

Time to Relapse of Severe Acute Malnutrition and Associated Factors Among Under Five Children in Hadiya Zone, Southern Ethiopia.

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Abstract

Background

In developing countries including Ethiopia, children under five years old are likely to suffer from repeated bouts of severe acute malnutrition as home level drivers are not mostly improved although the child is discharged after clinical and anthropometric cure. There is lack of study that documented time to relapse of severe acute malnutrition and its determinants.

Objective

To identify time of relapse and its determinants among children discharged after undergoing treatment for SAM in health facilities of Hadiya Zone, South, Ethiopia

Methods

An institution based retrospective cohort study was carried out in Hadiya Zone, of Southern Ethiopia among under-five children admitted to health posts for treatment of SAM in the past five years spanning from 2014/2015 to 2019/2020 and discharged after cure. Both first admission data and relapse data were abstracted from the records of the SAM children from August 1 – 30 /2020 Using a data collection format. Data were coded and edited manually, then doubly entered into Epi-Data statistical software version 3.1 and then exported to SPSS for windows version 26. After checking all the assumptions, multivariable Cox Proportional Hazards model was fitted to isolate independent determinants of time to cure. All tests were two sided and P values <0.05 were used to declare statistical significance.

Results

The mean(\pm SD) time for relapse of severe acute malnutrition among under five children was 22(\pm 9.9) weeks from discharge to relapse time.

On multivariable Cox Proportional Hazards model, after adjusting for background variables the hazard of relapse for severe acute malnutrition was significantly higher for children who had edema during admission with (AHR =2.02 ,95%, CI: 1.17-3.50), were in the age group of 6-11 months (AHR = 5.2, 95%, CI:1.95-13.87), had discharge MUAC for the first admission not cured (AHR = 12,95%, CI: 7.90-19.52)

Conclusion

The finding showed that children discharged from Severe acute malnutrition are likely to have relapse in three weeks' time given the prevailing situation of the home environment. Having edema during admission, younger age and not being cured by MUAC at discharge were independent determinants of relapse. The results imply that the need for reviewing follow-up system after discharge and working on the caring practices through behavior change communication to improve the home environment. There also a need for revising the discharge criteria for edematous children rather than basing only on weight change.

Introduction

Malnutrition is a significant global public health burden with greater concern among children under five years in Sub-Saharan Africa (1). Nearly half of all deaths in children under 5 are attributable to undernutrition that puts children at greater risk of dying from common infections, increases the frequency and severity of such infections, and delays recovery(2).

In Ethiopia, over 25,000 children with severe acute malnutrition are admitted every month to and the survivors are more likely to perform poorly in school and, once grown up, girls are more likely to suffer from complications during childbirth(3). Severe acute malnutrition (SAM) is a life-threatening condition among the children with children with SAM being nine(4) to 11 times more likely to die than a non-malnourished child(5).

Early identification of severe acute malnutrition is important for initiating treatment and minimizing the risk of complications which can be done in both community and health-care settings using appropriate indicators(6). It can also be prevented by specific interventions on promoting exclusive breastfeeding, vaccination, and timely health care seeking behaviors would definitely improve the outcomes(7).

Malnutrition has many unpleasant results on child health during illness and after discharge. Many children younger than 5 years in developing countries are exposed to multiple risks, including poverty, malnutrition, poor health, and unstimulating home environments, which detrimentally affect their cognitive, motor, and social emotional development(8) and lead to repeated bouts of severe acute malnutrition. Nearly half of all deaths in children under five children are attributable to undernutrition, which puts them at greater risk of dying from common infections, increases the frequency and severity of such infections, and delays recovery(9).

On another hand, relapse after treatment is another challenge for SAM cases reported to be happening at 4 months or 16 weeks post-discharge (10). Close follow-up of children with SAM following discharge is crucial for successful management as complications including relapse and mortality can happen during this period. Weekly follow-up for at least two months is recommended, as these patients have a tendency to relapse. A quarter of these children fail to follow up in six months due to migration, social, political and logistic reasons(11).

