Edematous Type of Malnutrition Takes Longer Recovery Time Compared to Severe Wasting (Marasmus): Findings on 6-59 months old children treated for Severe Acute Malnutrition After the War in Northern Ethiopia, 2023: Prospective Longitudinal Study

Wagnew Tesfay[1] and Mebrahtu Abay[2*]

[1]Nutrition Supervisor, Medical Teams International (MTI), Shire field office.

Email: wagnew.tesfaye@gmail.com

[2]College of Health Sciences, Aksum University, Aksum, Ethiopia.

Email: gmebrahtuabay@gmail.com, **ORCID**: 0000-0002-3307-0588

*Corresponding author: Aksum, Ethiopia.

Abstract

Background: Severe acute malnutrition (SAM) is still having public health significance by attributing almost fifty percent of the estimated ten to eleven million deaths encountered in less than five-years old children, imposing nine-fold likelihood of death compared with well-nourished children of similar age group. It increases terrifyingly and become lethal during conflicts due to lack of food, compromised water supply and hygienic practices along with insufficient healthcare services.

Methods: Hospital-based prospective cohort study was conducted using regularly collected programme data of children admitted to the stabilization center in Suhul general hospital from January 1st, 2023 up to July 31st, 2023. To collect the data, pretested structured questionnaire was generated referring to the national SAM management protocol. Then collected data get coded and entered into Microsoft Excel spreadsheet 2016 version. All forms of analyses were done using statistical package for social sciences (SPSS) version 25.

Results: From the total 168 children aged 6-59 months enrolled in the study, ninety-four per cent of them were recovered and transferred to the outpatient therapeutic programme while the rest six per cent of the participants were censored. Appetite test (AHR = 1.874; 95% CI: 1.180-2.978), level of dehydration (AHR = 0.538; 95% CI: 0.361-0.800 for some/moderate dehydration and AHR = 0.250; 95% CI: 0.128-0.489 for severe dehydration or shock), diagnosis at admission (AHR = 0.452; 95% CI: 0.294-0.694), blood transfusion (AHR = 5.559; 95% CI: 2.419-12.773), type of antibiotics (AHR = 0.365; 95% CI: 0.192-0.692) and nasogastric tube feeding (AHR = 0.531; 95% CI: 0.372-0.758) were declared significant predictors of recovery time.

Conclusion: Bottom line of the study shows the inpatient therapeutic feeding center has met the agreed indicators for nutrition interventions during humanitarian crises. We recommend the hospital leadership, the regional health bureau and other humanitarian agencies to stress on training clinical workforce directly involved in patient management and care.

Key words: Recovery time, severe acute malnutrition, war, northern Ethiopia

Background

The World Health Organization (WHO) defines severe acute malnutrition (SAM) as having severe wasting (measured by mid-upper arm circumference (MUAC) of less than 11.5 centimetre in children 6 to 59 months old, and/or weight-for-length/height (WFL/H) below -3 Z scores in kids 0-59 months of age) and/or bilateral pitting oedema (1).

Acute undernutrition is affecting more than 45 million under-five years old children worldwide, of whom about 14 million are severely malnourished (2–4). Although significant and productive efforts made to tackle it, SAM is still having public health significance by attributing almost 50% of the estimated 10 to 11 million deaths encountered in less than five-years old children, imposing nine folds likelihood of death compared with well-nourished children of similar age group (5,6). SAM increases terrifyingly and become lethal during conflicts due to lack of food, compromised water supply and hygienic practices along with insufficient healthcare services (7). All population segments are affected by acute malnutrition during emergencies, but SAM it is main cause of morbidity and mortality in infants and young children (8).

The armed conflict between Tigray regional forces and the federal government of Ethiopia erupted in November the 4th, 2020 has led to mass displacements and destruction of healthcare system in the region. As a result, with six and twenty two per cent of SAM and moderate acute malnutrition (MAM) rates respectively, nutritional status of children under-five years of age reached above the emergency threshold level for acute malnutrition (9,10). The regional rate of SAM before the conflict was about one per cent.

