Survival Status and Determinants of Mortality Among Severely Malnourished Children Aged 0-59 Months Admitted to Jinka Hospital, South Omo Zone, Ethiopia: A Retrospective Cohort Study

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Research

Abstract

Sever acute malnutrition (SAM) remains a major public health problem contributing to morbidity and mortality among children aged 0-59 months. However, little is known about the survival status and determinants of mortality among children admitted to stabilization centers (SC) in Ethiopia particularly in study setting. The objective: to assess the survival status and determinants of mortality among severely malnourished children aged 0-59 months admitted to SC in Jinka general hospital from September 1, 2014 to August 30, 2018.

Hospital based retrospective cohort study design was used among 588 severely malnourished children aged 0-59 months admitted to SC of Jinka general hospital from March 20-30, 2019. Simple random sampling method was used to select medical records of the study participants. Proportional hazard assumption over time was checked by Schoenfeld's global test. The Kaplan-Meier survival curve with log-rank test was used to compare survival across groups. Bivariable and multivariable Cox proportional hazard regression was used to assess the association between each independent variable and the outcome variable. Level of statistical significance was declared at p less than 0.05.

Among cohort of children studied, nearly 11% of children were died during follow up. The overall mean survival time was 38 days, 95% CI :(36.3, 39.7).Urban residence [AHR=2.24, 95% CI: (1.17, 4.30)], presence of dehydration [AHR =3.94, 95% CI:(1.89, 8.22)], presence of shock [AHR=4.15, 95% CI:(2.01, 8.55)], altered body temperature [AHR= 2.01, 95% CI:(1.01, 3.91)], failure to take F100 formula milk [AHR= 4.87, 95%CI:(2.75, 8.63)] and oral antibiotics [AHR=3.57, 95%CI:(1.88,6.77)] were identified to be the independent determinants of mortality

The mortality rate for severely undernourished children was higher than global sphere standard and national protocol.Societal and individual level determinants of mortality were identified. Therefore, interventions to reduce mortality should focus on altered clinical conditions and comorbidities/ infections.

Background

Severe Acute Malnutrition (SAM) is defined as a very low weight for height (below − 3 z scores of the median world health organization (WHO) growth standards, or below 70% of the median of reference population and the presence of nutritional edema, bilateral pitting edema, or middle upper arm circumference (MUAC) less than 115 mm for children aged 6−59 months [1, 2].

SAM remains a major public health problem contributing to morbidity and mortality among children aged 0−59 months throughout the developing world. It is estimated that more than 52 million children worldwide are affected by acute malnutrition, of which 17 million are suffering from SAM [2] and the majority of these affected children are living in South Asia and sub Saharan Africa (SSA). Nearly 3·1 million children under five years from these settings die every year due to undernutrition which

contributes to 45% of the total child deaths of which 4.4% of deaths specifically is attributed to its severe form, and 15, 652, 300 total global disability adjusted life years (DALYs) [2–4].

The SSA accounts for 14.0 million wasted children aged under-five years of which 4.1 million are severely wasted [5] with the prevalence ranging from 10% to 20% [6]. In Ethiopia, 38%, 24% and 10% of children under five years are stunted, underweight and wasted respectively [7] and over half of the deaths among these children is related to undernutrition [8]. SAM accounts for 19.5% pediatric hospital admissions and 3–29% inpatient case fatality rate among under-five children [9–12].

The complicated form of SAM is the commonest reason for pediatric hospital admission and death. Thus, children who are severely undernourished had nine fold-increased risk of death than their well-nourished counterparts [13]. However, only 10% of children under five affected by SAM have access to treatment worldwide [6]. Hence, poor adherence to inpatient treatment protocol causes high mortality contributing to 25% to 30% of children with SAM to die during hospital admissions [14].

Although the case fatality rates for inpatient treatment of SAM using the world health organization (WHO) protocol ranged from 8% to 16% [15] still most of the cases admitted to stabilization centers (SCs) suffer from a number of fatal co-morbidities and infections that cause mortality which include diarrhea, pneumonia, sepsis and tuberculosis [6, 16]. Moreover, respiratory tract infections and malaria are also the most common comorbidities [17].

Researches revealed that mortality due to complicated SAM among under five children is reduced globally while still there is unacceptably high death rate and low survival status in different inpatient SCs of low income countries (LICs) including Ethiopia [9, 12, 18–19). The risk of death is also high among HIV infected children whereby 80% of cases are more likely to die than HIV negative ones. Similarly, altered general conditions like shock, dehydration, impaired consciousness, and altered body temperature cause most children's death at admission among others [20–22]. In Ethiopia, in particular, the high risk of mortality is associated with low coverage rates of SAM management, late diagnosis of undernourished cases, and poor adherence to treatment protocol [23], and presence of high defaulter rates [24].

The Ethiopian Federal Ministry of Health (FMoH) currently adopted WHO guidelines for the management of SAM, which are widely promoted as standard to treat SAM cases [25–26]. It is indicated that the management of severe cases according to this guideline could reduce the case fatality rate by 10% in inpatient settings. The mortality could be reduced to less than 5% with strict adherence to these guidelines [27]. However, improved reduction in case fatality rates was not always sustained over time, despite consistent implementation of the WHO's guidelines [28] the mortality rate among admitted under five children is unacceptably high [9].

Despite the availability of treatment for children with SAM in SCs, the mortality rate continues to be high in Ethiopia [9]. Therefore, this study was aimed at assessing the survival status and determinants of mortality among severely undernourished children aged 0–59 months admitted to SC in Jinka general

hospital, South Omo Zone, Southern Nation Nationalities and Peoples Regional state (SNNPR), South Ethiopia

Methods

Study settings, period, and design

Hospital based retrospective cohort study design was used in Jinka General Hospital SC, South Omo Zone, Southern Nation Nationalities and Peoples Regional state (SNNPR), South Ethiopia from March 20–30, 2019. Jinka, the administrative capital of South Omo Zone, is located at 750 km to the South of Addis Ababa, the capital City of Ethiopia, 399 kms from Hawassa (capital of SNNPR). South Omo Zone has eight districts (Woredas in local contexts) with sixteen indigenous ethnic groups, which belong mostly to pastoralists and agro-pastoral communities [29], study participants and sample selection

All randomly selected records of children aged 0–59 months admitted with SAM in Jinka General Hospital SC from September 1, 2014 to August 30, 2018, which fulfilled treatment and management protocol guidelines developed by Ethiopian FMoH for admission of children with SAM such as weight for height below −3 z scores of the median or the presence of nutritional (bilateral pedal) edema or middle upper arm circumference (MUAC) less than 11.5 cm [30], were included in the study. Moreover, we considered the last admission for children who were admitted more than once to the treatment corner. In contrary, ,records of children whose anthropometric data were not completely registered, treatment outcome not recorded, and admission and discharge date not recorded, and children with chronic illness and h congenital anomalies were excluded from study.

The required Sample size was computed using Epi Info version 7 computer software. Double population proportion formula was used to calculate the sample size with the following assumptions: 95% confidence level, 5% margin of error, power 80%, unexposed to exposed ratio of 2:1, risk of having an outcome among unexposed to be 7.9%, and 15.9% among exposed with risk ratio of 2 [20] .The main exposure variable was superimposed comorbidity. The estimated sample size was 602 with additional 10% for non-response. Simple random sampling technique was used to select the records of the admitted children from SAM registries. Accordingly, from 968 children with SAM admitted to the hospital in the last five years, 86 records were excluded since they were older than five years at admission. From the rest of 882 eligible records 602 cases were selected using simple random sampling technique. However, records of 14 cases of SAM were excluded due to incomplete treatment outcome and the final sample size of 588 was used for this study.

Data collection and quality control

All required data were collected using structured data retrieval format, which was adapted from standard treatment protocol guidelines and registration book for the management of SAM, monitoring multi chart, and related available literature. Five clinical nurses and one BSc nurse who had previous exposure to data collection and training on SAM management were deployed to collect the data and supervise the process

of data collection respectively. Primarily, the inpatient SAM treatment registration book was used to find their unique SAM numbers and medical record numbers. Then, registry clerks retrieved the patient card from card room using their medical record numbers. Based on pretested structured data extraction format, the required data from SAM registers, SAM monitoring multi charts, and individual patient cards were collected

Data collection team was trained on how to retrieve the data using data retrieval format from SAM registers and monitoring multi charts and individual patient card. Pre-test was done on randomly selected 30 medical records. All collected data were checked for the completeness, consistency and accuracy by the research team, and corrections were made accordingly. Data consistency and accuracy were checked before data entry. Two data clerks were trained on how to enter data onto EpiData version 3.1. Computer software .Data were double entered and validated for consistency

Study variables and measurements

Survival status of children admitted with SAM, death and time to event from admission until death, was understood as an outcome variable in this study. The outcome variable was coded as "1" if died and "0" if censored (other treatment outcomes cured, defaulter, nutritional transfer, none-recovered, and medical transfer). Children were labeled as cured if they have fulfilled the discharge criteria with nutritional improvement, died if passed away while they were in the program at SC, and defaulter if they were absent for 2 consecutive weighing sessions for 2 days [30].Moreover, children were known to have hyperthermia if body axillary temperature was above 38.5 °C and hypothermic if body axillary temperature was below 35 °C [30].Children who did not fulfill the discharge criteria after 40 days were said to be non-recovered and transfer out if transferred from in-patient care to outpatient program (OTP) but those children who were referred to higher health facilities for medical reasons did not continue the nutritional treatment [30]. Length of stay was measured as the number of days that SAM cases stayed in the hospital from admission until discharge [30]. Severe anemia was defined as the hemoglobin concentration of less than 4 gram /ml or the packed–cell volume of less than 12% [30].Weight gain was computed as the ratio of difference in weight at discharge to admission in Kg to the ratio of weight at admission to length of stay in days multiplied by 1000 [30].