However, in Ethiopia there is lack of study that address time to relapse among children with SAM. This study sets out to document time to relapse among children with SAM. This study is of paramount importance in generating evidence for focusing on post discharge status of SAM children.

Methods

Study area and design

An institution based retrospective cohort study was conducted among a cohort of children admitted and treated for SAM from 2014/2015-August 30/2020 among 20 selected health posts in Hadiya zone, SNNPR,

Ethiopia from August 1 – 30 /2020.

According to the May 24, 2004 World Bank memorandum, 6% of the inhabitants of Hadiya have access to electricity, this zone has a road density of 104.1 kilometers per 1000 square kilometers compared to the national average of 30 kilometers), (12) the average rural household has 0.6 hectare of land compared to the national average of 1.01 hectare (13) the equivalent of 0.6 heads of livestock. A fifth (22.8%) of the population has non-farm related jobs, compared to the national average of 25% and a regional average of 32%. A total of 74% of all eligible children are enrolled in primary school, and 21% in secondary schools and 43% of the zone is exposed to malaria and the memorandum gave this zone a drought risk (14). This zone is characterized by a predominant commitment to agricultural activities, especially the *enset*-growing, which is often combined with grain including, barley and maize, as well as the breeding of domestic animals (15).

In Hadiya Zone, there were 280 Health Posts (HPs), 60 rural Health Centers, one University teaching Hospital and 3 primary level Hospitals. Hadiya zone is divided into 11 districts for administrative purposes. The vast majority of the population were Hadiya in ethnic group and they earn their living through rain fed agriculture and it has 12 woredas and 2 administrative towns. The woredas were ; East Bedewacho, Siraro Bedewacho, West Bedewacho and Shone town administration separated from the rest of the zone by Kembeta Tambaro and the administrative center of Hadiya is Hosanna (16). Of which this was study conducted in two woredas and one town administration among 20 health posts with highest number of cases East Bedewacho (Tikere kokere, Tikere Anbesa, Mahal, Jariso, Amburse Anjulo, 2nd Chafa, Eddo, Lenda, Jerso Kutube and Bente Wosen).

Siraro Bedewacho (Abuka, Langano, Dongaro Bonkoya, Wera Bonkoya, sheriko Gafarso, Kumudo, Beshilo, Mahal Korga and Woldia) and Shone Town administration (Wera Gere and Shone town). The health posts were selected based on number of SAM cases.

Population

All records of under-five children who were admitted to the health posts of Hadiya Zone, in three woredas from November, 2014/2015-August 30/2020 were the source population. A total of 900 child records were eligible from which 760 were selected by simple random sampling methods using the ENA for SMART software. All records of under-five children with SAM admitted to 20 health post were included, but children with incomplete records, unknown admission dates and unknown discharge dates were excluded.

Sample size determination and sampling procedure

Sample size was determined from a study conducted in North Gondar zone, Northwest Ethiopia (17). Then, it is calculated by medcalc@version 119.1.1.3 survival analysis (logranktest) at <http://www.medcal.org> (18). And diarrhea on admission as the main exposure cured of 51, censored of 17, outcome of 75%, AHR of 0.81 and Log rank of 19 total event needed was 484. As we selected zones to woredas and from woreda to Kebeles, a design effect of 1.5 was considered giving a final sample size of 726. Finally, the

records were collected from the card room based on the MRN of the selected participants and the data were collected from these records.

Data collection procedure

A data extraction tool was prepared from the national treatment protocol for the management of SAM (3), SAM registration booklet, health management information system (HMIS) register. The data extraction format used consisted of socio-demographic data (age, sex) and anthropometric measurements (height, weight, MUAC, edema). Four data collectors (MPH) and one supervisor was recruited based on their experience in data collection. Data collectors received a one-day training on the Extraction tool and were deployed to collect data once the principal investigator was convinced about their competency. The primary investigator of the study and the supervisors critically followed the data collection process to minimize missing information and inconsistencies.

