CI was 18.54(15.66, 21.79) per 100 person weeks and 12.18(10.15, 14.49) per 100 person weeks respectively.

Table 4: The life table analysis of severely acutely malnourished children treated at outpatient therapeutic care program in Southern Ethiopia from Jan. 2011 to Jan. 2013.

Status	Time interval in days	No. entering interval	No. withdrawing during interval	No. exposed to risk	No. of subjects recovered	Prop. not recovering	Cum. Prop. not recovering
kwashiorkor	0-7	165	1	164.5	0	1.00	1.00
	7-14	164	1	163.5	0	1.00	1.00
	14-21	163	1	162.5	2	0.99	0.99
	21-28	160	2	159	15	0.91	0.89
	28-35	143	2	142	30	0.79	0.71
	35-42	111	2	110	45	0.59	0.42
	42-49	**64**	**3**	**62.5**	**28**	**0.55**	**0.23**
	49-56	33	5	30.5	24	0.21	0.05
	56-63	4	1	3.5	3	0.14	0.01
Marasmus	0-7	183	0	183	0	1.00	1.00
	7-14	183	3	181.5	0	1.00	1.00
	14-21	180	2	179	2	0.99	0.99
	21-28	176	0	176	5	0.97	0.96
	28-35	171	0	171	12	0.93	0.89
	35-42	159	0	159	19	0.88	0.79
	42-49	**140**	**4**	**138**	**41**	**0.70**	**0.55**
	49-56	95	44	73	46	0.37	0.20
	56-63	5	3	3.5	2	0.43	0.09

The Kaplan Meier estimate of survival curve for the type of SAM showed a significant difference (**Log Rank= 46.93, df=1, P<0.001**). Children with marasmus stayed longer on treatment as compared to children with kwashiorkor without getting recovered (**figure 2**).

After stratifying the type of SAM by age, the Kaplan Meier estimate of the cumulative hazard function showed significant difference. Children with kwashiorkor recover earlier in all age groups (for age group 6-23 months, Log Rank=10.08, df=1 P=0.002; >= 24 months, Log Rank=37.60, df=1 P<0.001) (**figure 3, 4**). The median survival time to recovery among the age groups of 6-23 months and >= 24 months was 35 days and 49 days among children with kwashiorkor and children with marasmus respectively. The overall median survival time to recovery in the age group of 6-23 months and >=24 months was 49 days and 42 days respectively.

Similarly when the type of SAM was stratified by weight gain (gm/Kg/day), the Kaplan Meier estimate of the cumulative hazard function showed a statistically significant difference (**Figure 5, 6**). Marasmic and kwashiorkor children in the weight gain range of 0.0-3.2 gm/Kg/day had a median time of recovery 54 days and 42 days respectively. Those children with kwashiorkor and children with marasmus in the weight gain range of >=3.21 gm/Kg/day had a median time of recovery 35 days and 42 days respectively.