Recent studies in Ethiopia showed that rates of recovery are below the standard set for stabilization center (SC) (11,12) while others concluded with findings in line with the standards (13–15). Similar study in Uganda also reported unacceptably high death rate (16). Age, breastfeeding, immunization and presence or absence of co-morbidities during admission were associated with recovery time and related outcomes of SC (11,14,15). Co-morbidities like diarrhea, pneumonia, human immune-deficiency virus (HIV) sero-status and anemia were found as independent predictors of SC

79 treatment outcomes (17,18). Variables like type of SAM, intravenous (IV) fluid resuscitation,
80 nasogastric (NG) tube feeding, appetite and admission status were also significantly associated with
81 therapy outcomes in SC (13,19–21).
82 During conflicts, research plays decisive role in understanding the main challenges faced by
83 humanitarian organizations and enables them make scientifically informed decisions (22,23).
84 Prolonged stay in SC is associated with a higher risk of hospital acquired infection which can raise
85 the increased risk of death as well. Meanwhile, as a quality service indicator, recovery time and
86 other related outcomes of nutrition interventions during humanitarian situation should be monitored
87 to get better results of efforts and to take further actions based on evidence. Nevertheless, very little
88 is known about the SC performance indicators in comparison against the standards during
89 humanitarian interventions. This study would be the first of its kind since the armed conflict in the
90 region broke out. Therefore, aim of this study is to avail evidences about recovery time and other
91 performance indicators in Suhul general hospital, Tigray region, Northern Ethiopia.
92 **Methods and materials**
93 **Study design**
94 Health institution based prospective cohort study was conducted using regularly collected
95 programme data of children admitted to suhul general hospital SC.
96 **Context and period of study**
97 Located 1087 kilometers north of Addis Ababa, Shire town is the capital of north west zone of
98 Tigray regional state and main host for internally displaced persons (IDPs). The inpatient
99 therapeutic feeding center (ITFC) in Shire's Suhul hospital has been the main management center
100 for children suffering from complicated severe undernutrition, both for host and IDPs residing in
101 the zone. Like almost all healthcare facilities in the region, this hospital has experienced extensive
102 looting of medical supplies and equipment, electrical installations and destruction of water supply
103 system. The cessation of hostilities agreement between the warring bodies signed in Pretoria paved
104 the way for humanitarian organizations to access the region as well as the zone. As a result, the

paediatrics ward of the general hospital, including the ITFC, has been receiving medical supplies and equipment as well as technical support from United Nations' agencies and other international non-governmental organizations (NGOs).

Admission, treatment and discharge procedures were done as per the Ethiopian federal ministry of health (FMoH) SAM management guideline (24). Pediatrician and general practitioners were doing ward rounds on a daily basis to diagnose, prescribe or revise medications and other interrelated decisions while the nurses and nutrition nurses were assigned to do appetite test and move children from Phase-I to transition phase and phase-II. Collective and individual infant and young child feeding (IYCF) counselling sessions were given for mothers or guardians about conditions of their child, sanitation and hygiene practices and the necessary follow up until discharged from the ward. This study was conducted from January 1st, 2023 to July 31, 2023.

Source and Study population

Source population: All 6-59 months old children admitted to suhul general hospital SC, both from host and displaced communities.

Study population: All 6-59 months old children admitted to suhul general hospital SC, both from host and displaced communities from January 01, 2023 to 31st of July, 2023.

Study unit: Severely undernourished 6-59 months old child hospitalized to the stated SC from January 01, 2023 to 31st of July, 2023.

Inclusion and exclusion criteria

Inclusion criteria: All 6-59 months old children hospitalized to the SC both from host and displaced communities from January 01, 2023 to July 31, 2023.

Exclusion criteria: Children less than six months old, those with ready-to-use therapeutic food (RUTF) intolerance and children having secondary causes of malnutrition like cerebral palsy, congenital heart defects and cleft lip and palate were excluded from the study.

Sampling procedure and sample size

We exhaustively included all 6-59 months old children hospitalized to the SC from January 01, 2023 to July 31, 2023 and our final sample was 168 children.

Variables of the study

Outcome variable: Recovery time

Event: Stabilized and transferred to out-patient therapeutic programme (OTP)

Censored: Death, left against medical advice (LAMA), and medical referrals

Independent variables

- Main exposure variable: Type of SAM
- Other independent variables: Socio-demographic characteristics, routine medications, supplements and co-morbidities during admission

Operational definitions

- **Recovery time or length of stay (LoS)**: refers to the number of days it takes from admission until the child got recovered from medical complications.
- **Stabilized and transferred to OTP**: 6-59 months old children can continue the nutritional rehabilitation phase at OTP once they become free of medical problems, grade three oedema and regained appetite.
    - **Defaulted or left against medical advice (LAMA)**: Patients who are not found in SC for two consecutive days, or who left the hospital contrary to medical advice offered while the child has not recovered.
- **Death**: child who deceases while taking management in stabilization center.