Operational definition

Relapse rate/repeated episodes; The proportion of children who re-enrolled after they recovered and discharged(19).

Wasting is defined; as low weight-for-height. It often indicates recent and severe weight loss, although it can also persist for a long time(20).

Severe acute malnutrition: It is diagnosed by weight for- height below -3 SD of the WHO standards, by a MUAC <11.5 cm and by Clinical sign like bilateral edema (21-23).

Kwashiorkor or edematous malnutrition; is also form of severe under nutrition, the child's muscles were wasted, but wasting may not be apparent due to generalized edema or swelling from excess fluid in the tissues (21, 24).

Criteria for discharging children from treatment; weight-for-height/length is ≥ -2 Z-scores and they have had no oedema for at least 2 weeks, or mid-upper-arm circumference is ≥ 125 mm and they had no oedema for at least 2 weeks(25).

Data processing and analysis

Data were coded, entered into Ep-data software version 4.2 and exported to SPSS for windows version 25 software for analysis. The presence of missing values, possible outliers, and multicollinearity were checked through exploratory analysis.

Both bi-variate and multivariable Cox regression analyses were performed. Kaplan Meier hazard curve with the log-rank test was fitted to identify the presence of a difference in recovery rate among the categorical variables. Mantel-Cox and Generalized Wilcoxon test of equality of survival distributions is significant and one minus survival function line is also parallel for those candidate variables of multivariable Cox regression (Fig1 and Fig2).

For the different levels, under-five children with SAM were followed in weeks from admission to the occurrence of the event (relapse). Person-time was calculated and the incidence was determined. In this study, person-time was reported in child-week. Child-week are total follow up times of each child from admission to the occurrence of the events (relapse or censored)

Those variables with $p \leq 0.25$ in the bi-variable Cox-regression were selected for the multivariable Cox-regression analysis. All statistical tests were considered significant at 95% confidence interval the final significant value is determined at p-values of 0.05.

Ethical Considerations: Before starting the data collection process, ethical clearance was given secured by Jimma University Health Research Ethics Review Committee (IHRERC). An official letter was written from Jimma University to the Hadiya Zonal Health Office.

Informed written consent was obtained from all health extension workers of selected health posts and woreda health office, confidentiality of the study documents was' information was also ensured according to the Helsinki declaration of ethical code for human subjects.

Results

Sociodemographic and Anthropometric Characteristics

In this study, 726 SAM cases seen from registration book for severe acute malnutrition among 20 health posts. From the total admission 640(88.2%) were new admissions and 86(11.8%) were relapsed or readmitted with severe acute malnutrition in the last five years and of the total 51% were females, 24.2% were in the age of 6-11 months followed by those in the age group of 12-23 months (20.2%).

During the first admission, 33.3% had edema and the mean weight of children during admission 7.94(± 2.36) kg. Similarly, the mean(\pm SD) MUAC of children during admission was 10.60(± 0.76) cm.

Treatment out comes

The outcome of SAM treatment for the first admission was majority of children cured for SAM during first admission, 91.9% cured and followed by those who died (2.8%). 11(1.5%),6(0.8%) and 16(2.2%) defaulter, unknown status or not recorded, non-response during treatment and transfer out from the program and mean(\pm SD) time for recovery from severe acute malnutrition is 10(± 3.3) weeks for the first admission. The mean discharge weight was 11.15(± 2.1) Kg and mean discharge MUAC was 11.57(± 0.81 ?) cm, when we see the admission condition there were 640(88.2%) at (95%, CI: 85.8-90.2) new admission and 86(11.8%) at (95%, CI:9.8-14.2) relapsed cases for severe acute malnutrition (Table;1)

Time to relapse of SAM

From the total cases seen 11.8% had relapse and got readmitted with severe acute malnutrition in last five years. The mean time for relapse of severe acute malnutrition was 22(± 9.9) weeks at from discharge of the first admission with minimum and maximum time for relapse was 9 and 67 weeks, respectively.