The independent variables of this study included age of the child, type of SAM, residence, presence of malaria, dehydration, shock, diarrhea, and hypoglycemia, body temperature, use of F100 and oral antibiotics, level of consciousness, naso-gastric tube feeding, and blood transfusion.

Statistical data analysis

Data were cleaned, coded and entered onto EpiData version 3.1 and exported to STATA version 13 Windows for analysis. Exploratory data analysis was performed to check the levels of missing values and presence of influential outliers. The effect of multicollinearity among independent variables was checked using variance inflation factor (VIF) for which the values were within normal range (1.43.). Cox regression model's fitness to the survival data and proportional Hazard assumptions were checked with

Schoenfeld's residuals test (p value = 0.4742. Descriptive statistics such as mean, median, interquartile range was used to summarize the data. The Kaplan-Meier non- parametric estimator was used to estimate the mean survival time and Log-rank significance test was used to compare survival between categorical groups. Life table was constructed to estimate probabilities of death at different time intervals. Bivariable Cox proportional hazard regression model was used to see the association between each independent variable and the outcome variable. Variables with p value less than 0.2 during bivariable cox regression analyses were entered into final multivariable cox regression model using enter procedure to control for all possible confounders and identify determinant of mortality. The final model fitness was checked by Nelson−Aalen cumulative hazard function against Cox−Snell residuals plot and global test using Schoenfeld's residuals. Cox regression hazard ratio along with 95% CI were estimated to measure the strength of the association. Level of statistical significance was declared at p value less than 0.05.

Results

Socio-demographic and admission characteristics study participants

Out of the 602 selected SAM records, 588 patient cards were extracted with data retrieval rate of (97.67%). A cohort of 588 severely malnourished children was followed retrospectively for 60 months with median (± IQR) time of follow up to be 12 (± 8) days. About 340 (57.8%) of those enrolled into the study were males. The majority of admitted children 490(83.3%) were from rural areas. The mean (± SD) age of children was 22.05 (± 15.31) months. The minimum and maximum age boundaries were 12 months and 59 months respectively.

The majority 534 (90.8%) of the cases were newly admitted of which 330 (56.1%) had clinically evident edematous malnutrition, 227(38.6%) clinically identified as kwashiorkor while 103(17.5%) were marasmic- kwash and 258(43.9%) were clinically recoded as having marasmus. Likewise, more than half of children, 330(56.1%), had nutritional edema. From total admission, 164(27.9%) of children had weight for height (WFH) 70% below the median. From 62 total admission deaths 47(75.8%) were from rural areas and more than half 35(56.45%) of deaths belonged to children aged 6−23 months (Table 1).

Table 1
Socio-demographic and admission characteristics among severely malnourished children age 0–59 months admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019

Variables (n = 588)		Survival status		Total, n (%)
		Died, n (%)	Censored, n (%)	
Sex	Male	38(6.5)	302(51.4)	340(57.8)
	Female	24(4.1)	224(38.1)	248(42.2)
Age	< 6 months	5(0.9)	54(9.2)	59(10.0)
	6–23 months	35(6.0)	233(39.6)	268(45.6)
	24–59 months	22(3.7)	239(40.6)	261(44.4)
Place of residence	Urban	15(2.6)	83(14.1)	98(16.7)
	Rural	47(8.0)	443(75.3)	490(83.3)
Breast feeding status	Yes	25(4.3)	199(33.8)	224(38.1)
	No	37(6.3)	327(55.6)	364(61.9)
Type of admission	New	57(9.7)	477(81.1)	534(90.8)
	Readmission	5(0.9)	49(8.3)	54(9.2)
Type of SAM	Marasmic	31(5.3)	227(38.6)	258(43.9)
	Kwashiorkor	17(2.9)	210(35.7)	227(38.6)
	Marasmic-kwashiorkor	14(2.4)	89(15.1)	103(17.5)
Nutritional edema	Yes	31(5.3)	299(50.9)	330(56.1)
	No	31(5.3)	227(38.6)	258(43.9)
WFH %	< 70%	29(4.9)	135(23.0)	164(27.9)
	≥ 70%	33(5.6)	391(66.5)	424(72.1)

Clinical profile and comorbidity patterns at admission

About 103(17.5%) and 41(7%) of children developed pneumonia and tuberculosis at the time of admission respectively. Similarly, 44(7.5%) of children were infected with malaria and 21(3.6%) of children were HIV Sero-positive.

A significant proportion of children had interrupted clinical condition and vital signs during admission. About, 382(65.0%) of children had developed anemia, 216(36.7%) of children had vomiting, 146 (24.8%) of children suffered from dehydration, 48(8.2%) of them had altered level of consciousness and 52(8.8%)

of them had altered axillary body temperature (hypothermia or hyperthermia). Likewise, 39(6.6%) of children developed shock. (Table 2).

Table 2
Clinical conditions and comorbidity patterns among severely malnourished children admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019.

Variables (n = 588)		Survival status		Total n (%)
		Died n (%)	Censored n (%)	
Pneumonia	Yes	9(1.5)	94(16)	103(17.5)
	No	53(9)	432(73.5)	485(82.5)
Malaria	Yes	8(1.4)	36(6.1)	44(7.5)
	No	54(9.2)	490(83.3)	544(92.5)
HIV Sero status	Sero positive	3(0.5)	18(3.1)	21(3.6)
	Sero negative	32(5.4)	295(50.2)	327(55.6)
	Not known	27(4.6)	213(36.2)	240(40.8)
Diarrhea	Yes	43(7.3)	228(38.8)	271(46.1)
	No	19(3.2)	298(50.7)	317(53.9)
Tuberculosis	Yes	6(1.0)	35(6.0)	41(7.0)
	No	44(7.5)	375(63.8)	419(71.3)
	Not known	12(2.0)	116(19.7)	128(21.8)
Vomiting	Yes	27(4.6)	189(32.1)	216(36.7)
	No	35(6.0)	337(57.3)	371(63.3)
Level of Consciousness	Altered	25(4.3)	23(3.9)	48(8.2)
	Normal	37(6.3)	503(85.5)	540(91.8)
Shock	Yes	20(3.4)	19(3.2)	39(6.6)
	No	42(7.1)	507(86.2)	549(93.4)
Dehydration	Yes	42(7.1)	104(17.7)	146(24.8)
	No	20(3.4)	422(71.8)	442(75.2)
Hypoglycemia	Yes	11(1.9)	26(4.4)	37(6.3)
	No	51(8.7)	500(85.0)	551(93.7)
Anemia	(Hgb < 11 g/dl)	44(7.5)	338(57.5)	382(65.0)
	(Hgb > 11 g/dl)	18(3.0)	188(32.0)	206(35.0)
Body temperature	Altered	19(3.2)	33(5.6)	52(8.8)

Variables (n = 588)		Survival status		Total n (%)
		Died n (%)	Censored n (%)	
	Normal	43(7.3)	493(7.3)	536(91.2)
Appetite test	Passed	7(1.2)	41(7.0)	48(8.2)
RUTF	Failed	55(9.2)	485(82.5)	540(91.8)
Cough	Yes	25(4.3)	191(32.5)	216(36.7)
	No	37(6.3)	335(57.0)	372(63.3)
Skin lesion	Yes	7(1.2)	57(9.7)	64(10.9)
	No	55(9.4)	469(79.8)	524(89.1)

The most frequent comorbidities affecting severely malnourished children aged 0−59 months admitted to Jinka hospital SC were diarrhea, 271(46.1%) and pneumonia 103(17.5%) respectively (Fig. 1).

Therapeutic feeding, routine and special medication provision

The most frequently delivered therapeutic food and medication was F-100 formula milk 452(76.6%) and intravenous antibiotic medication 366(62.24%) respectively. Likewise, 276(46.9%) of children admitted were supplemented with folic acid and 289(49.1%) of children were given deworming medication. Moreover, 305(51.9%) of children were treated with oral antibiotics medication, 274(46.60%) were resuscitated with intravenous fluid and 53(9.0%) of them were blood transfused (Table 3)

Table 3
Therapeutic feeding, routine and special medication provision among severely malnourished children age 0–59 months admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019

Variables (n = 588).		Survival status		Total
		Death n (%)	Censored n(%)	n (%)
Vitamin A supplementation	Yes	25(4.3)	210(35.7)	235(40.0)
	No	37(6.3)	316(53.7)	353(60.0)
Folic acid supplementation	Yes	25(4.3)	251(42.7)	276(46.9)
	No	37(6.3)	275(46.8)	312(53.1)
Dewormed by anti-helmets	Yes	34(5.8)	255(43.4)	289(49.1)
	No	28(4.8)	271(46.1)	299(50.9)
Oral Antibiotics	Yes	14(2.4)	291(49.5)	305(51.9)
	No	48(8.2)	235(40.0)	283(48.1)
F100 intake	Yes	27(4.6)	425(72.3)	452(76.9)
	No	35(6.0)	101(17.2)	136(23.1)
IV Fluid infusion	Yes	34(5.8)	240(40.8)	274(46.6)
	No	28(4.8)	286(48.6)	314(53.4)
NG tube feeding	Yes	35(6.0)	141(24.0)	176(29.9)
	No	27(4.6)	385(65.5)	412(70.1)
Treated with IV antibiotics	Yes	42(7.1)	324(55.1)	366(62.2)
	No	20(3.4)	202(34.4)	222(37.8)
Blood transfusion	Yes	17(2.9)	36(6.1)	53(9.0)
	No	45(7.7)	490(83.3)	534(90.0)

Survival status and treatment outcome of children admitted with severe acute malnutrition

From 588 cohort of children, 402 (68.37%, 95%CI :(64.48%, 72.01%) children were cured and discharged, 62 (10.54%, 95% CI: (8.30%, 13.30%) were died during treatment, 41 (6.97%, 95% CI: (5.17%, 9.34%) were defaulted and left the TFU before completing their treatment. The average length of hospital stay was 13.46 days 95% CI: (12.88, 14.05) with the minimum and maximum stay of one day and 44 days respectively. The average weight gain was 6.16 g/kg/day (0.54 g/kg/day for edematous malnutrition and 13.36 g/kg/day for non-edematous malnutrition) (Fig. 2)

The cumulative survival rates at the end of 1st, 2nd and 3rd and 4th weeks were 93.5%, 95% CI :(91.16%, 95.26%), 90.7%, 95%CI: (87.81%, 92.89%), 85.4%, 95%CI: (80.9%, 88.89%) and 80.2%, 95%CI :(72.35%, 86.05%) respectively (Fig. 3).