Data collection tools and data quality control

Data collection tool

Structured questionnaire was generated referring to the FMoH SAM management protocol. The questionnaire was attached with the patient file and needed information was collected as stated in

the important documents like SAM registration logbook, SAM monitoring multi-chart and patient clinical files.

Data quality assurance

The structured questionnaire was prepared in English, same language used by the Ethiopian SAM treatment protocol. It is pretested in 17 patients from a different health facility (ten per cent of our total sample), was reviewed for sequence and layout. After receiving one-day training on data collection, the nurses, nutrition nurses and nutrition supervisor were in charge of completing the questionnaire along with their routine activities. The collected data was checked by the nutrition supervisor for its accuracy, completeness & consistency and remedial actions were taken on spot.

Data processing and analysis

The collected data got coded and entered into Microsoft Excel spreadsheet 2016 version and then exported to statistical package for social sciences (SPSS) version 25 for analysis. For analytical convenience, variables were transformed and recoded into numeric variables. Data was cleaned earlier to analysis by exploring levels of missing values and applied standardized Z score to check presence of significant outliers and did not found any extreme values. Variance inflation factor (VIF) and levels of tolerance was used to assess multicollinearity among independent variables and none of them was suggestive of significant correlation.

Descriptive analysis is executed and presented in tables and percentages along with the appropriate central tendency measure (median survival time in days). Kaplan-Meier & Cox regression was applied to determine the association of independent variables with dependent. Length of stay was (LoS) estimated using Kaplan-Meier procedure with Log Rank (Mantel-Cox) test to examine whether the observed difference of LoS between different groups of predictor variables is significant or not. Chi-square test was done to determine if there were adequate cell counts for each categorical variable. Independent variables with *p-value* of <0.2 during the bivariate Cox regression were nominated for multivariable Cox regression.

The proportional hazard assumption was checked by examining plots of LoS for model variables. The plotted points approximately lie nearby a line that has unit slope and zero intercept. Overall fitness of the model was assured by Omnibus tests of model coefficients at 5% level of significance. With entry and removal probabilities of 0.05 and 0.1 respectively, multivariable Cox regression was run using Stepwise Backward Wald method to detect independent predictors of recovery time. Finally, adjusted hazard ratio (AHR) with 95% confidence interval (CI) was used to show the strength of association and declare a statistical significance at p-value of < 0.05.

Results

From the total 194 children aged 6-59 months admitted to suhul hospital with complicated SAM, 168 were enrolled in this study while the remaining 26 were ineligible due to the exclusion criteria. Recovery rate was 94% while the rest six per cent of the participants were censored.

Socio-demographic characteristics and baseline clinical conditions at admission

With mean and median age of 21.65 and 18 months respectively, majority (68.5%) of the participants fall under the 6-24 months old category while 54.2 per cent out of the whole cohort were females. About 29.2 per cent of patients were from IDPs and most of participants were new admissions (97%). Ninety-six children (57.1 per cent) of children were breastfed while one fourth of them had edematous type of SAM at admission. Dehydration, failed appetite, pneumonia, persistent diarrhea, hyperthermia, malaria and skin lesions found to be main contributors of hospitalization whereas anemia, unconsciousness and vomiting were less encountered complications comparatively. **(Table 1)**

Treatment, feeding and final outcome

Fifteen patients received blood transfusion, exactly the same number of patients were also resuscitated with intravenous (IV) fluids. Only sixteen patients took oral antibiotics while the rest received their medications through IV line. Nasogastric (NG) tube was inserted to administer therapeutic milk and rehydration solutions in seventy-one patients. Out of the 156 children eligible for measles vaccination, only 89 of them got vaccinated because of lack of the antigen. However,

all children in the appropriate age for deworming (≥ 24 months) took single dose of albendazole or mebendazole. 95.2% of patients hospitalized with severe wasting were recovered whereas the recovery rate for children having edematous type of SAM at admission was 90.5%. Finally, 158 patients (94%) got stabilized and transferred to OTP whereas four (2.4%) and six (3.6%) were defaulted and dead respectively. The overall median length of stay until final outcome was 8 days (95% CI: 7.4, 8.6). **(Figure 1)**

