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Treatment outcome of severe acute malnutrition and determinants of survival in Northern Ethiopia: A prospective cohort study

Desalegn Massa[1], Kifle Woldemichael[1], Birtukan Tsehayneh[1,2] and Amanuel Tesfay [3,4*]

[1]Department of Epidemiology and Biostatistics, Jimma University, Jimma, Ethiopia.
[2]Department of Statistics, Alberta University, Canada.
[3]Department of Population and Family Health, Jimma University, Jimma, Ethiopia.
[4]CIH [LMU] Center for International Health, Ludwig-Maximilians-University of Munich, Germany.

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Ethiopia has long history of food insecurity and nutritional problems affecting large proportion of the population caused by successive droughts. Despite of different interventions to tackle the problem there is no explicit data showing treatment outcome of the children generally in Ethiopia and specifically in the study area. Institutional based general prospective cohort study was employed. The respondents were 332 children of 6-59 months age admitted to Outpatient therapeutic program (OTP) providing health facilities and their mothers /caregivers from January-April, 2012. Data was analyzed using SPSS. Kaplan Meir (KM) curve, log rank test and proportional hazards Cox model were performed. The bivariate and adjusted hazard rate and its 95%Confidence interval were estimated. Out of 332 children, 255 children (76.8%) have recovered. Fifty-eight children (17.5%) defaulted from the program. Factors significantly associated with good recovery were children whose mothers travel below 2 hours to the health facility ,male children ,children with baseline WFH of ≥60% and children from mothers whose age at first marriage is >18 years. Efforts to trace defaulters from OTP should be emphasized and strengthened. To overcome the high length of stay and low weight gain among patients in the OTP, stakeholders need to consider and give emphasis to the identified determinants of the treatment outcomes to achieve fully effective and sustainable program.

Key words: Treatment outcomes, severe acute malnutrition, children, prospective cohort.

INTRODUCTION

Although the world produces enough food to feed everyone, in 2011 almost 1 billion children, men and women go to bed hungry every night. Millions of these, particularly young children, suffer the dire effects of

*Corresponding author. E-mail: amanuelpraise@gmail.com.

under-nutrition (International Federation of Red Cross and Red Crescent Societies (IFRC), 2011). Every year some 9 million children across the world die before they reach their fifth birthday, and about one-third of these untimely deaths are attributed to under-nutrition (Black et al., 2008). For every child who dies as a result of under-nutrition, there are many millions more who suffer permanent damage to their health; this impairs the rest of their lives. Today, some 178 million children under the age of five suffer from stunted growth as a result of under-nutrition [Department of International Development (DFID), 2010).

In spite of important advances in prevention and treatment, malnutrition continues to be a worldwide problem. Internationally, some 55 million children under the age of five are estimated to be wasted, of whom 19 million (35%) are severely wasted or severely under-nourished (Bhutta et al., 2008).

Ethiopia has long history of food insecurity and nutritional problems affecting large proportion of the population caused by successive droughts. Even during the relatively good non-drought seasons, levels of malnutrition in children and women in Ethiopia were extremely high putting the survival of these groups of the population at a greater peril (CSA and ORC, 2005). The most important forms of malnutrition in Ethiopia are macro nutrient deficiency), vitamin A deficiency, Iodine deficiency disorders, and Iron deficiency anemia (Bhutta et al., 2008). The National Demographic Health Survey (DHS) conducted by Central Statistical Agency in Ethiopia in 2011 showed that the prevalence of wasting, underweight and stunting was 10, 29 and 44%, respectively which is very high. This report also showed that a higher percentage of males are underweight compared with females (31 and 27%, respectively); thirty percent of rural children are underweight compared with 16 percent of urban children; and the percentage of children who are underweight is eight times higher for those born to uneducated mothers as for those whose mothers have more than secondary education (32 versus 4%) (Ethiopia Demographic and Health Survey, 2011).

Severe acute Malnutrition (SAM) is defined as weight for height (W/H) of less than -3 standard deviations below the median reference population or weight-for-height (W/H) ratio of below 70% or presence of nutritional edema (Sylvie et al., 2007)

In Tigray the prevalence of wasting, underweight and stunting was very high; 10.3, 35.1 and 51.4%, respectively (CSA and ORC, 2005). In response to the high malnutrition rate UNICEF launched Enhanced Outreach Strategy Program all over Ethiopia in collaboration with other partners (WFP, MOH and DPPC) and has been operationalized in Tigray since 2005. The strategy involved the screening of under-five children, pregnant and lactating mothers in food insecure areas to identify and treat acutely malnourished cases. Through Outpatient therapeutic program (OTP). The OTP offers services to severely malnourished children aged 6-59 months. The admission criteria for OTP according to the protocol for management of SAM is Mid Upper Arm Circumference (MUAC) of less than 110 mms and /or W/H of less than 70% or presence of bilateral pitting edema. Regardless of these, children presented with medical problems won't be admitted to the OTP. Rather, they need to be referred to Therapeutic Feeding Units (TFU) [10]. Children get a weekly Plumpy' Nut sachets according to their body weight once admitted to the program. Routine medications would also be supplemented during the course of the treatment such as Vitamin A, Folic acid, antibiotics, de-worming and measles vaccine. Children admitted with marasmus cases are discharged from the OTP when they reach target weight and/or weight-for-height ratio .85%. Unlike the marasmus cases, the Kwashiorkor cases are discharged from the OTP after their edema gets disappeared regardless of their body weight status. These children are declared as 'recovered'. However, children may have different outcomes such as 'defaulter', 'non-respondent', 'medical transfer' and 'died'. 'Defaulter' is a patient that is absent for two consecutive weeks and confirmed that the patient is not dead by home visit. If the patient is confirmed as dead by home visit, s/he is labeled as 'died'. A patient that has not reached either of the discharge criteria after staying under OTP is considered to be 'non-respondent'. A patient is determined as 'Medial transfer' when s/he develops any medical complications and referred to hospital for treatment under TFU.