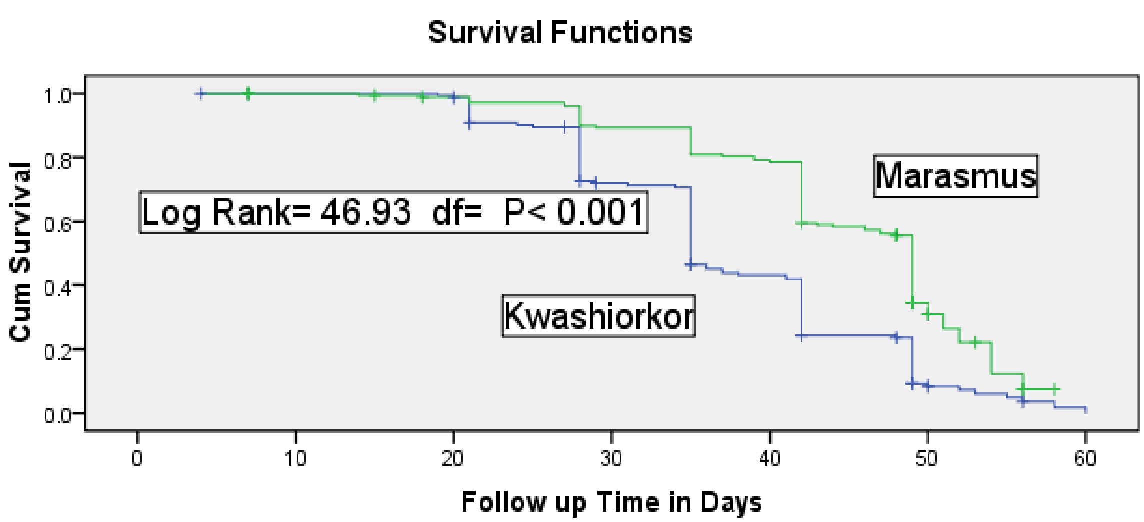

Figure 2: The KM estimate of survival to recovery of children with kwashiorkor and marasmus treated at OTP in Southern Ethiopia from Jan. 2011-Jan. 2013.

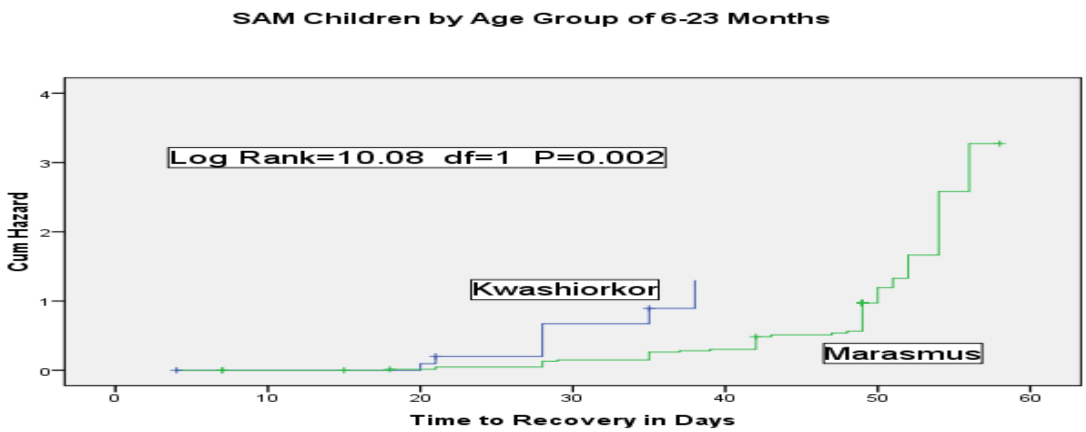

Figure 3: The KM estimate of recovery among children with kwashiorkor and marasmus in the age group of 6-23 months treated at OTP in Southern Ethiopia from Jan. 2011-Jan. 2013.

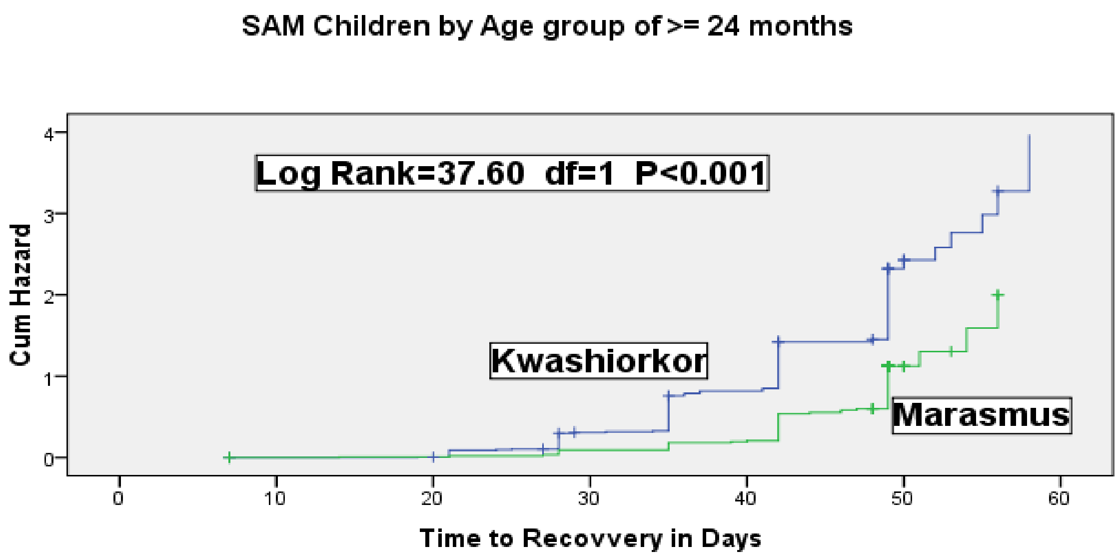

Figure 4: The KM estimate of recovery among children with kwashiorkor and marasmus in the age group of >=24months treated at OTP in Southern Ethiopia from Jan. 2011-Jan. 2013.