There was variation the mean time to relapse by different variables. The mean time of relapse was 21(\pm 8.6) weeks for male children and 24(\pm 11.1) weeks for female children. Likewise, the mean relapse time among edematous children was 22(\pm 11.77) weeks. The mean relapse time was shorter for, children 48-60 months 15(\pm 3.52), while it was longer for children aged 24-35 months 21(\pm 8.4). (Tabel2)

Determinants of time to relapse

In Cox Proportional Hazards Model, after adjusting for background variables, children in the younger age (6-11 months) had 5.2 times increased hazard of relapse (AOR=5.2, 95%, CI:1.95-13.87) compared to age group of 48-60 months. Similarly, having edema on the first admission increased the hazard of relapse twice (AOR=2.02, (95%, CI: 1.17-3.50) compared to non-edematous children. The hazard of relapse was 12 times higher among children who had an outcome of not cured on the first treatment (AOR= 12.42, 95%, CI: 7.90-19.52) compared to cured ones.

Discussion

We found out that the mean(\pm SD) time for relapse of severe acute malnutrition among under five children was 22(\pm 9.9) weeks, which is a long relapse time compared to in the report from Nigeria (26). This may be due to differences in study design as study conducted in Nigeria was prospective cohort conducted for only six months, while this study is captured data over five years in addition to being a retrospective cohort which may result in a different result.

In this study, the frequency of relapse was 11.8% for severe acute malnutrition, which is similar to the report of a study in Burkina Faso (27). This may show that the communalities of the problem and lack of other similar studies for comparison and post discharge status of children with severe acute malnutrition.

On Multivariable analyses, variables that were independent determinants of the hazard of relapse of severe acute malnutrition were: age, having edema on the first admission and not being cured on the first discharge.

Children in the age group of 6-11 months had 5.2 times higher hazards of relapse compared with those in the age of 48–60-months. This study showed that as the age of the child increased the hazard of time to relapse was higher among the age of 6-24 month and finding from this study is in line with other cross-sectional study conducted in Ethiopia Afar region(28).This may be at this age children were mostly dependent on maternal source of energy and physiological it includes the age highest demand in energy kg/day and it also may be the chance of readmission for SAM at this age is high because as we know that screening and admission for malnutrition is mainly limited for the age below 59 months.

Another variable that was significant determinant of the hazard of time relapse was having edema on the first admission. Having edema on the first admission increased the hazard relapse twice compared to non-edematous children. This may be related to early discharge from the program as weight is discharge criteria for SAM cases at health post. Children with edema may have false weight as remnant of nutritional edema. As nutritional oedema affects the function of the glycocalyx are dependent upon sulphated

proteoglycans and other glycosaminoglycans and fundamentally related to a defect in Sulphur metabolism which can explain all the clinical features of the condition, including the formation of oedema individual may have false weight that related to prior edema (29).

Similarly, children who were not cured during discharge from the first admission had more than 12 times higher hazard of relapse compared to cured ones. This finding is similar with the report of a study conducted in Ethiopia (30). This may be due to the fact that treatment discontinuation like defaulting may increase the risk of readmission as children are not fully treated for the metabolic and nutritional derangements that occurred with severe acute malnutrition.

The results have practical implications for the management of children with SAM. The fact that SAM children with edema and those who were not cured during discharge of the first admission had high hazard of relapse calls for reconsideration of the SAM management protocol and the discharge criteria. It also implies the need for strict monitoring of edema before discharge and follow up of SAM cases to avoid defaulters and partially treated cases through strong awareness creation and counseling of mothers/care givers.

In this study as much as possible we have tried to cover 20 health posts to minimize sampling error. As there is no prior study on time for relapse this study will give new insight for researchers and program planners. As this study is retrospective cohort study, we acknowledge the limitation of not being able to assess multiple determinants, which should be addressed in future study using a prospective cohort design.