The overall survival time was 38 days, 95%CI: (36.3, 39.73). The total time at risk for 588 SAM children was 7920 days of observation with incidence rate during follow up period to be 7.8 deaths 95% CI: (6.10, 10.04) per 1000 person days. The majority of the children 37(59.68%) were died with in first week of admission while 12(19.35%) were died during second week of admission.

To estimate the hazard of death and compare survival experience between groups, Kaplan–Meier survival curves with log-rank test was used. These survival curves were estimated for each group separately using Kaplan Meier method and compared statistically using Log-rank test. Therefore ,the survival experience was significantly different among groups, whereby children admitted with WFH 70% below the median had short survival time than their counterparts (log-rank test (χ2 = 11.2, p < 0.001), children with clinical sign of altered level of consciousness had short survival time than their counterparts (log-rank test (χ2 = 128.23, p < 0.0001). In contrast, children who were adhering to F100 formula milk based on national treatment protocol during admission had higher survival time compared with their counterparts (log-rank test (χ2 = 55.74, p < 0.0001). However, children who were supplemented with folic acid during admission had no any significant difference in survival compared with their counterparts (log-rank test (χ2 = 1.17, P < 0.27) (Table 4).

Table 4
Mean survival time and log-rank test among severely malnourished children admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019

Variables (n = 588)		Mean survival time (95% CI)	Log-rank test
WFH of median	< 70%	34.61 (31.5, 37.72)	$\chi 2$ = 11.2, p < 0.008 **
	≥ 70%	39.0 (37.0, 41.1)	
Level of consciousness	Altered	13.60(10.85, 16.35)	$\chi 2$ = 128.23, p < 0.0001**
	Normal	40.03(38.52, 41.54)	
Presence of shock	Yes	15.01 (11.46, 18.56)	$\chi 2$ = 94.97, p < 0.0001***
	No	39.83(38.26, 41.40)	
Presence dehydration	Yes	29.18 (25.53, 32.83)	$\chi 2$ = 67.26, P < 0.0001***
	No	40.94 (39.11, 42.7)	
Folic acid supplementation	Yes	37.17(34.44, 39.90)	$\chi 2$ = 1.17, P < 0.27*
	No	37.93(35.80, 40.06)	
Dewormed by anti-helmets	Yes	35.95(33.02, 38.88)	$\chi 2$ = 0.82, p < 0.36*
	No	38.99(37.13, 40.86)	
Oral antibiotics	Yes	40.82(38.65, 43.10)	$\chi 2$ = 25.23, p < 0.0001***
	No	32.65(30.32, 34.99)	
F100 intake	Yes	39.88(38.05, 41.73)	$\chi 2$ = 55.74, p < 0.0001***
	No	22.44(20.29, 24.58)	
Presence of diarrhea	Yes	35.30 (32.44, 38.17)	$\chi 2$ = 16.55, p < 0.0001***
	No	40.27 (38.29, 42.25)	
NG tube feeding	Yes	33.12 (30.03, 36.21)	$\chi 2$ = 21.37, p < 0.0001***
	No	39.87 (37.76, 41.98)	
Blood transfusion	Yes	28.34 (22.65, 34.02)	$\chi 2$ = 27.74, p < 0.0001***
	No	39.14(37.43, 40.86)	
Axillary body temperature	Altered	20.19(16.71, 23.66)	$\chi 2$ = 57.73, p < 0.0001***
	Normal	39.01(37.23, 40.78)	
Statistically significant difference at p < 0.05) =*, P < 0.01=**,and P < 0.001=***			

Children admitted with shock had higher risk of experiencing death than children without shock, as the survival curve declines faster than the curve for those without shock (log-rank test(χ2 = 94.97, p < 0.0001) (Fig. 4).

Dehydrated children had higher risk of experiencing death than non-dehydrated children did, as the survival curve declines faster than the curve for non-dehydrated children (log-rank test (χ2 = 67.26, P < 0.0001) (Fig. 5).

Determinants of mortality among children admitted with sever acute malnutrition

Bivariable Cox proportional hazard regression was performed for each independent variable with the outcome variable. Accordingly, altered level of consciousness, presence of shock, dehydration, hypoglycemia, and diarrhea, altered body temperature, blood transfusion, naso-gastric (NG) tube feeding, F100 formula milk and oral antibiotics intake were significantly associated with mortality (Table 5)

Table 5

Result of multivariable cox proportional hazard regression analysis for determinant of mortality among severely malnourished children aged 0–59 months admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019

Variables (n = 588)		Survival status		CHR (95%CI)	AHR (95%CI)
		Died	Censored		
Age	< 6 months	5	54	1.16(0.44, 3.07)	0.45(0.14, 1.37)
	6–23 months	35	233	1.59(0.93, 2.70)	0.57(0.30, 1.10)
	24–59 months	22	239	1	1
Type of SAM	Marasmic	31	227	1.09(0.54, 1.9)	0.64(0.32, 1.31)
	Kwashiorkor	17	210	0.58(0.28, 1.17)	0.53(0.25, 1.13)
	Marasmic - Kwashiorkor	14	89	1	1
Place of residence	Urban	15	83	1.49 (0.83, 2.67)	2.24(1.17, 4.30)*
	Rural	47	443	1	1
Presence of malaria	Yes	8	36	1.73(0.82, 3.63)	1.90(0.79, 4.87)
	No	54	490	1	1
Presence of dehydration	Yes	42	104	6.78(3.98, 11.56)**	3.94(1.89, 8.22)**
	No	20	422	1	1
Presence of shock	Yes	20	19	8.89(5.21, 15.17)**	4.15(2.01, 8.55)**
	No	42	507	1	
Body temperature	Altered	19	33	5.14(2.99, 8.84)*	2.02(1.01, 3.91)*
	Normal	43	493	1	1
F100 intake	Yes	27	425	1	1
	No	35	101	5.49(3.32, 9.09)**	4.87(2.75, 8.63)**

* = p < 0.05, **= P < 0.001

Variables (n = 588)		Survival status		CHR (95%CI)	AHR (95%CI)
		Died	Censored		
Oral antibiotics Intake	Yes	14	291	1	1
	No	48	235	4.06(2.24, 7.37)**	3.57(1.88, 6.77)**
Level of consciousness	Altered	25	23	10.68(6.39, 17.86)*	1.97(0.99, 3.94)
	Normal	37	503	1	1
Presence of hypoglycemia	Yes	11	26	3.57(1.86, 6.86)*	1.01(0.45, 2.29)
	No	51	500	1	1
Presence of diarrhea	Yes	43	228	2.90(1.69, 4.98)*	1.69(0.90, 3.17)
	No	19	298	1	1
NG tube feeding	Yes	35	141	3.0(1.85, 5.0)*	1.10(0.59, 2.06)
	No	27	385	1	1
Blood transfusion	Yes	17	36	3.99(2.28, 6.99)*	1.61(0.76, 3.41)
	No	45	490	1	1
* = p < 0.05, **= P < 0.001					

In multivariable cox proportional hazard regression analysis, urban residence, presence of dehydration and shock, altered body temperature, failure to take F100 milk and oral antibiotics were found to be independent determinants of mortality among severely malnourished children admitted to SC in Jinka hospital. Children born to mothers from urban residence were two times [AHR = 2.24, 95%CI: (1.17, 4.30)] more likely to die compared with their counterparts .Children who had dehydration were nearly 4 times [AHR = 3.94, 95% CI: (1.89, 8.22)] more likely die compared with children who did not have signs of dehydration .The hazard of death was two times [AHR = 2.02, 95%CI:(1.01, 3.91) higher among children who had altered body temperature compared with those with normal body temperature .Children who undergone shock were four times [AHR = 4.15, 95%CI : (2.01, 8.55)] more likely to die compared with their counterparts .The hazard of death was also nearly five times [AHR = 4.87, 95%CI: (2.75, 8.63)] higher among children who failed to feed on F-100 formula than those who used to fed on it .Moreover, children who did not get antibiotic upon admission were nearly four times [AHR = 3.57, 95%cI : (1.88, 6.77)] more likely to die compared with their counterparts (Table 5).

Discussion

The overall survival time for severely malnourished children was 38 days in the follow up of 7920 days of observation and the cumulative survival rates at the end of 1st, 2nd, 3rd and 4th weeks were 93.5%, 90.6%, 85.4% and 80.2%, respectively. During follow up, 10.54% of children were died of which 37(59.68%) were died with in first week of admission. The mean length of hospital stay was 13.46 days. The average weight gain was 6.16 g/kg/day (0.54 g/kg/day for edematous malnutrition and 13.36 g/kg/day for non-edematous malnutrition). Urban residence, presence of dehydration, presence shock, altered body temperature, failure to take F100 formula milk and oral antibiotics were independent determinants of mortality among children admitted with SAM.