Kaplan Meier estimates of recovery time

Recovery time was estimated using Log Rank (Mantel-Cox) test of equality of survival distribution for all independent variables. **(Table 1)**. The minimum, maximum, mean and median length of stay estimated to be two, twenty, eight point nine and eight days respectively. The LoS for children aged 25-59 months was higher than those aged 6-24 months. Nonetheless, this detected difference is by chance as it is not significant statistically (*p-value* 0.051). Similarly, we found some differences in LoS in residence of patient, breastfeeding status and persistent diarrhea with no statistical significance. However, the observed LoS differences in variables like type of SAM at admission **(Figure 2)**, appetite test **(Figure 3)**, hyperthermia, malaria status, anemia, blood transfusion **(Figure 4)**, type of antibiotics, dehydration **(Figure 5)**, NG tube feeding, skin lesions and deworming were statistically significant. The recovery time for those having edematous type of SAM was 10 days (95% CI: 8.7, 11.3), significantly longer compared with children having marasmus. **(Figure 2)**

Predictors of recovery time

Fourteen independent variables with *p-value* < 0.2 during the bivariate Cox regression were included in the final multivariable Cox regression. Once validity of the model assumptions ascertained and amendment for potential confounders, six significant predictors of recovery time were identified, namely; appetite test, level of dehydration, diagnosis at admission, blood transfusion, antibiotics and NG tube feeding.

Patients hospitalized with failed appetite found to have about two times highly likely to stabilize compared to those admitted with other medical complications, for whom appetite test is not

indicated (AHR = 1.874; 95% CI: 1.180-2.978). Level of dehydration resulted in 46.2% (AHR = 0.538; 95% CI: 0.361-0.800) and 75% (AHR = 0.250; 95% CI: 0.128-0.489) less likelihood of recovering from SAM in children being dehydrated and shocked at admission respectively. Compared with patients having severe wasting, those suffering from edematous SAM were less likely to recover by 55% (AHR = 0.452; 95% CI: 0.294-0.694). Patients who did not receive blood transfusion had more than fivefold likelihood of quicker recovery compared with their blood transfused counter parts (AHR = 5.559; 95% CI: 2.419-12.773).

Similarly, children treated with IV antibiotics and those who took the therapeutic milk via NG tube were 63.5 (AHR = 0.365; 95% CI: 0.192-0.692) and 46.9 per cent (AHR = 0.531; 95% CI: 0.372-0.758) less likely in recovering early compared to their counterparts who took oral antibiotics and who were able to take the therapeutic milk orally respectively. **(Table 2)**

Discussion

This research has assessed whether there is significant difference in recovery among different groups of patients and the overall recovery time from complicated SAM with its predictors. We have compared the reproducibility of our current findings with different studies of similar titles.

Hence, marasmus was the main provisional diagnosis at admission, consistent with reports from recent studies in Aksum (17), Addis Ababa (25) and Southern Ethiopia (6). The median recovery time was 8 days (95% CI: 7.4, 8.6) which fulfils the requirement for maximum LoS in SC by WHO to be less than four weeks (26). This finding is similar with prospective study conclusions from Sidama regional state of Ethiopia (27). Conversely, this is much better (shorter) compared to findings from different public hospitals in the capital city of the country and different institutions in Oromia (25,28), at which children were staying for about 19 and 21 days to be stabilized respectively. Such variability could be due to differences in adhering to the national guideline strictly and lack of trainings on the protocol as well as supply shortage among hospitals.

The rates of recovery, defaulter and death from the whole cohort were 94, 2.4 and 3.6 per cent respectively. This satisfies the performance indicators for SC set by the sphere association (29) and is way better achievement in reference to recent study findings from Jimma university medical center (30), that found only a quarter of the participants recovered. This is probably attributed to the comprehensive medical supplies interconnected with training, health promotion and supplementary IYCF services Suhul hospital was receiving from several humanitarian organizations during the crisis. Nonetheless, our achievements are similar with reports from Katsina state of Nigeria (31), a project received similar assistance from humanitarian NGO, achieved 95.7% of recovery and 4.3% death rate with LoS till outcome of 6 days.

In the final multivariable analysis using Cox proportional hazard regression, failed appetite test was significant predictor of time to recover, that in line with study results from Adama hospital (32). Likewise, we detected edematous type of SAM at admission resulted in reduced chance of earlier

recovery by 55% compared to those hospitalized with marasmus. This is compatible with findings from Benishangul Gumuz (20) who declared children admitted with severe wasting had 1.7 times higher chance of recovering early than those with edema, Amhara regional state of Ethiopia (33) who concluded hospitalized with edematous type of SAM resulted in 41% lower likelihood of recovery and researchers from Uganda (34) as well as Nigeria (31) stated that edematous form of SAM had extended LoS till recovery. But this is contradicting to reports from southern Ethiopia (27,35). This might be due to the added co-morbidities either forms of SAM, which opens areas of further studies to figure out reasons.