Conclusion

The finding showed that children discharged from Severe acute malnutrition are likely to have relapse in three weeks' time given the prevailing situation of the home environment. Having edema during admission, younger age and not being cured by MUAC at discharge were independent determinants of relapse. The results imply that the need for reviewing follow-up system after discharge and working on the caring practices through behavior change communication to improve the home environment. There also a need for revising the discharge criteria for edematous children rather than basing only on weight change.

Declarations

Ethics approval and consent to participate; Before starting the data collection process, ethical clearance was given secured by Jimma University Health Research Ethics Review Committee (IHRERC). An official letter was written from Jimma University to the Hadiya Zonal Health Office

Consent for publication; All authors in this work agreed to publish on this journal.

Availability of data and material; yes

Competing interests; No competing interest

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Authors' contributions;

AL; Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Project administration, Resources, Software, Visualization, Writing and original draft.

DT; Conceptualization, Data curation, Formal analysis, Writing and review & editing.

TB; Conceptualization, Data curation, Formal analysis, Methodology, Resources, Software, Software, Supervision, review & editing.

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Tables

Table;1 Profile of admitted children with severe acute malnutrition (SAM) in Sothern Region Hadiya zone Ethiopia.

Variable	Frequency (%)
Sex	
Male	352(48.5)
female	374(51.2)
Age	
6-11 months	176(24.2)
12-23 months	147(20.2)
24-35 months	136(18.7)
36-47 months	172(23.7)
48-60 months	95(13.1)
Edema during admission	
Yes	242(33.3)
No	484(66.7)
Outcome	
Cured	667(91.9)
Dead	6(0.8)
Defaulter	20(2.8)
Unknown	11(1.5)
Non response	6(0.8)
Transfer out	16(2.2)
Type of admission	
New	640(88.2)
Relapsed	86(11.8)

Table;2 Mean time of relapse among children with severe acute malnutrition (SAM) in Sothern Region Hadiya zone Ethiopia.

Variable	Mean time of relapse in week	±SD
Sex		
Male	21	8.6
Female	23	11.1
Age in months		
6-11	21	21.4
12-23	25	25.2
24-35	26	15
36-47	21	8.3
48-60	15	3.5
Edema during first admission		
Yes		
No	22	11.8
	22	8.7
Outcome of treatment		
Cured		
Not cured	23	11.8
	21	7

Table 3. Cox proportional hazards model identifying the determinants of time to relapse among children with severe acute malnutrition (SAM) in Sothern Region Hadiya zone Ethiopia.

<u>Variables</u>	<u>B</u>	<u>P</u>	<u>AHR</u>	<u>95.0% CI for AHR</u>
<u>Sex</u>	-	-	-	-
<u>Male</u>	=	=	=	=
<u>Female</u>	<u>-0.32</u>	<u>0.16</u>	<u>0.72</u>	<u>0.46-1.14</u>
<u>Admission edema</u>	-	-	-	-
<u>Yes</u>	<u>0.70</u>	<u>0.01</u>	<u>2.02</u>	<u>1.17-3.50</u>
<u>No</u>	=	=	=	=
<u>Admission MAC</u>	<u>-0.10</u>	<u>0.53</u>	<u>0.90</u>	<u>0.65-1.25</u>
<u>Age of the child in month</u>	-	-	-	-
<u>6-11</u>	-	-	-	-
<u>12-23</u>	<u>1.65</u>	<u>0.001</u>	<u>5.200</u>	<u>1.95-13.87</u>
<u>24-35</u>	<u>0.79</u>	<u>0.151</u>	<u>2.194</u>	<u>0.75-6.41</u>
<u>36-47</u>	<u>0.80</u>	<u>0.131</u>	<u>2.230</u>	<u>0.79-6.31</u>
<u>48-60</u>	<u>0.86</u>	<u>0.090</u>	<u>2.369</u>	<u>0.87-6.42</u>
	=	=	=	=
<u>Outcome during discharge</u>	-	-	-	-
<u>Cured</u>	-	-	-	-
<u>Not cured</u>	-	-	-	-
	=	=	=	=
	<u>2.519</u>	<u>0.001</u>	<u>12.42</u>	<u>7.90-19.52</u>