This study revealed that the survival time for SAM children was 38 days in the follow up of 7920 days of observation. It is lower than studies conducted in different parts of Ethiopia Tigray which reported 41.93 days [31], in Gondar University hospital (69 days) [12], in DireDawa, (69.28 days) [24], in Gedeo zone (79.6) [32], and in Dilla (47 days) [18]. However, it is higher than studies conducted in Lusaka, Zambia (13 days) [21] in Sekota, north Ethiopia (10days) [9]. This might be due to difference in hospital facilities, difference in study setting; sample size difference, difference in follow up periods, difference skills of professionals, difference in adherence to management protocol, and difference in severity of cases and comorbidity might attribute these variations.

In this study, 10.54% of children were died during follow up period of whom 37(59.68%) were died with in first week of admission during the follow-up period. This is in line with some studies conducted in Ethiopia, Gondar (12.5%) [12] and Wolaita, (12.4%) [33]. But it is higher than other studies conducted in India 3.5% [34], in Ethiopia, Woldia (6%) [35], and Gedeo Zone (9.3%) [32] Moreover, this result is also higher than acceptable levels of international standards and national protocol set for management of SAM, which describes that it should be less than 10% [30, 36]. However, the result obtained in this study is lower than results of studies conducted in Nigeria (40%) [37], Zambia Lusaka 40% [21] and in Seqota hospital (28.67%), north Ethiopia [9]. This variation might be attributed to difference in study setting, adherence to management protocol, sample size, follow up periods and skills of professionals, delay case presentation of mothers /caregivers to treatment, and high comorbidity patterns. The variation also could be attributed to inadequately trained health staff, poor compliance with WHO treatment guidelines, or even faulty practices [38]

The finding of this study showed that the mean length of hospital stay was 13.46 days. This finding was acceptable when compared with minimum international SPHERE and national standard set for management of SAM, which is less than 30 days [36]. It is also comparable with study done in Zambia, Lusaka (13 days) [21], Gedeo zone (13 days) [32] and Woldia (13.2 days), Ethiopia [35]. Nevertheless, it is higher than the results of studies done in Cameron (8.25 days) [17], in some parts of Ethiopia, DireDawa (10 days) [24] and Wolaita zone (11 day) [33]. In contrast, it is lower than studies done in India (14.2 days) [34], Ethiopia, Mekelle (17 days) [19] and Dilla (15 days [18]. This variation might be due to

difference in adherence to management protocol, follow up periods, severity of cases/complication, study setting, and treatment skills of health professionals.

This study also showed that the average weight gain among severely malnourished children aged 0−59 months was 6.16 g/kg/day which represents 13.36 g/kg/day for non-edematous and 0.54 g/kg/day for edematous malnutrition. It was unacceptably low when compared with international and national standards set for management of SAM, which recommends greater than 8 g/kg/day [36]. This finding was also lower than other studies done in Ethiopia including Woldia hospital north Ethiopia 12.03 g/kg/day [35], Jima university teaching hospital 10.4 g/kg/day [20], and Dilchora hospital 15.6 g/kg/day [24]. This might be because most of the children included in the current study had edematous malnutrition whereby weight loss is expected rather than weight gain. This low weight gain might be explained by improper therapeutic feeding practice during admission [30].

The finding of this study revealed that children who were lived in urban area were 2.24 times more likely to die at any given time compared with their counterparts This is congruent with study done in north part of Ethiopia where children from urban settings had an increased hazard of death by 2.73 times [31]. However, this finding contradicts with finding from a previous prospective cohort study done in Ethiopia, which revealed that children living 2 hours far apart from the health facility had high hazards of death than their urban counterparts [39]. This might be due to disparity in soio-economic characteristics

In this study, children who had shock were 4.15 times more likely to die at any given time than their counterparts This finding was comparable with other studies conducted in some parts of Ethiopia like Gondar university hospital, Dilla University specialized hospital, Dilla University specialized hospital Wolaita zone, and Gedeo zone, which have found that shock predicted an increased hazards of death among children admitted with SAM [12, 32−33].This might be due to difference in the typology of shock like, low volume, cardiogenic, obstructive and distributive. However, hypovolemic shock indicates the presence of severe dehydration, fluid and electrolyte imbalance, and low blood circulation in the body contributes to death [30].

It was also observed that dehydrated children were found to be 4 times more likely to die earlier than those children who were not dehydrated. This is consistent with studies conducted in Cameron where dehydration increased the hazards of death by 29.6% [17]and in Jimma University specialized hospital where double fold hazards of death [20] were repored. However, it contradicts with other studies, where dehydration had no association with death [12, 40]. This might be due to depleted circulation and electrolyte imbalance with fluid overload, which may be attributed to secondary complication, infection and cardiac failure [30].

The hazards of death were 2times higher among children with altered body temperature (hypothermia or hyperthermia) when compared with their counterparts. This is supported by studies done in different parts of Ethiopia where the hazards of death due to altered body temperature were higher among children with altered body temperature [11, 20, 18, 32−33]. This might be attributed to the effects of hypothermia and hyperthermia, which may affect the biochemical reactions of the body and indicators of altered

metabolism suggesting the presence of sepsis and serious infections. In addition, hypothermic child may not have enough calories that keep the body warm and may develop hypoglycemia. Both hypothermia and hypoglycemia are signs acute serious systemic infection, which could lead to death when intervention is delayed [30].

In this study, children who failed to take F100 formula milk according to SAM treatment protocol had nearly 5 times hazards of death than their counterparts. This finding was in agreement with results of other studies whereby failure to feed on F100 formula milk has increased the hazards of death by three folds [12] and 26% increased risk of death [24]. However, it contradicts with other studies in Ethiopia [33] and Uganda [40], which reported lack of an association. This might be attributed to appropriate use the formula as it contains high calories and protein that hasten recovery, rapid weight gain and growth by rebuilding wasted tissues of the severely malnourished children. [2, 30].

Moreover, the hazards of death were nearly 4 times higher among children who did not take oral antibiotics compared with their counterparts. This finding was consistent with studies conducted among children admitted to three hospitals of Dhaka city in Bangladesh where non- intake of antibiotics has increased the hazards of death [41] Similarly, according to studies done in Gondar university hospital and Wolaita zone South Ethiopia non- intake of any antibiotics has increased the hazards of death by two folds and four fold respectively [12,33]. In the same line, failure to take intravenous antibiotics has increased the hazards of death 3 times among SAM cases admitted to Seqota hospital of North Ethiopia [9]. This might be explained by the rationale behind antibiotic treatment for children with SAM lies in observation that malnourished children may not show sign of clinical infection. Therefore, treatment of infection and small intestine bacterial over growth, prevention of colonizing pathogens, and minimization of nutrient diversion are of paramount importance in increasing recovery rate [40]

This study could have the following limitations: Firstly, as it was based on record reviews, the chance of capturing all-important risk factors of mortality could be low unlike prospectively capturing the data. Secondly, difference in health professionals' skill in the management of SAM could have influenced appropriate treatment of cases and record keeping.

Conclusion

The overall survival time for severely malnourished children aged 0–59 months was 38 days in the follow up of 7920 days observation. The mortality rate for severely malnourished children was higher than acceptable levels for global SPHERE standard and national protocol. Urban residence, presence of shock, presence of dehydration, altered body temperature; failure to take F100 formula milk and failure to take oral antibiotics were independent determinant of mortality for sever acute malnutrition.

Therefore, further interventions to reduce deaths among the eligible should focus on altered clinical conditions and comorbidities/infections.

Abbreviations

CHEW

Community Health Extension Worker; CSA:Central Statistics Authority; EDHS:Ethiopian Demographic and Health Survey; F 100:Formula Milk One Hundred; MUAC:Middle Upper Arm Circumference; NCHS:National Center for Health Statistics; RUTF:Ready-to Use-Therapeutic Food; SAM:Sever Acute Malnutrition; SNNPR:Southern Nations Nationalities and Peoples Regional State; WHZ:Weight for Height Z-score

Declarations

Ethics approval and consent to participate

Ethical clearance was secured from Haramaya University College of Health and Medical Sciences Institutional Health Research Ethical Review Committee (IHRERC). Moreover, an official letter was written from School of Public Health to Jinka General Hospital for cooperation to collect data. After reviewed ethical credibility, permission was obtained from Jinka General Hospital administration for their cooperation to accesses the data. However, since the study has used data from existing admission and patients' records of SC, there was no direct contact with children/caregivers. Hence, an informed, voluntary, written and signed consent from the parents or caregivers of the children was not applied; instead, consent or permission was secured from Hospital manager. All the necessary privacy and confidentiality was assured by collecting data secretly using medical record number of each patient. No patient card was lost during data collection period.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and/or analyzed during the current study are not publicly available due to restricted data sharing policy of Haramaya University but are available from the corresponding author on reasonable request.

Competing interests

The authors declared that there are no any competing interests. Author details

Funding

The authors did not receive any funding for preparation or publication of this manuscript.