According to an evaluative report of five regions in Ethiopia, the recovery (cure) rate of OTP in Tigray region was 72% which is below the sphere standard. The defaulter rate was also lower (8.8%) next to Oromia (9%) and the average mid upper arm circumference (MUAC) when defaulting was 10.2 cm. This indicates that children defaulted when they were still at a high risk of mortality. Length of stay (50.7 days) and average weight gain (4.6 g/kg/day) are the lowest scores when compared with the standard set by the National Guidelines. The practice of documenting cases as unknown does not distinguish which cases were deaths, defaulter or other. This tendency gives false confidence to the health workers that they are reaching the Sphere standards, as any defaulter recorded as unknown has not been counted as a defaulter (Gertrude et al., 2010). Important causes associated with failure of treatment were considered to be limited practical competency of health professionals and restrictions in the supply and materials needed for effective treatment. Important limiting factors that have not yet been adequately resolved/studied are individual factors, maternal factors and distance of residence from OTP site (Gertrude et al., 2010; International malnutrition task force, 2010).

Therefore, this study aimed to describe the treatment

outcomes of out-patient therapeutic feeding program and to identify their determinants prospectively.

MATERIALS AND METHODS

Study area and period

The study was conducted in Enderta district, Tigray region which is located at around 776.5 km North of Addis-Ababa (capital City of Ethiopia) from January-April 2012. The woreda has 15 health facilities (6 health centers and 9 health posts), where all of them were providing OTP service during the study period. The study population constituted 6-59 months age children who have been routinely admitted to OTP and their mothers/caregivers in Enderta woreda.

Study design

Institutional based general prospective cohort study was conducted in OTP sites in Enderta woreda, Tigray, North Ethiopia.

Sample size and sampling procedure

Sample size was determined by using COMPARE2 **(**WINPEPI program, Abramson 2004 Version 1.45) considering the following parameters; 5% level of significance, 80% power, ratio 1:1, P_1 (death rate among marasmic-kwashiorkor) (Percent of Exposed with Outcome) is 14.3% and P_2 (death rate among marasmic) (Percent of unexposed with Outcome) is 4.7% which provided maximum sample size. The rate was taken from a study conducted in Bedawacho, Ethiopia, between 16th October 2000 and 31st January 2001 (WHO, 1999). This provides a total of 332 sample size. Out of the 15 health facilities, which were providing OTP service in the woreda, only 11 (6 health centers and 5 health posts) were included in the study. Four health posts were excluded because those facilities started OTP program a couple of months before the initiation of the study. After determining the average number of admissions for each of the health facilities; the sample size was proportionally allocated according to their size. Then participants were selected consecutively.

Outcome measures

The main outcome measure in this study is recovery from severe acute malnutrition. Individuals defaulted, died, and non-response at the end of the study period has been considered as censored. Finally, the out-come of each subject was dichotomized in to censored or recovered. Other outcome measures considered were average length of stay, average rate of weight gain, cure rate, death rate, and default rate. A recovery/cure from sever acute malnutrition is defined as these children that has reached the discharge criteria i.e (W/L>=85% or W/H>=85% on more than one occasion for children with marasmus, and if edema is disappeared regardless of their body weight status for 14 days for kwashiorkor cases.

Data collection

A structured questionnaire was developed in English after reviewing relevant literature, and it was translated to the local language (Tigrigna) and back translated to English language to check for its consistency. Home visit record form was adopted to collect information about status of the child who lost with unknown status. Then Data collection instrument was also pre-tested on 17(5% of the sample size) that is not included into the main study. Structured interviewer administered questionnaire was used to collect information from each participant.

Anthropometric measurements and physical examination was made to collect data about children's treatment outcomes and their health status. Mothers or caregivers of the selected children were interviewed for the other variables through face to face at the health institution. Eleven data collectors; health workers who took training on OTP and currently working in each OTP sites (one in each health facility) was recruited to collect the required information. The principal investigator and one Health Extension program supervisors in each health center supervised the data collection process.

All data collectors and supervisor were trained for two days by the principal investigator before the data collection on the objectives of the study and how to interview, measure, fill the questionnaire and handle questions asked by subjects. Admission and follow-up weights and heights were taken with calibrated standard 'Salter' spring scales accurate to 100 g and locally constructed height boards accurate to 0.5 cm.

All measurements including medical complications and the presence of bilateral pitting edema was recorded on admission and at follow-up on a standard individual treatment card. The Scales were calibrated before and after the programme using a 1 kg weight, and were regularly adjusted to zero.

Each participant on OTP was visiting to their closest site weekly to receive food and a medical assessment. During every visit, the child was examined and given a weekly supply of RUTF. At admission, the data collectors were assessing degree of pitting edema, hydration, dysentery, diarrhea, anemia, and other signs of infections. At each follow-up visit weight of the child, existence/ extent of pitting edema, presence of disease, drugs prescribed and outcome (death, discharge cured, default, or transfer) had been recorded on patients' treatment cards and in the programme's register.

Lastly it was extracted using data extraction form from the cards and registration forms. The maximum follow up period for the children on OTP was 8 weeks or 56 days (10). A home visit was done for all children who did not return for follow up in order to know their treatment response status. During the home visit, the required information was recorded in a home visit record form.