Figures

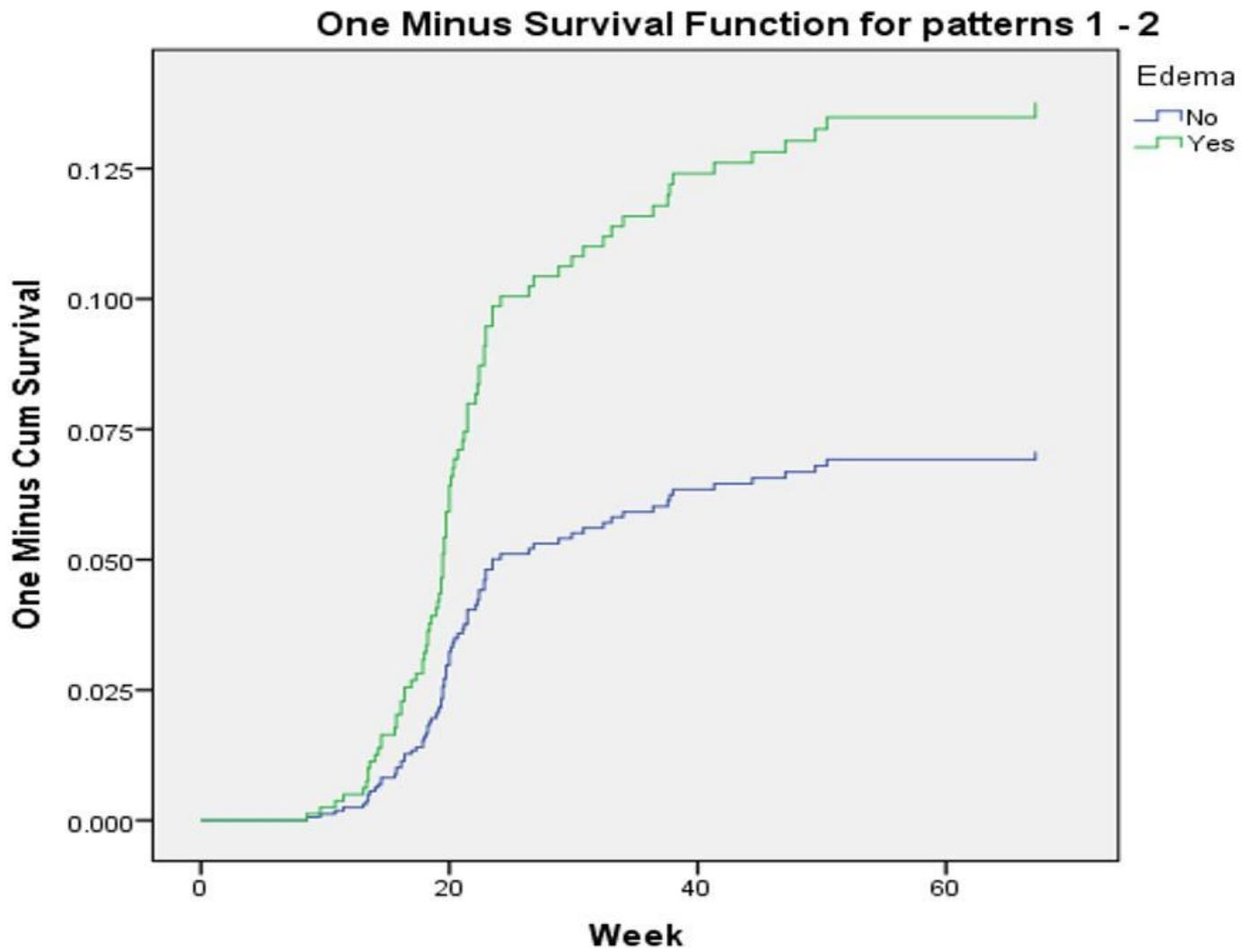


Figure 1

one minus survival function test for edematous children in Hadiya zone Southern Ethiopia