Our conclusion of special treatments like blood transfusion and provision of IV antimicrobials as independent predictors of LoS is on the same page with findings of researchers from Hawassa tertiary hospital, Southern Ethiopia (36) and other African Nations (34,37). By the same token, our finding on NG tube feeding resulted in significantly longer recovery time is backed by several researchers (38–40).

Conclusion and Recommendations

Bottom line of the study shows the inpatient therapeutic feeding center has met the agreed requirements (indicators) for nutrition interventions during humanitarian crises, which is relatively superior achievement compared with majority of latest studies in the thematic area. Appetite test, level of dehydration, diagnosis at admission, blood transfusion, type of antibiotics and nasogastric tube feeding were confirmed predictors of time till recovery from SAM.

Therefore, the hospital leadership along with the regional health bureau and other humanitarian agencies should give emphasis on training clinical workforce directly involved in severely undernourished child management and care, so that the clinicians will become skillful to identify and properly manage the main complications of SAM like severe anemia, dehydration and shock. Furthermore, the blood bank unit and the laboratory of the hospital should be looked after to ensure safe blood transfusion for those who need it.

Abbreviations

AHR: Adjusted Hazard Ratio; CHR: Crude Hazard Ratio; CI: Confidence Interval; IDP: Internally Displaced Person; IV: Intravenous; LoS: Length of Stay; NG: Naso-Gastric; NGO: Non-Governmental Organization; OTP: Outpatient Therapeutic Programme; SAM: Severe Acute Malnutrition; SC: Stabilization Center

Declarations

Ethical approval and consent to participate

Complying by the declaration of Helsinki for studies involving human beings, this research was commenced after receiving expedited ethics approval from Aksum university, college of health sciences, health research ethics review board (HRERB) with reference number: **IRB 009/2023**. This also fulfills the ethical standards set by the country (41). Permission was obtained from those in charge of the hospital's stabilization center to collect relevant data items for this study. Approved by HRERB in Aksum university, college of health sciences, informed written consent was taken from each participant's caretaker (legal guardian).

Consent for publication

Not applicable

Availability of data and materials

The records used to yield analytical outputs for this study are attached along with the manuscript as supplemental file **(S1: anonymized SC data. SAV).** Additionally, we have attached the steps we applied in the final multivariable Cox regression model **(S2).**

Conflicts of interest

We do not have any conflicting interests

Funding

We didn't receive any funding intended for this work.

Authors' contributions

317 WT proposed and designed the study. Analysis, writing up the manuscript and its final approval is
318 done by both authors.

319 **Acknowledgements**

320 Our earnest appreciation goes to the healthcare workers of the hospital who never gave up and were
321 tirelessly serving their society with almost no medical supplies and without salaries due to the war
322 for nearly two years. We are warmly grateful for the nurses assigned in the paediatrics ward for
323 their cooperation in collecting the data appropriately.

324

325

326

327

328

329

330

331

332

333

334

335

336

337

338

339

340

341

References

1. Dr Phoebe CM Williams and Prof James A Berkley. Severe Acute Malnutrition Update: Current WHO Guidelines and the WHO Essential Medicine List for Children. 2016.
2. UNICEF, WHO WBG. Levels and trends in child malnutrition. 2023;
3. World Health Organization. World Health Statistics: Mnitoring health for the SDGs, Sustainable Development goals. 2022.
4. UNICEF. Nutrition, for Every Child: UNICEF Nutrition Strategy 2020-2030. 2020.
5. Republic of the Philippines and World Food Programme (WFP). National Guidelines on the Management of Moderate Acute Malnutrition for Children under Five Years: Manual of Operations. 2020.
6. Abrham Bire, Shifeta M. Treatment Outcome From Severe Acute Malnutrition Among Children 6 to 59 Months Admitted To Hawassa University Comprehensive Specialized Hospital, Southern Ethiopia. Ethiop J Pediatr Child Heal. 2023;18(June):49–67.
7. Save the Children, UNHCR. Infant and Young Child Feeding in Refugee Situations: A Multi-Sectoral Framework for Action. 2018.
8. World Health Organization. Guideline: Updates on the Management of Severe Acute Malnutrition in Infants and Children. 2013.
9. UNICEF. Nutrition Situation in Tigray: A Rapid analysis of Nutrition Programme data. 2021;2020(September).
10. Mulugeta A, Gebregziabher M. Saving children from man-made acute malnutrition in Tigray, Ethiopia: a call to action. Lancet Glob Heal [Internet]. 2021;10(4):e469–70. Available from: http://dx.doi.org/10.1016/S2214-109X(22)00023-7
11. Kabthymer RH, Gizaw G, Belachew T. Time to Cure and Predictors of Recovery Among Children Aged 6 – 59 Months with Severe Acute Malnutrition Admitted in Jimma University Medical Center , Southwest Ethiopia : A Retrospective Cohort Study. Cinical Epidemiol.