Data Processing and Analysis

Data were entered to and analyzed using SPSS version 16.0 for windows. The main outcome in this study is recovery/cure from Sever acute Malnutrition (SAM). Individuals defaulted, died, and non-response at the end of the study period has been considered as censored. Finally, the out-come of each subject has been dichotomized in to censored or recovered. For the comparison of time to recovery among the different groups of children on OTP, Kaplan Meir (KM) curve has been used and significance test for these differences was assessed by log rank test. Then proportional hazards Cox model with stepwise variable selection procedural was used to identify independent predictors of survival. The assumption for proportional hazard was assessed graphically by log minus log survival curve. P-value less than or equal to 5% had been considered significant.

Ethical consideration

Ethical clearance was obtained from the Health research and post graduate coordinating Office of College of Public Health and Medical sciences, Jimma University. Official letter of co-operation

was also written to concerned bodies in the study area. Oral consent was taken from every mother or care giver before the interview by explaining the objective of the research. The study did not give any incentive to the participants as compensation for involving in the study. To append, any respondent identifiers weren't recorded to keep the confidentiality of the information.

Operational definitions

Severe acute protein energy malnutrition (SAM): weight for height/length (W/H or W/L)< 70% or MUAC < 110 mm with a Length > 65 cm.

Cured/recovered: Patient that has reached the discharge criteria.
Death: Patient that has died while he was in the programme at the facility or in transit to another component of the programme but has not yet been admitted to that facility. For the out-patient programme, the death has to be confirmed by a home visit.

Unknown: Patient that is absent for 3 consecutive weighing in out-patient care (21 days) but the outcome (actual defaulting or death) is not confirmed/ verified by a home visit.

Defaulter: Patient that is absent for 2 consecutive weighing (14 days), confirmed by a home visit for out-patient component of the programme.

Non-responder: Patient that has not reached the discharge criteria after 2months in the out-patient programme.

Discharge criteria: W/L≥85% or W/H≥85% on more than one occasion. (Two weeks for out-patients). No edema for 14 days if present (out-patient).

Weight gain (g/kg/day): is average weight (in gram) increase for every Kg of body weight of the child per day. It is determined by;

Individual weight gains in marasmic patients were calculated with:

$$\left(\frac{[\text{discharge weight} - \text{admission weight}]}{\frac{\text{admission weight}}{\text{numberofdays in programme}}}\right)$$

For children admitted with oedema, rates of weight gain after oedema had disappeared were calculated with:

$$\left(\frac{[discharge\ weight - weight\ at\ disappearnce\ of\ odema]}{\frac{weight\ at\ disappearnce\ of\ oedema}{numbers\ of\ days\ between\ disappearnce\ of\ oedema\ and\ discharge}}\right)$$

- Kwashiorkor: the presence of any bilateral pitting edema.
- Marasmus: weight for height ≤ -3 z scores or ≤ 70% of the median NCHS reference W/H.
- Marasmus kwashiorkor: weight for height ≤ -3 z scores or ≤ 70% of the median NCHS reference weight-for-height and bilateral pitting edema.

RESULTS

Socio demographic/economic characteristics of study Participants

A total of 332 children aged 6 to 59 months and their mothers/caregivers who had been enrolled to Outpatient therapeutic program (OTP) in the selected health facilities were followed for total of eight weeks. More than one third (36.4%) of mothers/caretakers were aged between 26-30 years and the mean age was 27.9(±6.3) years. Majority of the participants, 308(92.8%) were followers of Orthodox followed by Muslim18 (5.4%). Among the participants 301 (90.7%) belong to Tigray ethnic group. Regarding the educational status of mothers 210(63.3%) were illiterate and only 19(5.7%) had attended formal education. During the study period, most of the mothers were house wives 187(56.3%). The mean family size of the household was 5.6(±2.1). The median time lapse/distance to reach the health facility by the mothers was 2 h walking. Out of the 332 mothers 209(63.0%) usually worked out side home. The mean number of births of the mothers was 3.84(±2.0). Majority 227(68.4%) of the mothers' age at their first marriage was less than or equal to 18 year, with a mean age of 17.4(±2.5) years (Table 1).

Maternal and child related factors

The mean (±SD) age of the children was 15.8 (±8.0) months. One hundred forty four (43.4%) of the children were aged between 12-23 months. More than half 174(52.5%) of the children in the study were females. Majority 274(82.5%) of the children were fully vaccinated for their age. Concerning breastfeeding 288(86.7%) of the children were on breast feeding during the study. Regarding the nutritional diagnosis majority of the children 274(82.5%) had been diagnosed with marasmus. Only 54(16.3) children had Wt/Ht less than 60% at their admission. From the 25 children who have diarrhea, 6(24%) had dehydration (Table 2).

Environmental factors

Concerning the housing condition, the majority, 316 (95.2%) of the floor of the dwellings were made of earth. From the respondents 228(68.7%) of them store drinking water in 'jerican' and the rest store in traditional pot. Majority 257(77.4%) of the study participants have private latrine, of the only 69(26.8%) have hand washing facility in the latrine (Table 3).

Treatment outcome of severely malnourished children

Among the study participants, 255 patients (76.8%) have recovered with a median time to recovery of 49(28–56) days and mean rate of weight gain was 8.3 (±3.7) g/ kg/ day. Fifty eight patients (17.5%) defaulted and their median stay in the programme was 28 (14 to 49) days. This study showed that, the mean weight for height

Table 1. Socio-demographic characteristics of mothers/caregivers of children in the outpatient therapeutic feeding program in Enderta Woreda, Tigray,.North Ethiopia, 2012.