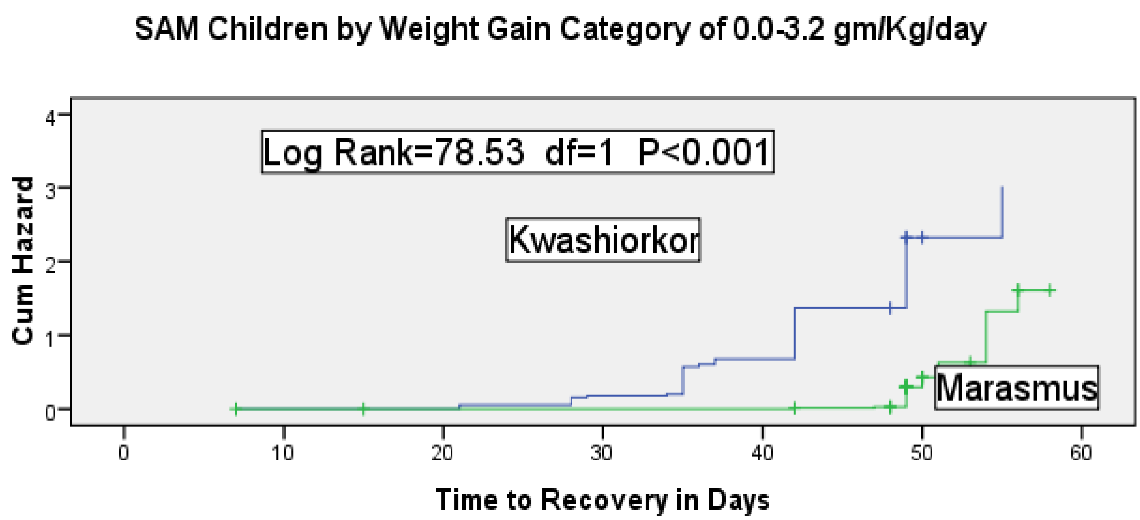

Figure 5: The KM estimate of recovery among children with kwashiorkor and marasmus with weight gain in the range of 0.0-3.2 gm/kg/day treated at OTP in Southern Ethiopia from Jan. 2011-Jan. 2013.

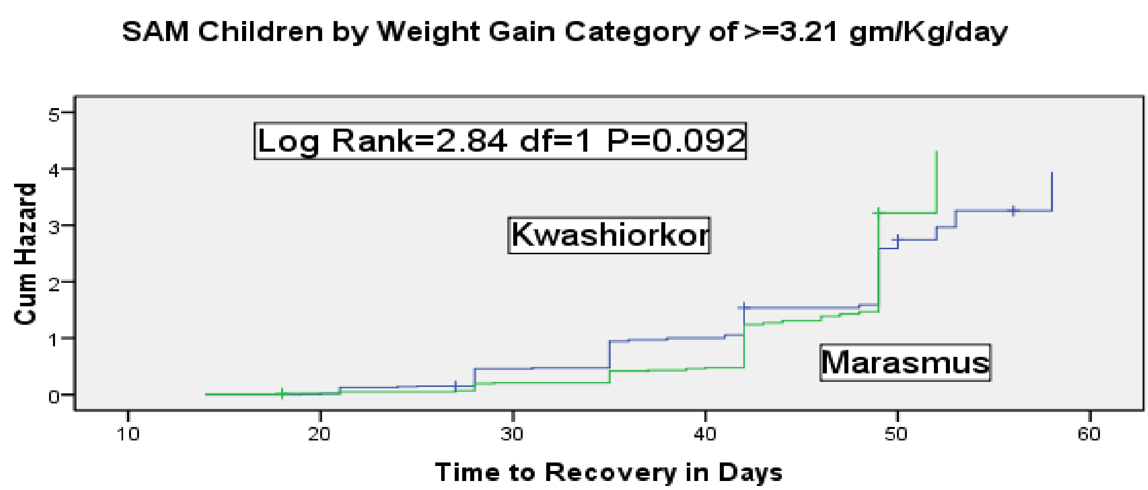

Figure 6: The KM estimate of recovery among children with kwashiorkor and marasmus with weight gain in the range of >=3.21gm/kg/day treated at OTP in Southern Ethiopia from Jan. 2011-Jan. 2013.