2020;

12. Wagnew F, Dejenu G, Eshetie S, Alebel A, Worku W, Abajobir AA. Treatment cure rate and its predictors among children with severe acute malnutrition in northwest Ethiopia : A retrospective record review. PLoS One. 2019;14(2):1–13.

13. Workneh ZB, Alebel A, Worku T, Alemu A. Recovery rate and its predictors among children with severe acute malnutrition in Addis Ababa , Ethiopia : A retrospective cohort study. PLoS One [Internet]. 2020;1–16. Available from: http://dx.doi.org/10.1371/journal.pone.0235259

14. Adimasu M, Sebsibie G, Abebe F, Baye G, Abere K. Recovery time from severe acute malnutrition and associated factors among under-5 children in Yekatit 12 Hospital , Addis Ababa , Ethiopia : a retrospective cohort study. Epidemiol Health. 2020;1–11.

15. Hassen SL, Astatkie A, Mekonnen TC, Bogale GG. Survival Status and Its Determinants among Under-Five Children with Severe Acute Malnutrition Admitted to Inpatient Therapeutic Feeding Centers in South Wollo Zone , Amhara Region , Ethiopia. Hindawi J Nutr Metab. 2019;1–9.

16. Nduhukire T, Atwine D, Rachel L, Byonanebye JE. Predictors of in-hospital mortality among under-five children with severe acute malnutrition in South-Western Uganda. PLoS One [Internet]. 2020;1–15. Available from: http://dx.doi.org/10.1371/journal.pone.0234343

17. Tesfay W, Abay M, Hintsa S, Zafu T. Length of stay to recover from severe acute malnutrition and associated factors among under-five years children admitted to public hospitals in Aksum , Ethiopia. PLoS One [Internet]. 2020;1–13. Available from: http://dx.doi.org/10.1371/journal.pone.0238311

18. Karunaratne R, Sturgeon JP, Patel R, Prendergast AJ. Predictors of inpatient mortality among children hospitalized for severe acute malnutrition : a systematic review and meta-analysis. Am J Clin Nutr [Internet]. 2020;112(4):1069–79. Available from: https://doi.org/10.1093/ajcn/nqaa182

19. Oumer A, Mesfin L, Tesfahun E, Ale A. Predictors of Death from Complicated Severe Acute Malnutrition in East Ethiopia: Survival Analysis. Int J Gen Med Dovepress. 2021;8763–73.

20. Bizuneh FK, Tolossa T, Bekonjo NE, Wakuma B. Time to recovery from severe acute malnutrition and its predictors among children aged 6 – 59 months at Asosa general hospital , Northwest Ethiopia . A retrospective follow up study. PLoS One [Internet]. 2022;(August). Available from: http://dx.doi.org/10.1371/journal.pone.0272930

21. Fassikaw Kebede T, Kebede, Belete Negese, Atitegeb Abera, Getahun Fentaw AK. Incidence and predictors of severe acute malnutrition mortality in children aged 6 – 59 months admitted at Pawe general hospital ,. PLOS ONES ONE [Internet]. 2022;568:1–10. Available from: http://dx.doi.org/10.1371/journal.pone.0263236

22. Allen C, Jansen J, Naude C, Durao S, Mehta M, Elm E Von, et al. Prevention and treatment of acute malnutrition in humanitarian emergencies : a multi-organisation collaboration to increase access to synthesised evidence. Vol. 8, Journal of International Humanitarian Action. 2019.

23. Ali E, Delchevalerie P, Shams Z, Alders P, Zachariah R. Community Based Management of Severe Acute Malnutrition: The MSF Experience from an Urban Slum Setting in Bangladesh. Food Nutr Sci. 2020;578–89.

24. The Government of Ethiopia; Federal Ministry of Health. National Guideline for the Management of Acute Malnutrition. 2019.