Variables		Cured No (%)	Defaulted No (%)	Died No	Non-response No (%)	Overall No (%)
Age of the mothers/caregivers (yrs)	<=20	38(14.9)	6(10.3)	0	0	44(13.3)
	21-25	68(26.7)	11(19.0)	0	9(52.9)	88(26.5)
	26-30	89(34.9)	24(41.4)	0	8(47.1)	121(36.4)
	31-35	28(11.0)	9(15.5)	2	0	39(11.7)
	36-40	23(9.0)	8(13.8)	0	0	31(9.3)
	>=41	9(3.5)	0	0	0	9(2.7)
Mother's education	illiterate	153(60.0)	43(74.1)	0	14(82.4)	210(63.3)
	Literate	102(40.0)	15(25.9)	2	3(17.6)	122(36.7)
Residence	rural	242(94.9)	50(86.2)	0	15(88.2)	307(92.5)
	urban	13(5.1)	8(13.8)	2	2(11.8)	25(7.5)
Ethnicity	Tigray	228(89.4)	56(96.6)	0	17(100.0)	301(90.7)
	Amhara	13(5.1)	2(3.4)	0	0	15(4.5)
	others	14(5.5)	0	2	0	16(4.8)
Marital status	Married	222(87.1)	45(77.6)	0	11(64.7)	278(83.7)
	widowed/divorced	33(12.9)	13(22.4)	2	6(35.3)	54(16.3)
Religion	Orthodox	237(92.9)	56(96.6)	0	15(88.2)	308(92.8)
	Muslim	14(5.5)	2(3.4)	2	0	18(5.4)
	Others	4(1.6)	0	0	2(11.8)	6(1.8)
Mothers Occupation	House wife	155(60.8)	22(37.9)	2	8(47.1)	187(56.3)
	Farmer	88(34.5)	34(58.6)	0	7(41.2)	129(38.9)
	Others	12(4.80)	2(3.4)	0	2(11.8)	16(4.8)
Family size	1-5	142(55.7)	31(53.4)	0	6(35.3)	179(53.9)
	>=6	113(44.3)	27(46.6)	2	11(64.7)	153(46.1)
Distance of HI from residence	≤2 h	196(76.9)	35(60.3)	0	11(64.7)	242(72.9)
	>2 h	59(23.1)	23(39.7)	2	6(35.3)	90(27.1)
Mother's usual work	Outside home	83(32.5)	33(56.9)	0	7(41.2)	123(37.0)
	Inside home	172(67.5)	25(43.1)	2	10(58.8)	209(63.0)
Mother have enough time to prepare food	Yes	229(89.8)	54(93.1)	2	15(88.2)	300(90.4)
	No	26(10.2)	4(6.9)	0	2(11.8)	32(9.6)
food preparation for <5 children	Separately	178(69.8)	22(37.9)	0	6(35.3)	206(62.0)
	Not separate	77(30.2)	36(62.1)	2	11(64.7)	126(38.0)
Number of births by the mother	1-3	132(51.8)	29(50.0)	0	6(35.3)	167(50.3)
	4-5	67(26.3)	10(17.2)	2	6(35.3)	85(25.6)
	≥7	56(22.0)	19(32.8)	0	5(29.4)	80(24.1)
Maternal age at 1st marriage	<18	176(69.0)	38(65.5)	2	11(64.7)	227(68.4)
	≥18	79(31.0)	20(34.5)	0	6(35.3)	105(31.6)

Mo, months; Yrs, years; HH, Households.

Table 2. Child characteristics of outpatient therapeutic feeding program in Enderta woreda, Tigray North Ethiopia, 2012.

Variables		Cured No (%)	Defaulted No (%)	Died No (%)	Non-response No (%)	Overall No (%)
Child age (mo)	6-11	105(41.2)	10(17.2)	0	9(52.9)	124(37.3)
	12-23	107(42.0)	33(56.9)	2	2(11.8)	144(43.4)
	>=24	43(16.9)	15(25.9)	0	6(35.3)	64(19.3)
Sex of the child	Male	124(48.6)	24(41.4)	2	8(41.1)	158(47.5)
	Female	131(51.4)	34(58.6)	0	9(58.9)	174(52.2)
Child immunization status	fully vaccinated	233(91.4)	31(53.4)	0	10(58.8)	274(82.5)
	Not fully vaccinated	22(8.6)	27(46.6)	2	7(41.2)	58(17.5)
Up to date Vit- A supplementation	Yes	243(95.3)	33(56.9)	0	17(100.0)	293(88.3)
	No	12(4.7)	25(43.1)	2	0	39(11.7)
Currently on breastfeeding	Yes	221(86.7)	48(82.8)	2	17(100.0)	288(86.7)
	No	34(13.3)	10(17.2)	0	0	44(13.3)
Type of nutritional diagnosis	Marasmic -Kwashiorkor	35(13.7)	17(29.3)	0	6(35.3)	58(17.5)
	Marasmus	220(86.3)	41(70.7)	2	11(64.7)	274(82.5)
Wt/Ht at admission	<60 %	37(14.5)	6(10.3)	2	9(52.9)	54(16.3)
	≥60%	218(85.5)	52(89.7)	0	8(47.1)	278(83.7)
Diarrhea at admission	No	240(94.1)	52(89.7)	2	13(76.5)	307(92.5)
	Yes	15(5.9)	6(10.3)	0	4(23.5)	25(7.5)

Table 3. Environmental characteristics of the participants of outpatient therapeutic feeding program in Enderta Woreda, Tigray, North Ethiopia, 2012.