Authors' contributions

SA: participated in the conception and designing of the study including data collection, data analysis, interpretation and write –up of the manuscript. TG: participated in all implementation stage of the study including the design, interpretation of result and write up of the manuscript. GE: participated in the designing of the study, interpretation of result and manuscript write up and revision

Acknowledgements

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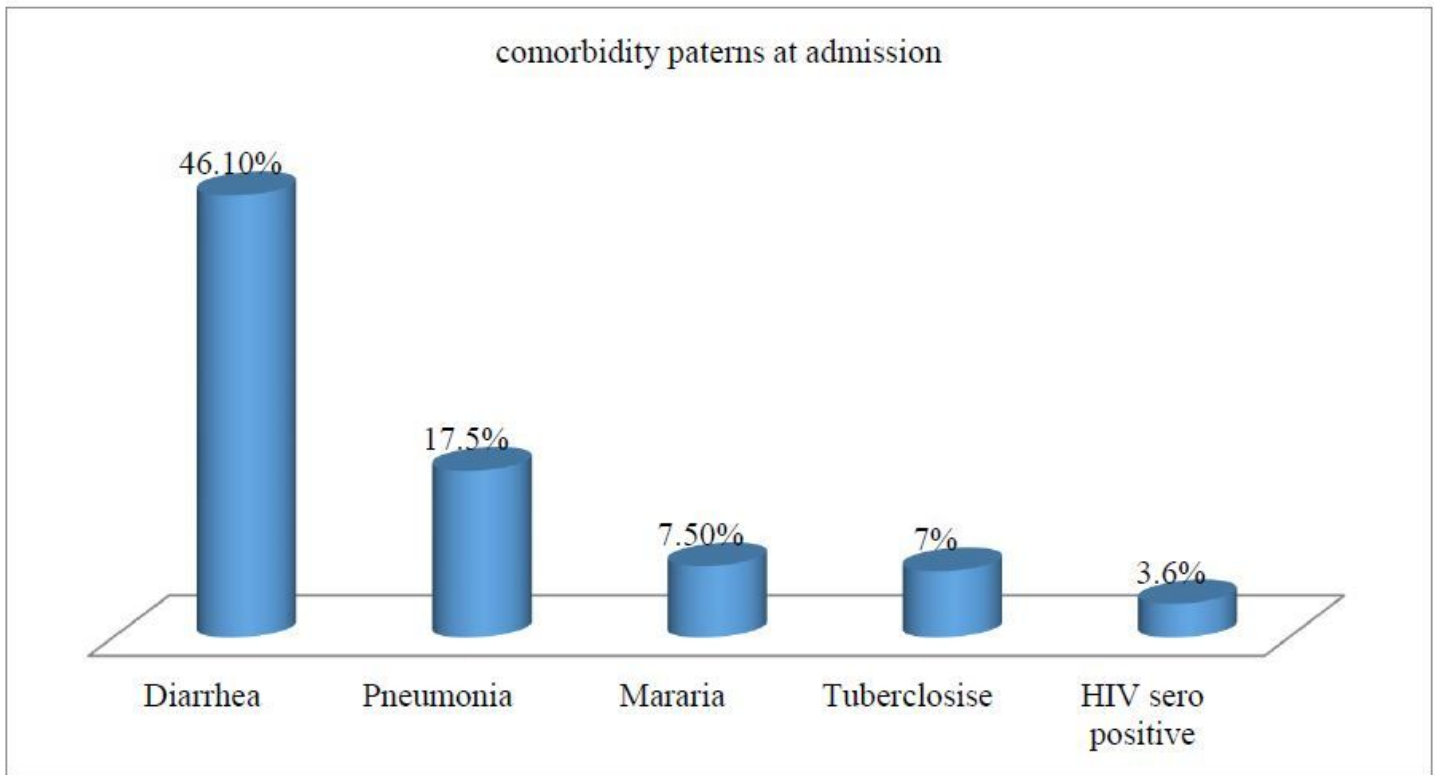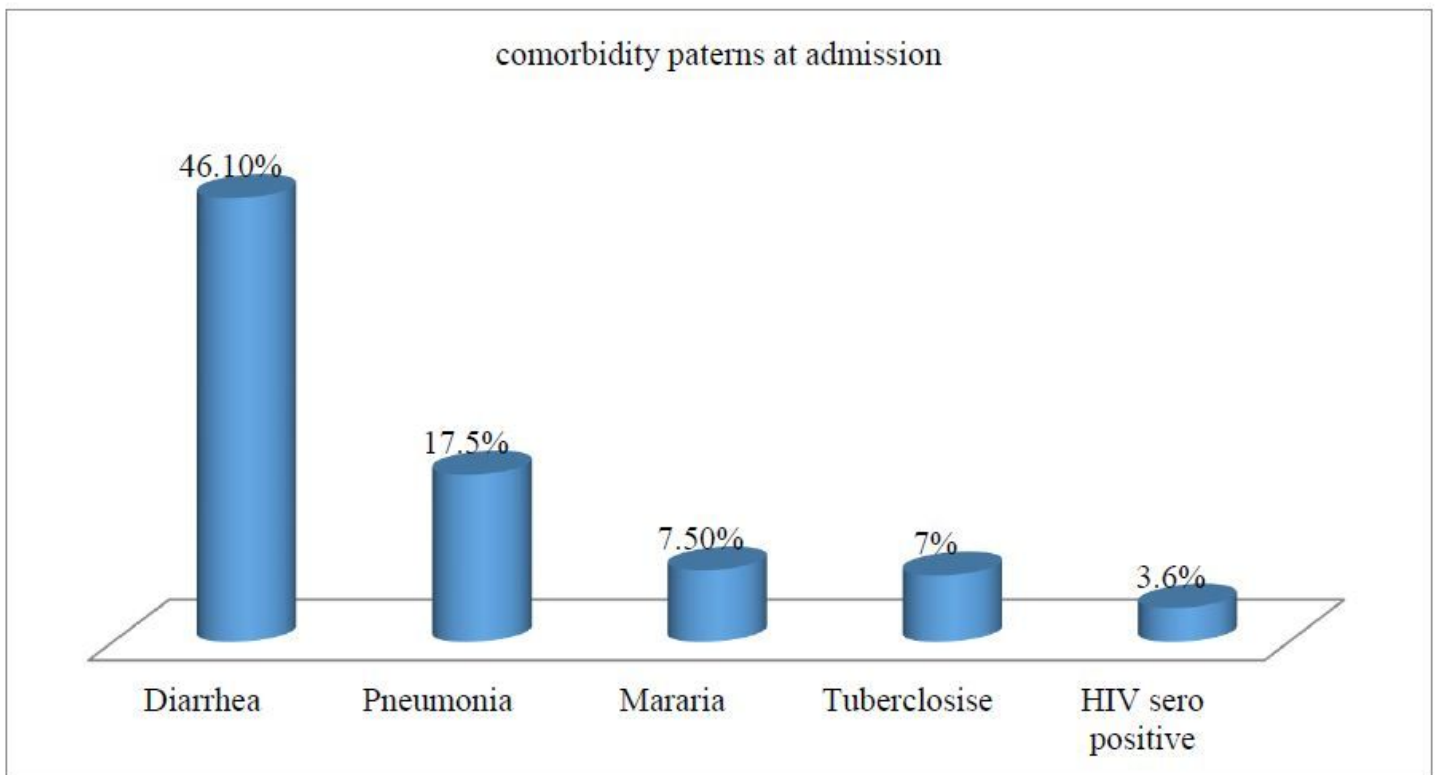
Figures

Figure 1

Comorbidity patterns among severely malnourished children age 0-59 months admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019.