25. Mezemir M, Girma M, Bekele D. Treatment Outcome and Associated Factors of Acute Malnutrition Among Children in the Therapeutic Feeding Center of Public Hospitals in Addis Ababa , Ethiopia : An Institutional-Based Cross-Sectional Study. Pediatr Heal Med Ther. 2022;(March):145–54.

26. WHO child growth standards and the identification of severe acute malnutrition in infants and children. A Joint Statement by the World Health Organization and the United Nations

Children's Fund. 2009

27. Abebe A, Simachew Y, Delbiso TD. Effect of ready-to-use therapeutic foods on time to recovery among children with severe acute malnutrition in Ethiopia : a prospective cohort study. BMC Pediatr. 2023;1–10.

28. Eyi SE, Debele GR, Negash E, Bidira K, Tarecha D, Nigussie K, et al. Severe acute malnutrition ' s recovery rate still below the minimum standard : predictors of time to recovery among 6 - to 59 - month - old children in the healthcare setting of Southwest Ethiopia. J Heal Popul Nutr [Internet]. 2022;1–12. Available from: https://doi.org/10.1186/s41043-022-00331-9

29. Sphere Association. The Sphere Handbook: Humanitarian Charter and Minimum Standards in Humanitarian Response, fourth edition, Geneva, Switzerland. 2018.

30. Adem F, Edessa D, Bayissa B, Hassen MM, Mohammed MA. Treatment Outcomes and Associated Factors in Hospitalised Children with Severe Acute Malnutrition : A Prospective Cohort Study. Dovepress Pediatr Heal Med Ther. 2020;

31. Joseph FI, Falade A, Earland J. Time to recovery and its predictors among children 6 – 59 months with acute malnutrition admitted to community inpatient therapeutic feeding centers in Katsina State , Northwest Nigeria : a retrospective review of health records (2010 – 2016). J Heal Popul Nutr [Internet]. 2023;1–11. Available from: https://doi.org/10.1186/s41043-023-00352-y

32. Derbe S, Rebitu AD, Nemo H. Treatment Outcome of Severe Acute Malnutrition and its Determinants among Under Five Children Admitted to Pediatrics Ward at Adama Hospital Medical College, Adama, Ethiopia. ACTA Sci Clin Case Reports. 2021;2(8):72–83.

33. Derseh B, Mruts K, Demie T, Gebremariam T. Co-morbidity , treatment outcomes and factors affecting the recovery rate of under -five children with severe acute malnutrition admitted in selected hospitals from Ethiopia: retrospective follow up study. BMC Nutr J.

2018;1–8.

34. E. Muwanguzi, J. Eros Oboi AN and RW. Treatment outcome and associated factors for severely malnourished children (1-5 years) admitted to Lacor hospital and Gulu Regional referral hospital in Uganda. J Nutr Sci. 2021;1–7.

35. Gebremichael DY. Predictors of nutritional recovery time and survival status among children with severe acute malnutrition who have been managed in therapeutic feeding centers , Southern Ethiopia: retrospective cohort study. BMC Public Health [Internet]. 2015;1–11. Available from: http://dx.doi.org/10.1186/s12889-015-2593-5

36. Fikrie A, Alemayehu A, Gebremedhin S. Treatment outcomes and factors affecting time-to-recovery from severe acute malnutrition in 6 – 59 months old children admitted to a stabilization center in Southern Ethiopia : A retrospective cohort study. Ital J Pediatr. 2019;45(46):1–9.

37. Vonasek BJ, Chiume M, Crouse HL, Mhango S, Kondwani A, Ciccone EJ, et al. Risk factors for mortality and management of children with complicated severe acute malnutrition at a tertiary referral hospital in Malawi. Paediatr Int Child Health [Internet]. 2020;40(3):148–57. Available from: https://doi.org/10.1080/20469047.2020.1747003

38. Tefera TK, Abebe SM, Hunegnaw MT, Mekasha FG. Time to Recovery and Its Predictors among Children 6 – 59 Months Admitted with Severe Acute Malnutrition to East Amhara Hospitals , Northeast Ethiopia : A Multicenter Prospective Cohort Study. Hindawi J Nutr Metab. 2020;

39. Lencha B, Urgessa M, Lemessa F, Minda Z, Beressa G, Ganfure G, et al. Severe Acute Malnutrition (SAM) among Children in Bale Zone Southeast Ethiopia: Treatment Outcome and its determinants factors. J Pediatr [Internet]. 2023;113743. Available from: https://doi.org/10.1016/j.jpeds.2023.113743

40. Ahmed JA, Yusuf N, Wilfong T, Tukeni KN, Berhanu H, Roba KT. Treatment outcomes

among children admitted stabilization centers in Eastern Ethiopia: retrospective study. Front Public Heal. 2023;2(July).