Variables		Cured No (%)	Defaulted No (%)	Died No (%)	Non response No (%)	Overall No (%)
Type of the roof	Corrugated	157(61.6)	44(75.9)	0	8(47.1)	209(63.0)
	Thatched	98(38.4)	14(24.1)	2	9(52.9)	123(37.0)
Kitchen status with the dwelling	Separated	224(87.8)	47(81.0)	0	11(64.7)	282(84.9)
	attached	31(12.2)	11(19.0)	2	6(35.3)	50(15.1)
Water storage	'Jerican'	193(75.7)	30(51.7)	0	5(29.4)	228(68.7)
	Pot	62(24.3)	28(48.3)	2	12(70.6)	104(31.3)
Have latrine	Yes	213(83.5)	32(55.2)	0	12(70.6)	257(77.4)
	No	42(16.)5	26(44.8)	2	5(29.4)	75(22.6)
Hand washing with the latrine	Yes	49(19.2)	14(24.1)	0	6(35.3)	69(20.8)
	No	164(64.3)	18(31.0)	0	6(35.3)	188(56.6)
	No latrine	42(16.5)	26(44.8)	2	5(29.4)	75(22.6)
Solid waste disposal means	disposal pit	178(69.8)	32(55.2)	0	11(64.7)	221(66.6)
	open field	73(28.6)	26(44.8)	2	6(35.3)	107(32.2)
	Others	4(1.6)	0	0	0	4(1.2)

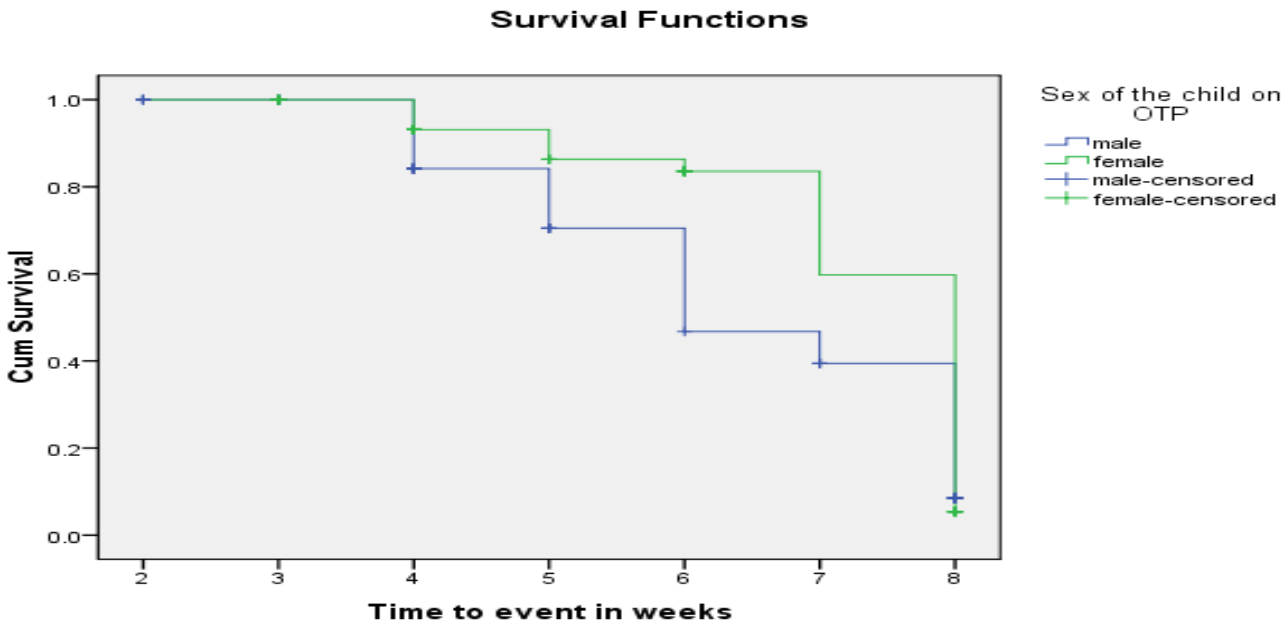

Figure 1. Kaplan-Meier survival curve of children on OTP by their sex in Enderta woreda, Tigray North Ethiopia, 2012.

(Wt/Ht) and mid upper arm circumference (MUAC) while defaulting were 73.3(±6.5)% and 11.3(±0.7) cm respectively. Overall mean time to clinical resolution of edema and mean rate of weight gain was 17.4(±4.4) days, 7.3(±3.8) g/ kg/ day respectively. The overall mean length of stay of the malnourished children in the programme was 44.1(±11.6) days. (Data not shown here).

Comparison of time to recovery among the different groups (The KM survival curve)

The Kaplan Meir (KM) survival curve for sex illustrates that the treatment outcome of males was better than that of females. The cure rate, median length of stay and mean weight gain per kg per day was 78.5%, 42 days and 8.6 g/kg/day for males respectively. For females cure rate, median length of stay and mean weight gain per kg per day was 75.3%, 50 days and 7.9 g/kg/day respectively (Figure 1).

The KM survival curve of distance of health institution from the residence of participants in relation to time to event illustrates that those who travel for less or equal to 2 h have better treatment outcomes of OTP (cure rate of 81.0%, median length of stay of 42 days and mean weight gain of 8.4 g/kg/day) as compared to those who travel more than 2 h (cure rate of 65.6%, median length of stay of 52 days and mean weight gain of 7.6 g/kg/day) (Figure 2). Children who were born from mothers whose age at first marriage was greater than or equal to 18 yrshave better response to OTP.

The time to recovery of OTP was shorter for children of age 18 months and below as compared to children above 18 months. Treatment outcome of children with baseline W/H greater than or equal to 60% have better time to recovery as compared to children with baseline W/H less than 60% (Figure 3).

Factors associated with survival time of children on OTP

The significance of the observed differences of the Kaplan Meier survival curves (times) among different groups of children was assessed using log rank test. As a result, distance of the health facility from the family's residence, means of drinking water storage at household level, sex of the child, age of the child, weight for height of the child at admission, maternal age at first marriage and way of food preparation for under five children by the mothers were found to have statistically significant association. Therefore, these variables were included in multiple variable analysis of proportional hazards Cox model (Table 4).