Figure 1

Comorbidity patterns among severely malnourished children age 0-59 months admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019.
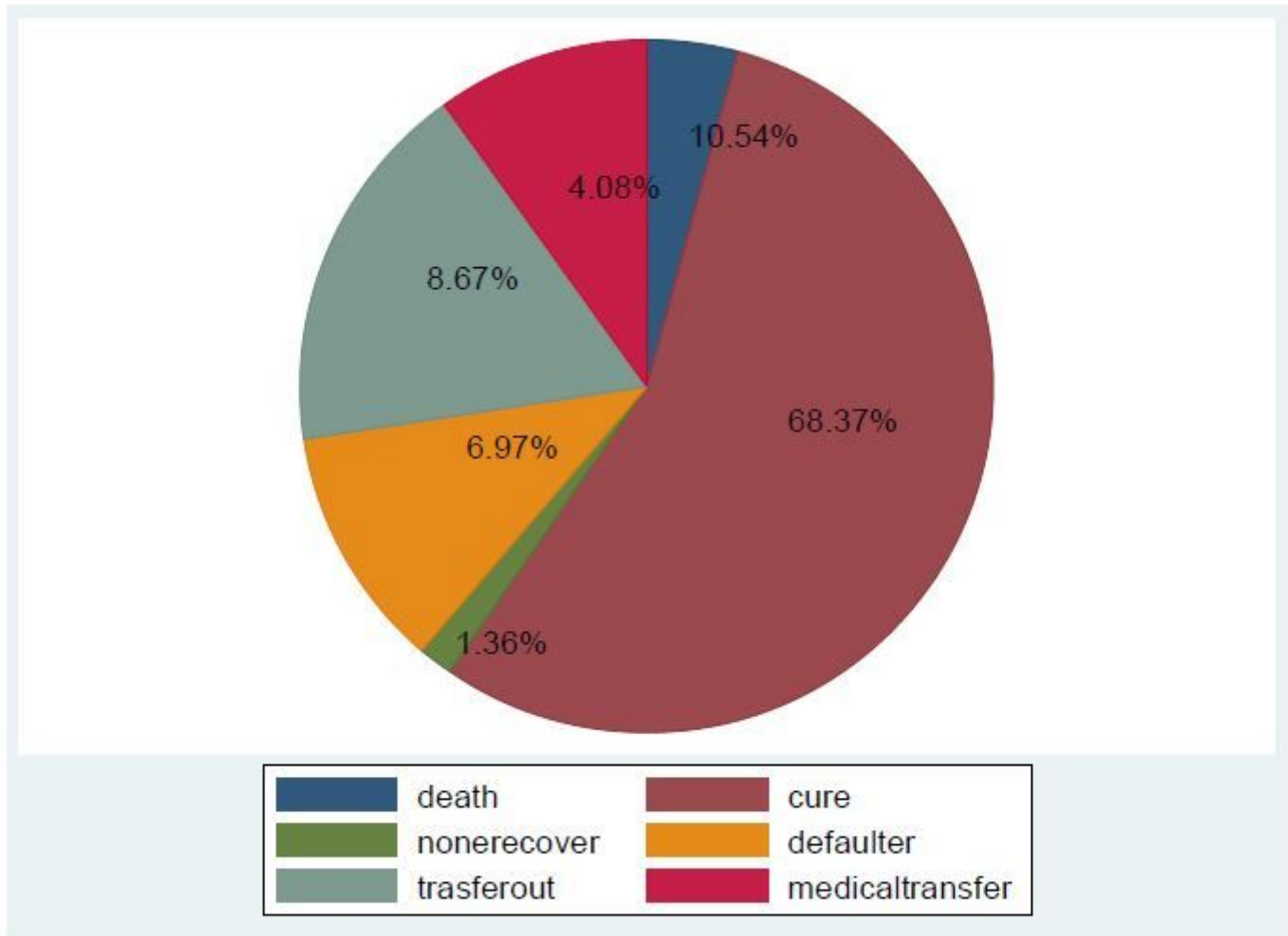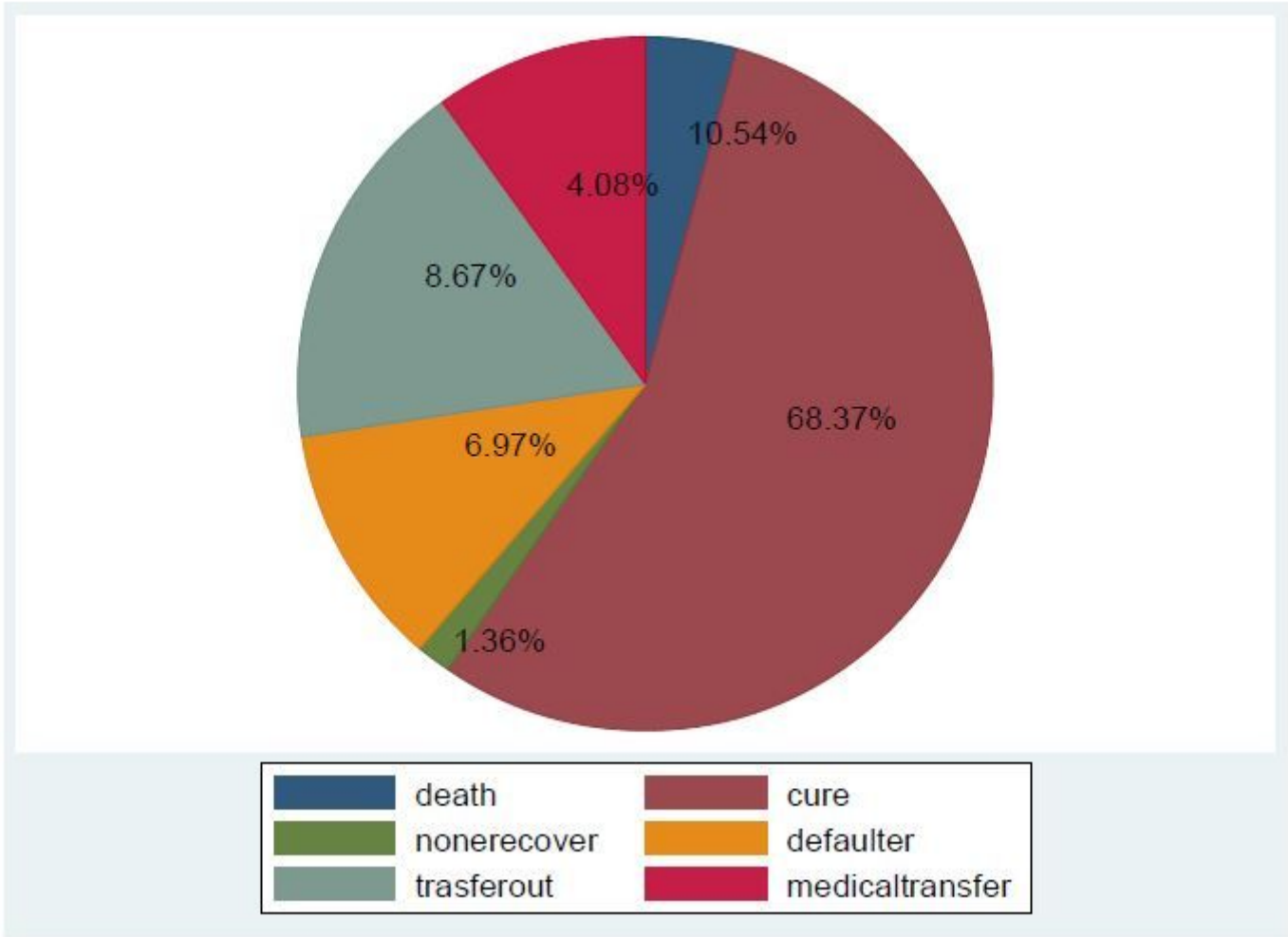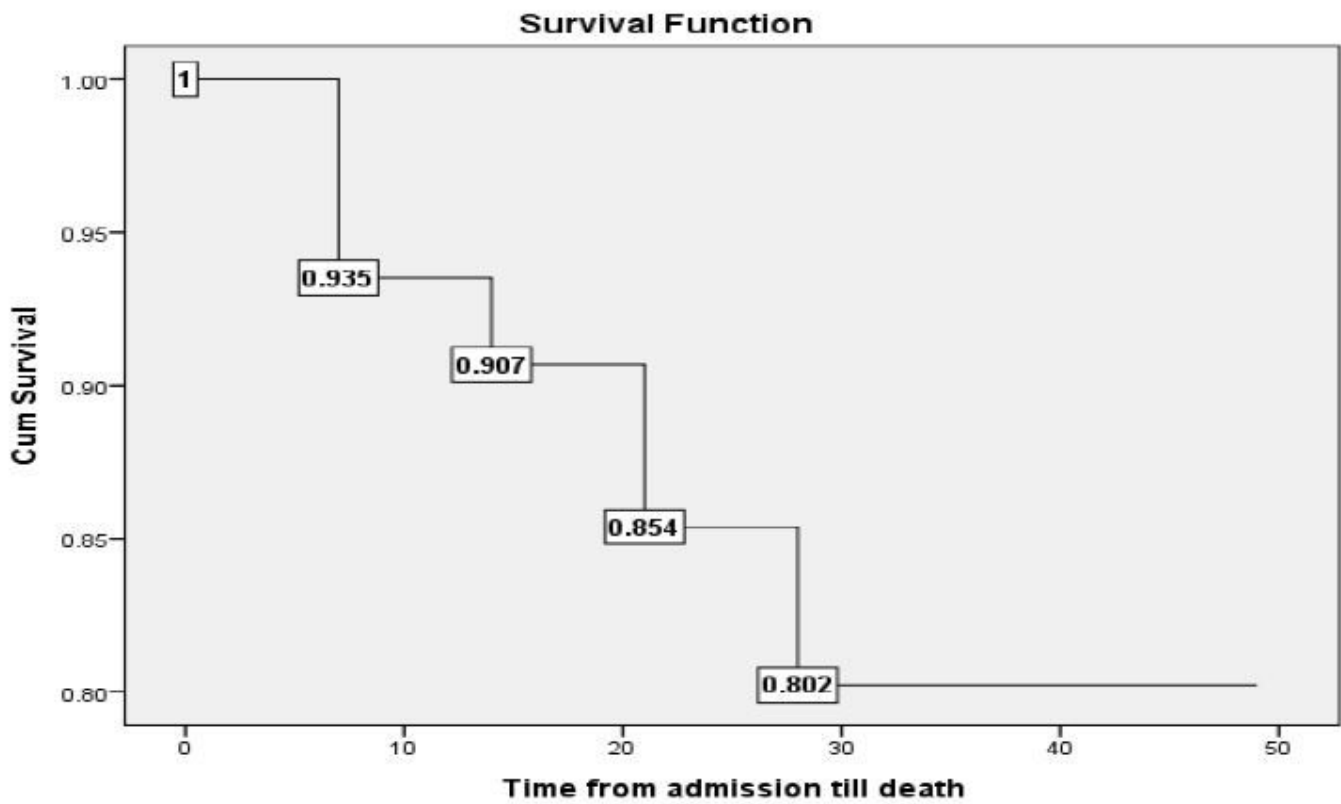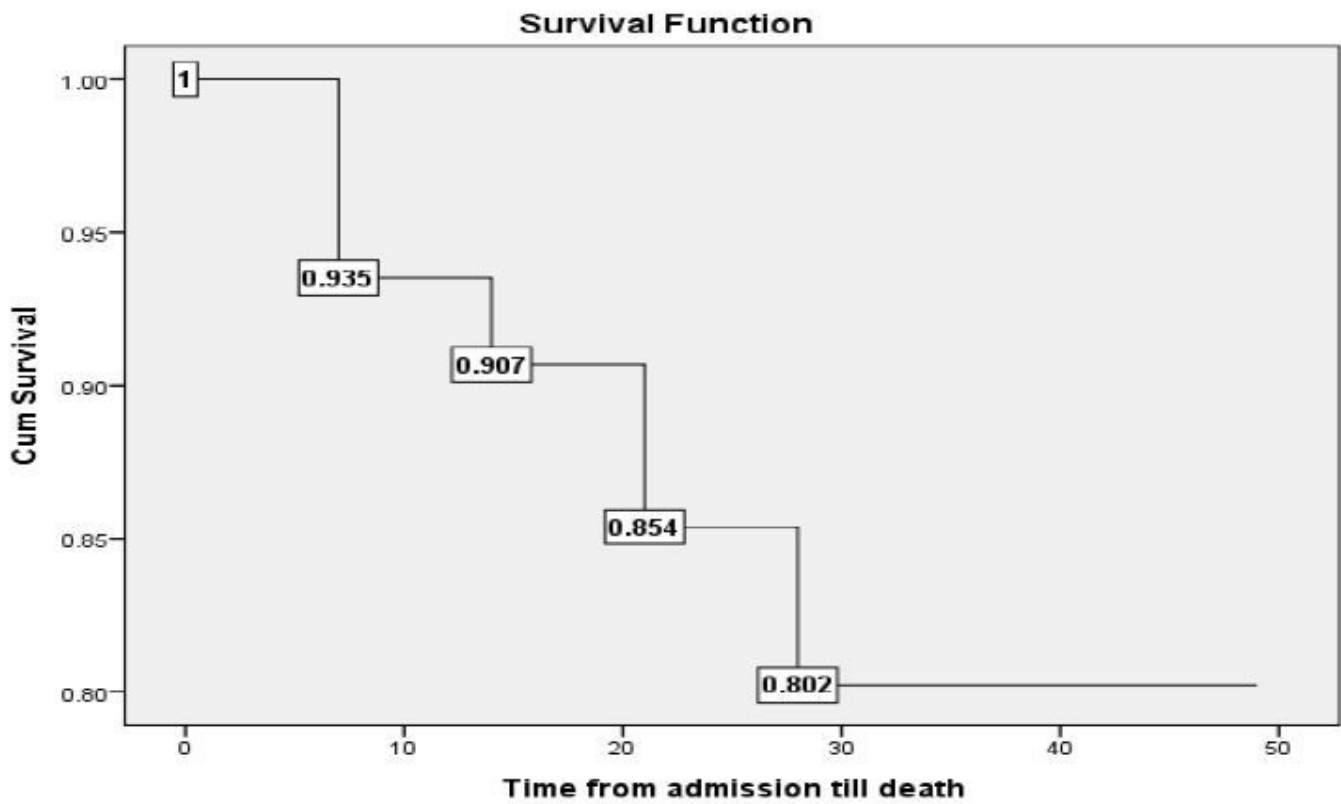