5.4. Predictors of recovery from severe uncomplicated acute malnutrition

The proportional hazard assumptions were checked by obtaining the Schoenfeld residuals for each of the covariates before running the Cox Regression.

In the bivariate weight gain, MUAC gain, and type of SAM were found significant. Children with SAM having a weight gain of >=3.21 gm/Kg/day were 2.83 times more likely to recover than those children with a weight gain below 3.2 gm/Kg/day (CHR= 2.83, 95% CI (2.169, 3.694))(**Table 5**).

Children with marasmus were 52% less likely to recover compared to children with kwashiorkor (CHR=0.48, 95% CI (0.377, 0.611)) (**Table 5**). For a unit increase of MUAC gain (mm/day) there was 3.79 times increase in recovery in the bi-variate (CHR=3.785, 95% CI (2.318, 6.183)) (**Table 5**).

Table 5 Predictors of recovery in the bivariate Cox Regression among children with severe acute malnutrition treated at outpatient therapeutic care program in Southern Ethiopia from Jan. 2011-Jan. 2013.

Ser No.	Variables		Frequency	Recovered n (%)	CHR (95% CI)
	Age (months)		343	274 (78.7)	1.006(0.999,1.014)
	Sex	Male	149	116 (77.9)	1
		Female	185	145 (78.4)	1.077 (0.843, 1.376)
	Admission	New	248	190 (76.6)	1
		Readmission	70	60 (85.7)	1.138 (0.851, 1.522)
	Breast feeding	No	245	200 (81.6)	1
		Yes	96	68 (70.83)	0.78 (0.592,1.029)
	Type of SAM	Kwashiorkor	165	147 (89.1)	1
		Marasmus	183	127 (69.4)	0.48 (0.377, 0.611)
	MUAC gain (mm/day)		328	267 (81.4)	3.785 (2.318, 6.183)
	Weight gain	0.0-3.2	135	79 (58.52)	1
		>=3.21	200	194 (97.0)	2.83 (2.169, 3.694)
	Medication	Amoxplus	277	219 (79.1)	0.917 (0.668, 1.257)
		Amoxicillin	62	47 (75.8)	1
	Plumpy nut dose change	No	259	207 (79.9)	1
		Yes	71	56 (78.9)	0.768(0.568, 1.039)
	Season	Summer	128	103 (80.5)	0.812 (0.617, 1.069)
		Autumn	65	49 (75.4)	1.104 (0.783, 1.555)
		Winter	24	19 (79.2)	0.978 (0.598, 1.60)
		Spring	131	103 (78.6)	1

**Significant at α=0.05

*Other medication include vitamin A, measles vaccine and deworming

The covariates having P-value <0.1 in the bi-variate were entered in to the multivariate Cox Regression model. Multi co-linearity was checked using the VIF (variance inflation factor) before fitting the final model and no multi co-linearity was detected.

The factors affecting time to recovery identified in the multivariate Cox Regression model were age, the type of SAM, MUAC gain (mm/day), and weight gain (gm/Kg/day).

After controlling for the effect of weight gain, age, plumpy nut dose change, breast feeding and MUAC gain, children with marasmus were 48% less likely to recover (AHR= 0.517, 95% CI (0.386, 0.691)). There was a 1.2% decrease in the likelihood of recovery for one month increase in age (AHR=0.988, (0.977, 0.999)). Children having a weight gain of >=3.21 gm/Kg/day were 2.43 times more likely to recover (AHR=2.434, 95% CI (1.828, 3.241)). There was a 2.33 times increase in recovery for a unit increase in MUAC gain (mm/day) (AHR=2.326, 95% CI (1.373, 3.942) (**Table 6**).

Table 6 The independent predictors of recovery in the multivariate Cox Regression among children with severe acute malnutrition treated at outpatient therapeutic care program in Southern Ethiopia from Jan. 2011-Jan. 2013.