The rate of recovery from OTP among children whose mothers travel below 2 h to the health facility was 1.48 times higher than that of children whose mothers travel 2 h and above at any time during the study [AHR 1.48(95% CI: 1.08, 2.01)]. At any time during the study the rate of recovery from OTP among male children were 1.30 times higher than that of females [AHR 1.30(95% CI: 1.01, 1.68)]. The rate of recovery from OTP among children

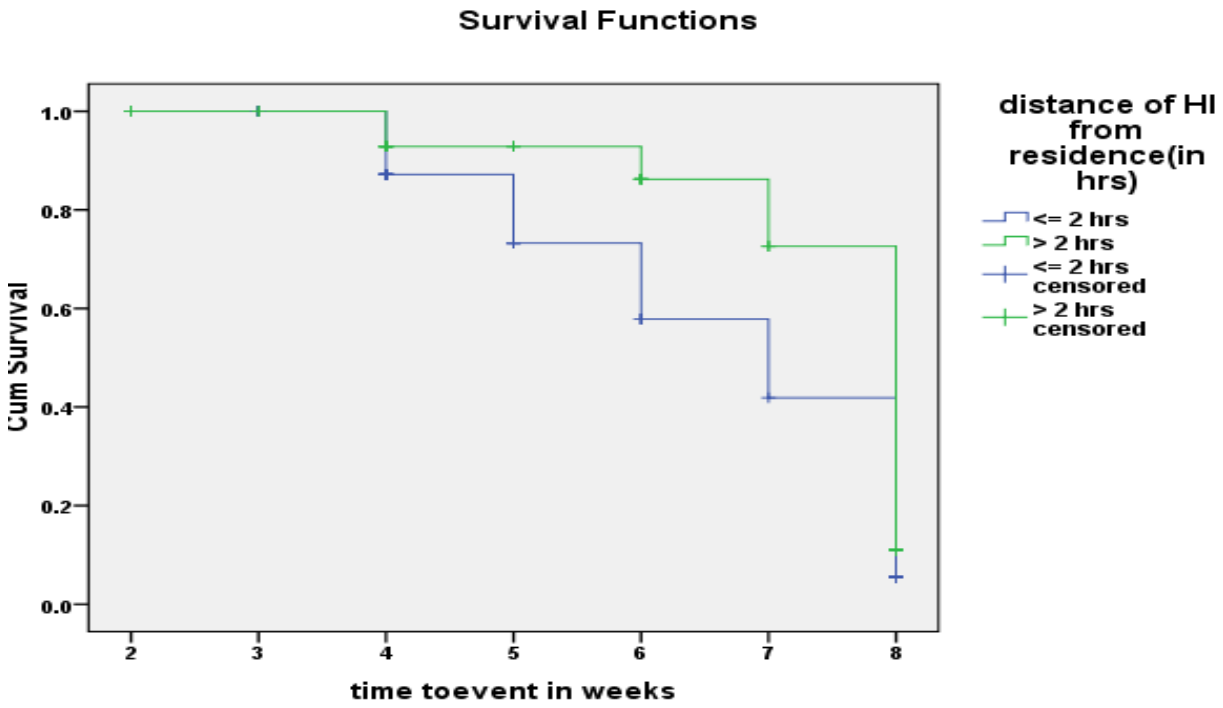

Figure 2. Kaplan-Meier survival curves among participants by distance of the health institution from their residence in Enderta woreda, Tigray, North Ethiopia, 2012.

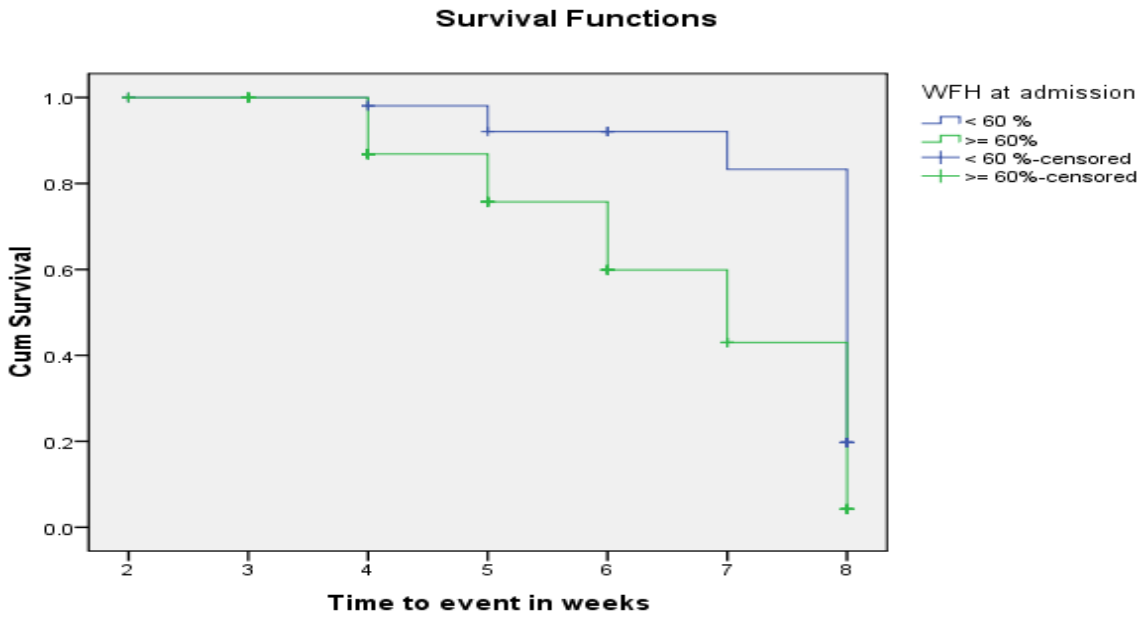

Figure 3. Kaplan-Meier survival curve of children on OTP by WFH at admission in Enderta woreda, Tigray North Ethiopia, 2012.

with baseline Wt/Ht of ≥60% was 1.87 times higher than that of children with baseline Wt/Ht of ≤ 60% at any time during the study [AHR 1.87(95% CI: 1.31, 2.66)]. The rate of recovery from OTP among children born from

Table 4. Log rank test of significance for the predictors of treatment outcomes of OTP in Enderta woreda, Tigray,North Ethiopia, 2012 (Univariate analysis).