Figure 2

Treatment outcome among severely malnourished children aged 0-59 months admitted at stabilization center in Jinka General Hospital, South Omo Zone, Ethiopia, 2019.

Figure 2

Treatment outcome among severely malnourished children aged 0-59 months admitted at stabilization center in Jinka General Hospital, South Omo Zone, Ethiopia, 2019.

Figure 3

Life table probability estimate of survival at different time interval from admission to death among severely malnourished children aged 0-59 months admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019.
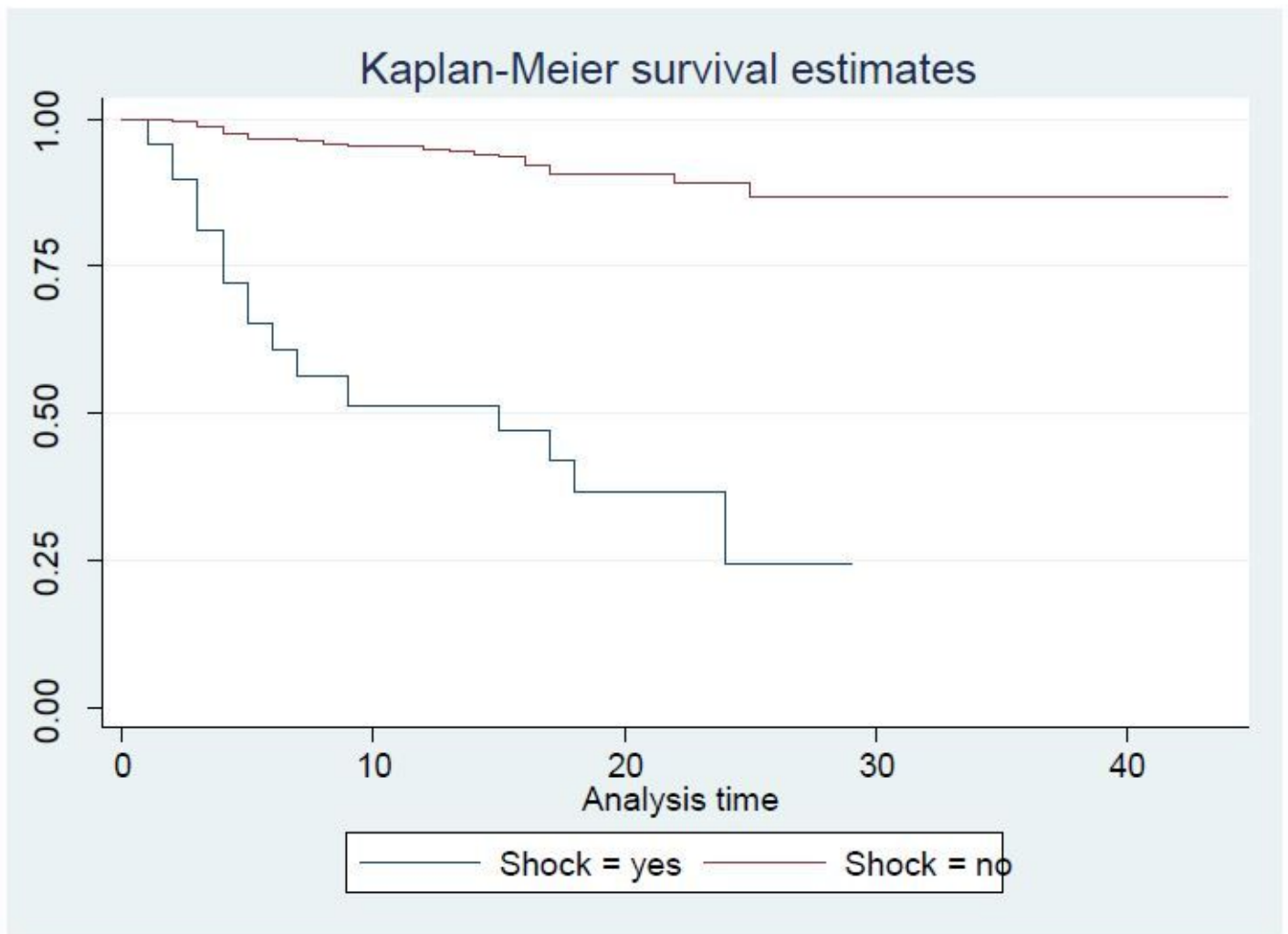
Figure 3

Life table probability estimate of survival at different time interval from admission to death among severely malnourished children aged 0-59 months admitted in Jinka General Hospital, South Omo Zone, Ethiopia, 2019.
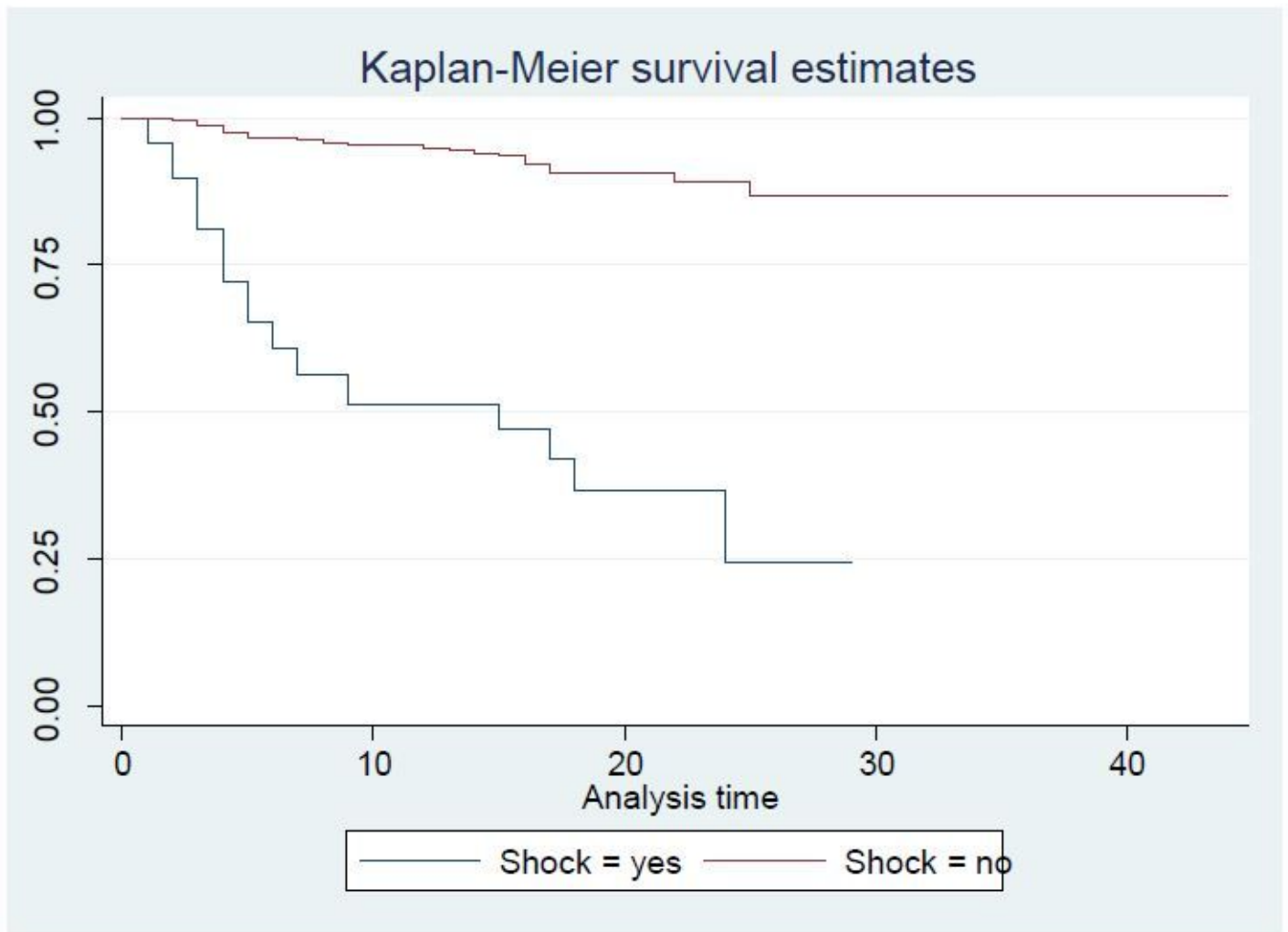
Figure 4