Variables		**Crude HR (95% CI)**	**Adjusted HR (95% CI)**
Type of SAM	Kwashiorkor	1	1
	Marasmus	0.48(0.377, 0.611)	**0.517 (0.386, 0.691)***
Weight gain	0.0-3.2	1	1
(gm/Kg/day)	>=3.21	2.83(2.169, 3.694)	**2.434 (1.828, 3.241)***
Plumpy nut	No	1	1
dose change	Yes	0.768 (0.568, 1.039)	0.961 (0.706, 1.309)
MUAC gain (mm/day)		3.785 (2.318, 6.183)	**2.326 (1.373, 3.942)***
Age in months		1.006 (0.999, 1.014)	**0.988 (0.977, 0.999)***
Breast feeding	No	1	1
	Yes	0.78 (0.592, 1.029)	0.77(0.534, 1.133)

*Significant at α = 0.05

6. Discussion

This study examined survival to recovery in children with severe acute malnutrition treated at outpatient therapeutic care program in Southern Ethiopia. The overall median time of recovery was 42 days. And the median time of recovery was significantly different among children with kwashiorkor and marasmus. The factors affecting recovery identified in this study were age, weight gain (gm/Kg/day), MUAC gain (mm/day), and type of SAM.

The age distribution of children by type of SAM showed a statistically significant difference. The median age (IQR) in months among the kwashiorkor and marasmic group was 48 (36-48) and 36 (12- 48) respectively. A retrospective cohort study done in Bedawacho, Hadya, among children with severe acute malnutrition had a similar age distribution (14).

The distribution of children with severe acute malnutrition across the different seasons of the year was significantly different. This can be explained by the variations in the seasons of the year with the availability of agricultural productions for the household food consumption through the year (17).

The overall proportion of recovery among children with severe acute malnutrition in this study was 78.74 %. The proportion of recovery among children with kwashiorkor and children with marasmus was 89.1% and 69.4 % respectively. This finding was supported by findings from different settings. Outcome of the first OTP program in Dowa district of Malawi reported that 83.3 % of kwashiorkor children who were directly admitted to OTP were recovered. Similarly 68.4 % of marasmic children who were directly admitted to the same program were recovered. The CTC program in Wollo, Ethiopia showed that 82 % of severe acutely malnourished children were recovered. A study done in Bedawacho indicated that 96% of children with kwashiorkor and 81% children with marasmus recovered and which was much higher as compared to our study. Another study also documented higher level of recovery was a study done on a regional level in SNNPR where the average cure rate for the region was 91% (8, 11, 14). These differences may possibly be explained by supplementation of ration besides the therapeutic diet and differences in the definition of non-response to treatment in those studies.

The overall proportion of non-response and transfer out in this study was 57(16%) and 17(4.9%) respectively. There was relatively high non-response in this study compared to other studies (11, 16). This may be explained by the difference in the definition of non-response.

There was no reported death and default in this study. This positive finding could be due to the accessibility of health posts per kebele, low case load managed per OTP site, active early case finding and home visits to track the children with severe acute malnutrition.

The Kaplan Meier survival curve for the groups of children with marasmus and children with kwashiorkor showed a significant difference (Log Rank=46.93, df=1, $P<0.001$). The overall median time of recovery in our study was 42 days. While the median time of recovery among children with kwashiorkor and marasmus was 35 days and 49 days respectively. This is a similar finding with (8, 14).

The factors affecting recovery identified in this study were age, weight gain (gm/Kg/day), MUAC gain (mm/day), and being marasmic. Marasmic children were less likely to recover as compared to children with Kwashiorkor (AHR=0.517, 95% CI (0.386, 0.691)). A study done in Malawi supported this finding that children without edema were less likely to recover (HR=0.802, 95% CI (0.764, 0.951)) (16). As the weight and MUAC gain increases, there was an increased potential of getting recovered (for >=3.21 gm/K/day, AHR=2.434, 95% CI (1.828, 3.241); MUAC gain (mm/day), AHR=2.326, 95% CI (1.373, 3.942)). The acceptable length of stay according to the minimum SPHERE standard was < 4 weeks for weight gain of >= 8gm/Kg/day (18). Similarly in this study, children with severe acute malnutrition having an increased weight gain were more likely to stay a shorter duration stay on treatment.