Variables		cured	censored	Log rank	p-value
Distance of HI from residence	≤2 h	196	46	19.3	< 0.001**
	>2 h	59	31		
Storage of drinking water at home	'Jerican'	193	35	21.8	< 0.001**
	Pot	62	42		
Sex of the child	Male	124	34	12.6	<0.001**
	Female	131	43		
Age of the child on OTP	< 18 months	176	39	18.3	<0.001**
	≥ 18 months	79	38		
Wt/Ht at admission	< 60%	37	17	27.1	<0.001**
	≥ 60 %	218	60		
Maternal age at 1st marriage	< 18 yrs	176	51	15.5	0.001**
	≥18 yrs	79	26		
Way food preparing for <5 children	Separately for them	178	28	5.9	.015**
	Together with adult	77	49		
Source of drinking water	hand pump and protected spring/well	218	45	4.614	0.032*
	un Protected spring/well	37	32		
Educational status of the mother	Illiterate	153	57	6.321	.042*
	Able to read and write only	85	18		
	Educated(formal education)	17	2		
Maternal occupation	Housewife	155	32	13.60	.0001*
	Farmer	88	41		
	Others	12	4		

** Are variables with significant association on Log rank and the assumption for Kaplan Meier was met. *Are variables with significant association on Log rank but the assumption for Kaplan Meier was not met.

mothers, whose age at first marriage is18 yrs and above, was 1.46 times higher than that of children born from mothers, whose age at first marriage is below 18 yrs at any time during the study [AHR 1.46(95% CI: 1.10, 1.91)] (Table 5).

DISCUSSION

In this study 255(76.8%) children were cured from malnutrition and this finding is above the sphere standard which states recovery rate should be greater than 75% (The Sphere Project, 2011). When this result is compared with a study conducted in 2010 among four regions of Ethiopia; it is below the recent total average of the four regions (79%), Amhara regional average (87%) and SNNPR regional average (90%) but still it is higher than that of Tigray regional average (72%) (Gertrude et al., 2010). the median length of stay (49 with (IQR 28-56 days) for recovered/cured children in this study was found to be higher than 42 with (IQR28–56 days) reported by a retrospective cohort study conducted in Ethiopia since 2000/01 (Steve and Sadler 2002). The mean (+SD), of weight gained (8.3, ±3.7 g/kg/day) for recovered/cured of this study was consistent with that of the required sphere standard (> 8g/kg/day) (The Sphere Project, 2011).

Regarding defaulters, out of the 332 children included

Table 5. Proportional hazards Cox model multiple variable analysis of determinants of survival/treatment outcomes of OTP in Enderta woreda, Tigray North Ethiopia, 2012.

Variables		cured	censored	AHR	p-value	95%CI
Distance of HI from residence	≤2 h	196	46	1.48	0.013*	1.08,2.01
	>2 h	59	31	1		
Means drinking water storage	'Jerican'	193	35	1.51	0.008*	1.11, 2.05
	Pot	62	42	1		
Sex of the child	Male	124	34	1.30	0.043*	1.01, 1.68
	Female	131	43	1		
Age of the child on OTP	< 18 months	176	39	1.20	0.259	.87, 1.64
	≥ 18 months	79	38	1		
WFH at admission	< 60%	37	17	1	0.001*	1.31, 2.66
	≥ 60 %	218	60	1.87		
Maternal age at 1st marriage	< 18 yrs	176	51	1	0.007*	1.10, 1.91
	≥18 yrs	79	26	1.46		
Way of food preparing for <5 children	Separately for them	178	28	1.24	0.117	0.94,1.63
	Together with adult	77	49	1		

*P-value less than 0.05 which are statistically significant. AHR- adjusted hazard ratio.

in the study 58(17.5%) had defaulted from the program and this finding is higher than the sphere standard and reports from Tigray (8.8%), Amhara (4%), Oromia (9%) and South nations and nationalities peoples region (SNNPR) (4.6%) (Gertrude et al., 2010). This difference might be due to the high proportion of unknown (9.5% ranging from 1.9% in SNNPR regional state and 18.9% in Oromia regional state) cases, which underestimates the defaulter rate (Gertrude et al., 2010). However, in this study home visit had been made to know the real status of lost cases from the program. Nevertheless it is far below 47% reported in a study conducted in Jimma in a period from December 2005 to April 2007 (Martin and Girma, 2005). The mean MUAC of defaulters were 11.3(±0.7) cm respectively. This was relatively higher as compared to the result of the evaluative study conducted in the four regions of Ethiopia, 10.2 and 10.9 cm in Tigray and Oromia respectively (Gertrude et al., 2010). Out of the 58 defaulted malnourished children from OTP 28 (48.3%) had MUAC less than 11.0 cm. This finding showed that the children had defaulted while they were at higher risk of Mortality. The mean distance (minutes) traveled by the mothers/caregivers to the health institution was 150(±30) min walking. This is consistent with the evaluative study which found the mean distance (minutes) was 140.9 min for Tigray (Gertrude et al., 2010).