Difference in survival among severely malnourished children admitted with shock in Jinka general hospital, South Omo Zone, Ethiopia, 2019.
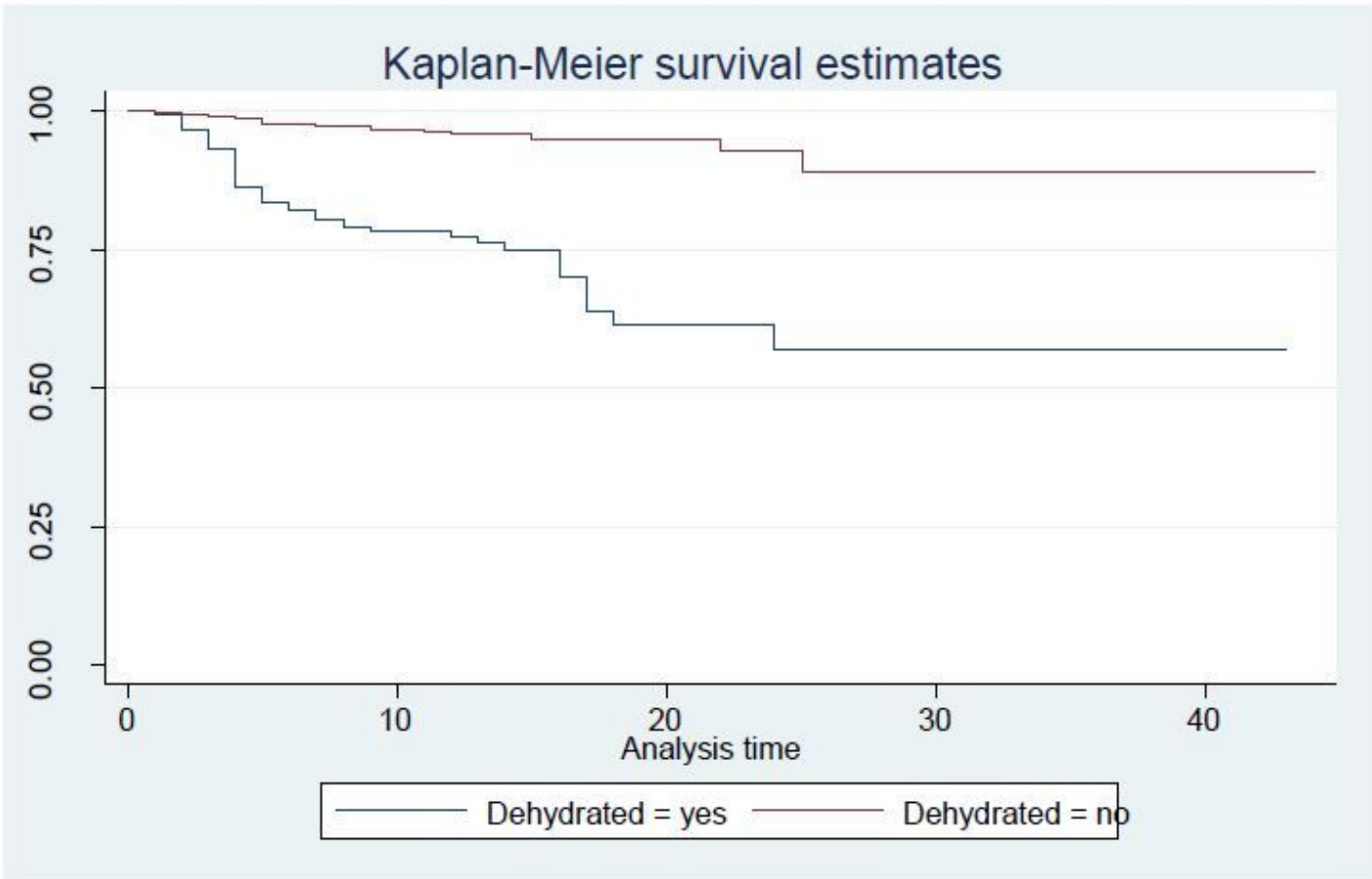
Figure 4

Difference in survival among severely malnourished children admitted with shock in Jinka general hospital, South Omo Zone, Ethiopia, 2019.
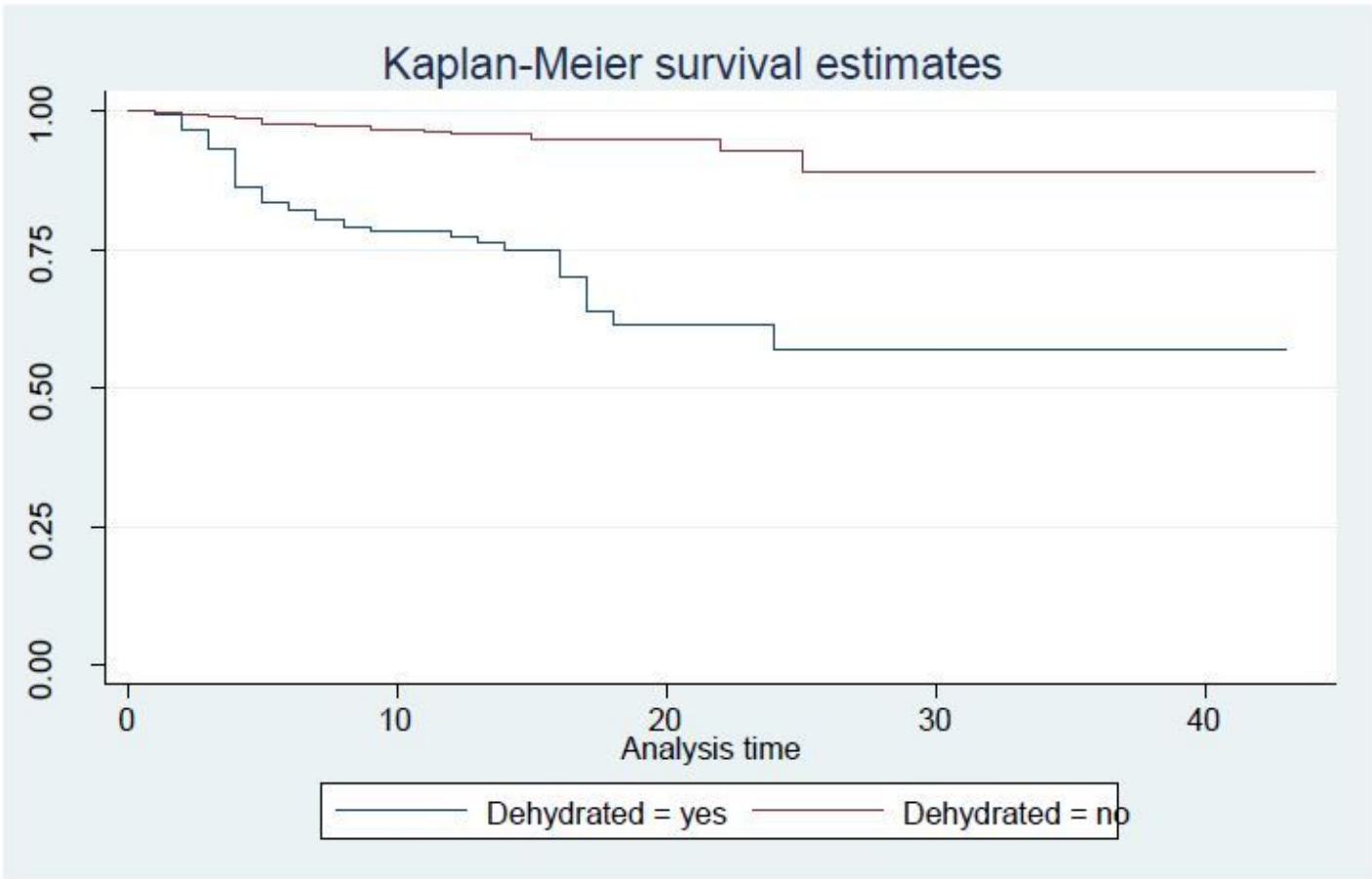
Figure 5

Difference in survival among severely malnourished children admitted with dehydration in Jinka general hospital, South Omo Zone, Ethiopia, 2019.

Figure 5

Difference in survival among severely malnourished children admitted with dehydration in Jinka general hospital, South Omo Zone, Ethiopia, 2019.