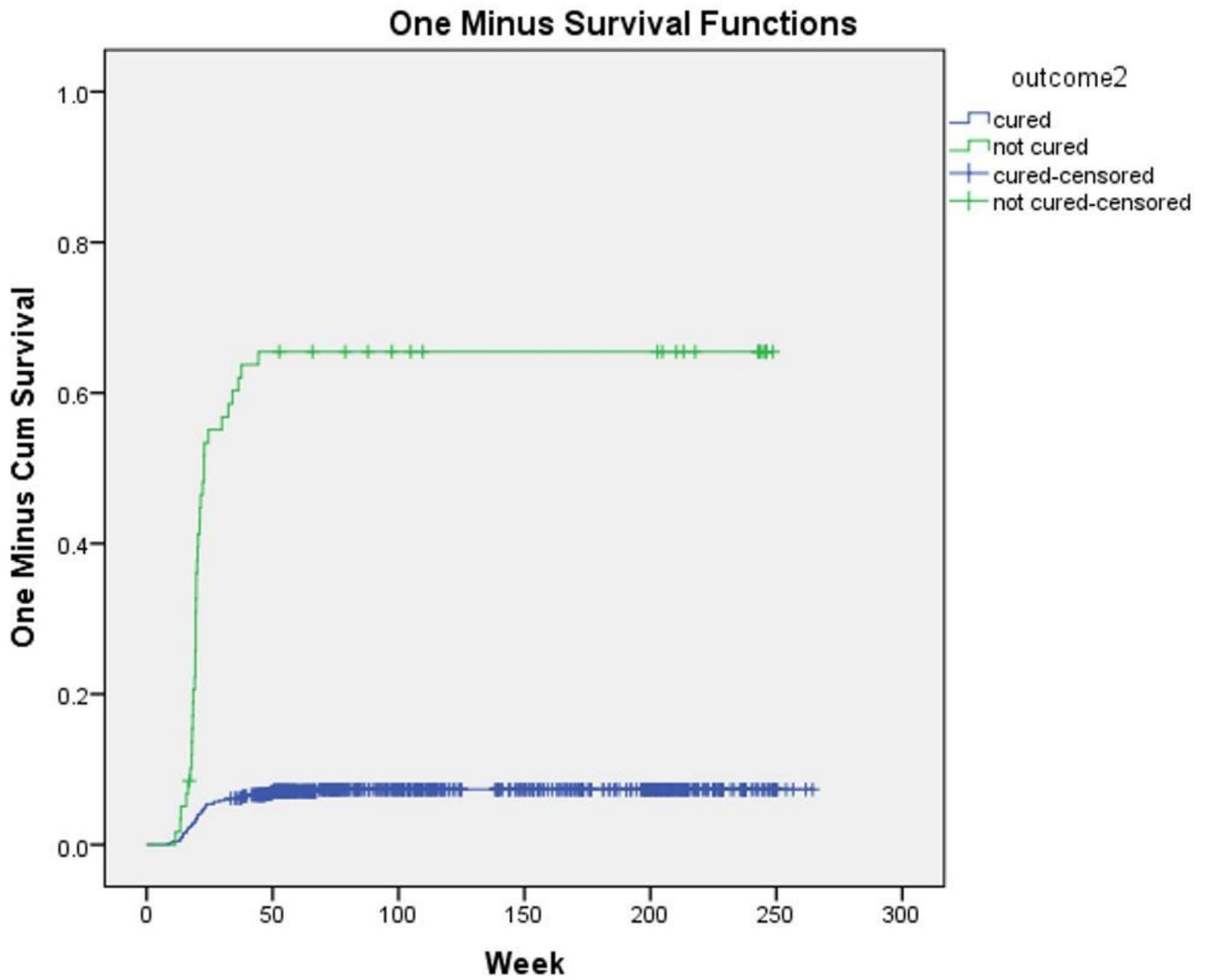


Figure 2

One minus curve for testing parallel hazards assumption among children in Hadiya zone Southern Ethiopia