This study also showed that the non-response rate and deaths rate were 5.1 and 0.6% respectively, which are much lower than that of the sphere standard (The Sphere Project 2011) (death rate is considered as good indicator of performance if it is <10%). The death rate in this study is similar with 0.7% reported in the study conducted in four regions of Ethiopia since 2008-2010 (Chomios, 2011).

The overall mean length of stay (in days) of the malnourished children on the outpatient therapeutic feeding program was 6.28 weeks [44.1(±11.6) days]. This result is by far outside of the acceptable minimum SPHERE standards (28 days); yet,it is well within the standard Ethiopian protocol for management of SAM which allows children enrolled to OTP to stay under treatment to utmost eight weeks (64 days) (Sylvie et al., 2007). Moreover, the length of stay is comparable to other similar studies of OTP outcomes conducted in Bedawacho, Ethiopia (42 days) (Steve and Sadler).

The overall weight gain of the malnourished children on OTP was found to be 7.3(± 3.8)g/kg/day which is lower than the SPHERE standard (>=8g/kg/day).

The treatment outcome/response of this study showed that males had better outcome as compared to females. This difference was statistically significant and the rate of recovery from OTP among male children was 1.30 times higher than that of females at any time during the study. This was consistent with a similar study conducted in Senegal which showed that the recovery from underweight of boys was 1.09 times higher than that of girls (Gartner et al., 2006). The possible explanation could be that, in Ethiopia more families prefer to have son (20%) than daughter (7.6%) (Kana, 2008). This might affect equality of care and health seeking between the male and female child which in turn may affect the treatment outcome of OTP among < 5 children. The recovery rate among the study subjects also varies with the Wt/Ht of the children during admission to the program. This difference was statistically significant with

hazard ratio of 1.87, (95% CI: 1.31, 2.66). This finding is also similar with the study conducted in Senegal (Gartner et al., 2006). Children from mothers whose age at first marriage was 18 yrs and above had better response to OTP with higher cure rate (77.5%), lesser median length of stay (42 days) and higher mean weight gain (9.4 g/kg/day) as compared to those who were from mothers whose age at first marriage was below 18 yrs that had 74.3%, 49 days and 7.7 g/kg/day of cure rate, median length of stay and mean weight gain per kg per day respectively. The rate of recovery from OTP among children born from mothers whose age at first marriage was 18 yrs and above was 1.46 times higher than that of children born from mothers whose age at first marriage was below 18 yrs at any time during the study. The explanation for this difference could be that early marriage is linked to poor maternal health outcomes. These risks increase the likelihood of poor infant and child health outcomes (World Health Organization (WHO), 1999) and this might in turn affect the treatment out-come of malnutrition among < 5 children.

The Kaplan Meir (KM) survival curve of distance of health institution from the residence of participants in relation to time to event illustrates participants who travel for less or equal to 2hrs have better treatment outcomes of OTP (cure rate of 81.0%, median length of stay of 42 days and mean weight gain of 8.4 g/kg/day) as compared to those who travel more than 2 h (cure rate of 65.6%, median length of stay of 52 days and mean weight gain of 7.6 g/kg/day). This difference of treatment outcome by distance was statistically significant on log rank test and in the multiple variable proportional hazards Cox model. The rate of recovery from OTP among children whose mothers travel below 2 hours to the health facility was 1.48 times higher than that of children whose mothers travel 2 hours and above at any time during the study. Distance might affect the health seeking practice of the families that in turn could affect the treatment outcome of OTP among the children.

This study has strength and limitations that should be acknowledged. Since the study design was prospective longitudinal study temporality cause and effect relationship was possible to establish for the factors dealt in the study. The treatment outcome indicators have been appropriately described as maximum efforts was made to know the right treatment outcome of children who were lost to follow-up through home visit rather than classifying as unknown. As the study period of this study was in winter/dry season, the treatment outcome of OTP might have been affected by seasonal variation, as winter season in the study area is a none /less harvest season.

Conclusion

Among the treatment outcome standards/indicators of OTP, the overall recovery rate, death rate and non-response rate were within the recommended standards of sphere project. But regarding the overall defaulter rate, mean length of stay of the children in the program and mean weight gain in gram per kilogram of body weight per person was worse than the sphere standards. The Mid Upper Arm Circumference (MUAC) of the children when they default from outpatient feeding program indicated that the children defaulted while they were at higher risk of mortality. Hence, strengthening of food security at household level and tracing of defaulters is recommended as cue for action to prevent consequence of sever acute malnutrition in the age group.

Children with male Sex, baseline Wt/Ht of >60%, children whose mothers travel below 2 h to Health facility and children from mothers whose age at first marriage is ≥18 yrs were associated with better recovery from under nutrition as compared to their counterparts. However; age of the child and way of food preparation for children < 5 years of age were statistically significant on the log rank test only.

To improve the child morbidity and mortality, it is better to address the high rate of defaulter, low rate of weight gain and long length of stay in the program. Efforts to trace defaulters from OTP should be emphasized and strengthened. To overcome the high length of stay and low weight gain among patients in the OTP, health care providers need to consider and give emphasis to the identified determinants of the treatment outcomes. To complement the aforementioned limitations, further researches might be necessary in order to assess the situation at community (Household level).

Conflict of interests

The authors have not declared any conflict of interests.

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Abbreviations

DHS, Demographic health survey; **DPPC,** disaster prevention and preparedness commission; **MOH,** ministry of health; **MUAC,** middle upper arm circumference; **OTP,** outpatient therapeutic feeding program; **PEM,** protein energy malnutrition; **SAM,** severe acute malnutrition; **SNNPR,** south nations and nationalities peoples region; **W/H,** weight for height measurement; **WFP,** World Food

Program.

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