7. Strengths and limitations

Strengths

1. A robust method of analysis of time to event data was used to identify factors affecting time to recovery.

Limitations

1. We did not assess important variables like the socio-economic and demographic characteristics of the care taker. The household and environmental factors in relation to the sick child were also not assessed. This omission might have confounded the findings of this study.
2. Missing values for important variables and lost patient cards might have biased the result.
3. Children gaining no weight for 3 weeks or with edema still present on the third week were not managed as per the national protocol in this study.
4. The findings of this study were dependent on the accuracy measurements and quality of the recording system as data were obtained through institution based recorded review.

8. Conclusion

Children with marasmus were staying longer on treatment to recover compared to children with kwashiorkor. The median weight gain was lower among children with marasmus compared to children with kwashiorkor.

The factors affecting recovery identified in this study were age, type of SAM, MUAC gain, and weight gain. The increase in weight gain and MUAC gain decreases the duration of stay on treatment of children with severe acute malnutrition in this study. Increase in age and being marasmic were identified as factors prolonging the duration of stay on treatment.

The distribution of severe acutely malnourished children across the seasons of the year was significantly different. A high number of children with severe acute malnutrition were admitted during the summer seasons of the year.

9. **Recommendation**

A) Strengthen counseling of the care taker about the appropriate way of feeding the therapeutic diet to the sick child.

B) Children with marasmus, older age children and those with weight gain below 3.2 gm/Kg/day should be closely monitored on the consecutive follow up visits.

C) Children who were admitting during the spring and summer seasons of the year need a due attention of feeding.

D) Prospective based researches need to be conducted for identification of independent predictors controlling for confounders.

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Annexes

<u>Annex 1:</u> Data collection format

<u>Introduction</u>

This data collection format is used to collect data for a study aimed to examine survival to recovery and related factors in children with severe acute malnutrition treated at outpatient therapeutic care program. The information will be collected by reviewing secondary data of the children baseline information and follow up visits from the patient's card or visiting home when the treatment outcome is missing. The benefit from the outcome of this scientific study in identifying those factors that positively or negatively affect the recovery of severe acute malnourished children would be most important in terms of improving the recovery of the malnourished children treated at outpatient therapeutic program running at the health post level.

Unique SAM number__________________ OTP site__________________

Name of the data collector________________ data collection date____/____/___

Name of the supervisor___________________ date ___/____/_____.

<u>Part-I</u>: Study participant demographic characteristics

No	Variables	Coding categories	Remark
101	Kebele	_________________________	
102	Facility	_________________________	
103	Age (months)	___________months	
104	Sex of the child	Male ☐ Female ☐	
105	Unique SAM number Registration number	☐☐☐☐☐ ☐ ☐☐☐☐☐	**If relapse add -2 on the unique SAM no.**

<u>Part II</u>: Patient's baseline information.

No	Variables	Coding categories	Remark
201	**Date of admission**	___/__/__E.C (Season__________)	**Season of the year**
202	**Referred by**	Community volunteer ☐ Self referred ☐ Other(specify) __________________	
203	**Admission type**	New ☐ Return after default ☐ Readmission ☐	
204	**Admission anthropometry**	MUAC ☐☐.☐ cm Weight ☐☐.☐ kg Edema Yes ☐ No ☐	
205	**History**	Diarrhea Yes ☐ No ☐ Breastfeeding Yes ☐ No ☐	**Refers to conditions only at admission**
206	**Physical examination**	**Respiratory rate (# min)** <30 ☐ 40-49 ☐ 30 – 39 ☐ 50^{+} ☐	
		Temperature __________ **^{o}C**	
		Skin changes None ☐ Ulcers/abscess ☐ Peeling ☐	

No	Variables	Coding categories	Remark
207	**Routine admission medication**	Amoxicillin: Yes ☐ No ☐ Date ____/_____/______E.C	
		Measles : Yes ☐ No ☐ Date ____/____/____E.C	
		Vitamin A : Yes ☐ No ☐ Date ___/____/_____E.C	
		Other medication: Yes ☐ o ☐ Drug name ______________ Date ___/____/_____E.C	
208	**Home visit**	Date ___/_____/____E.C Reason _______________	

<u>Part III:</u> Patient's follow up information

No	Variable	Coding category								Remark
	Target Wt.									
	Week	Adm.	2	3	4	5	6	7	8	
	Date	__/_/_	__/_/_	__/_/_	__/_/_	__/_/_	__/_/_	__/_/_	__/_/_	
301	**Weight**									
303	**MUAC**									
304	**Edema (yes/no)**									
305	**Sachet per week**									
	Outcome	Cured ☐ Defaulter ☐ Dead ☐ Non-response ☐								
306	**Week outcome ascertained**	Second ☐ Third ☐ Fourth ☐ Fifth ☐ Sixth ☐ Seventh ☐ Eighth ☐								
	Date outcome ascertained	________/________/__________E.C								

Annex 2: The minimum amount of therapeutic food for a child to consume to pass the appetite test

APPETITE TEST This is the *minimum* amount that malnourished patients should take to pass the appetite test			
Plumpy'nut		***BP100***	
Body weight (Kg)	**Sachets**	**body weight (Kg)**	**Bars**
Less than 4 kg	1/8 to ¼	Less than 5 kg	¼ to ½
4 – 6.9	¼ to 1/3	5 -9.9	½ to ¾
7 – 9.9	1/3 to ½		
10 – 14.9	½ to ¾	10 – 14.9	¾ to 1
15 - 29	¾ to 1	15 -29	1 to 1 ½
Over 30 kg	>1	Over 30 kg	> 1 ½

RUTF paste	
body weight (Kg)	**Grams**
3 - 3.9	15 - 20
4 - 5.9	20 - 25
6 - 6.9	20 - 30
7 - 7.9	25 - 35
8 - 8.9	30 - 40
9 - 9.9	30 - 45
10 - 11.9	35 - 50
12 - 14.9	40 - 60
15 - 14.9	55 - 75
25 - 39	65 - 90
40 - 60	70 - 100

Source: Federal Ministry of Health. Protocol for the management of severe acute malnutrition. 2007(19) .

<u>Annex 3:</u> Nutritional Composition of Ready to Use Therapeutic Diet (RUTF)

Nutritional composition	
Moisture content	2.5% maximum
Energy	520–550 Kcal/100 g
Proteins	10%–12% total energy
Lipids	45%–60% total energy
Sodium	290 mg/100 g maximum
Potassium	290 mg/100 g maximum
Calcium	300–600 mg/100 g
Phosphorus (excluding phytate)	300–600 mg/100 g
Magnesium	80–140 mg/100 g
Iron	10–14 mg/100 g
Zinc	11–14 mg/100 g
Copper	1.4–1.8 mg/100 g
Selenium	20–40 µg
Iodine	70–140 µg/100 g
Vitamin A	0.8–1.1 mg/100 g
Vitamin D	15–20 µg/100 g
Vitamin E	20 mg/100 g minimum
Vitamin K	15–30 µg/100 g
Vitamin B1	0.5 mg/100 g minimum
Vitamin B2	1.6 mg/100 g minimum
Vitamin C	50 mg/100 g minimum
Vitamin B6	0.6 mg/100 g minimum
Vitamin B12	1.6 µg/100 g minimum
Folic acid	200 µg/100 g minimum
Niacin	5 mg/100 g minimum
Pantothenic acid	3 mg/100 g minimum
Biotin	60 µg/100 g minimum
n-6 fatty acids	3%–10% of total energy
n-3 fatty acids	0.3%–2.5% of total energy

Source: World Health Organization, World Food Program, United Nations System Standing Committee on Nutrition and United Nations Children's Fund. Community Based Management of Severe Acute Malnutrition. May 2007(1).

<u>Annex 4:</u> Reference values for the main indicators ©Sphere project

	Acceptable	Alarming
Recovery rate	> 75%	< 50%
Death rate	< 10%	> 15%
Defaulter rate	< 15%	> 25%
Weight gain	>= 8 g/kg/day	< 8 g/kg/day
Length of stay	< 4 weeks	> 6 weeks
Coverage	> 50-70%	< 40%

Source: SPHERE project minimum standards (18, 19) .

DECLARATION

I, the undersigned, declare that this thesis is my original work and has not been presented for a degree in this or another university and all the sources of materials used for the thesis have been fully acknowledged.

Name: Melkamu Merid

Signature: _______________

Date ___/__/______

This thesis work has been submitted for the examination with my approval as a university advisor

Name: Dr. Nigussie Deyessa (MD, MPH, PhD)

Signature: _____________________

Date: ___/__/______