41. Federal Democratic Republic of Ethiopia (FDRE): Ministry of Science and Technology. National Research Ethics Review Guidline. 2014.

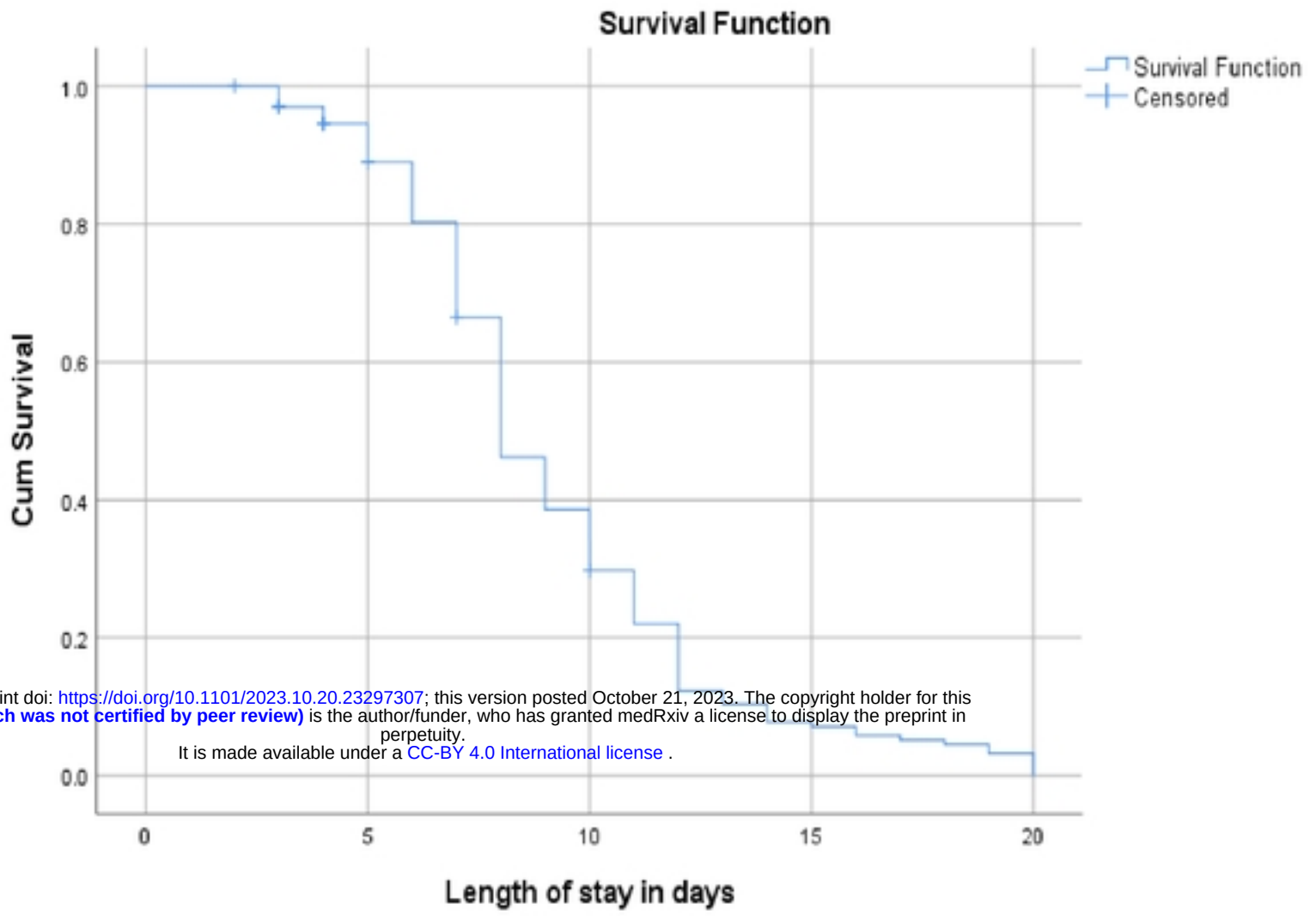

Figure 1: Final Kaplan Meier survival estimates of recovery time among 6-59 months old children treated for SAM in Suhul general hospital, 2023

Figure 1

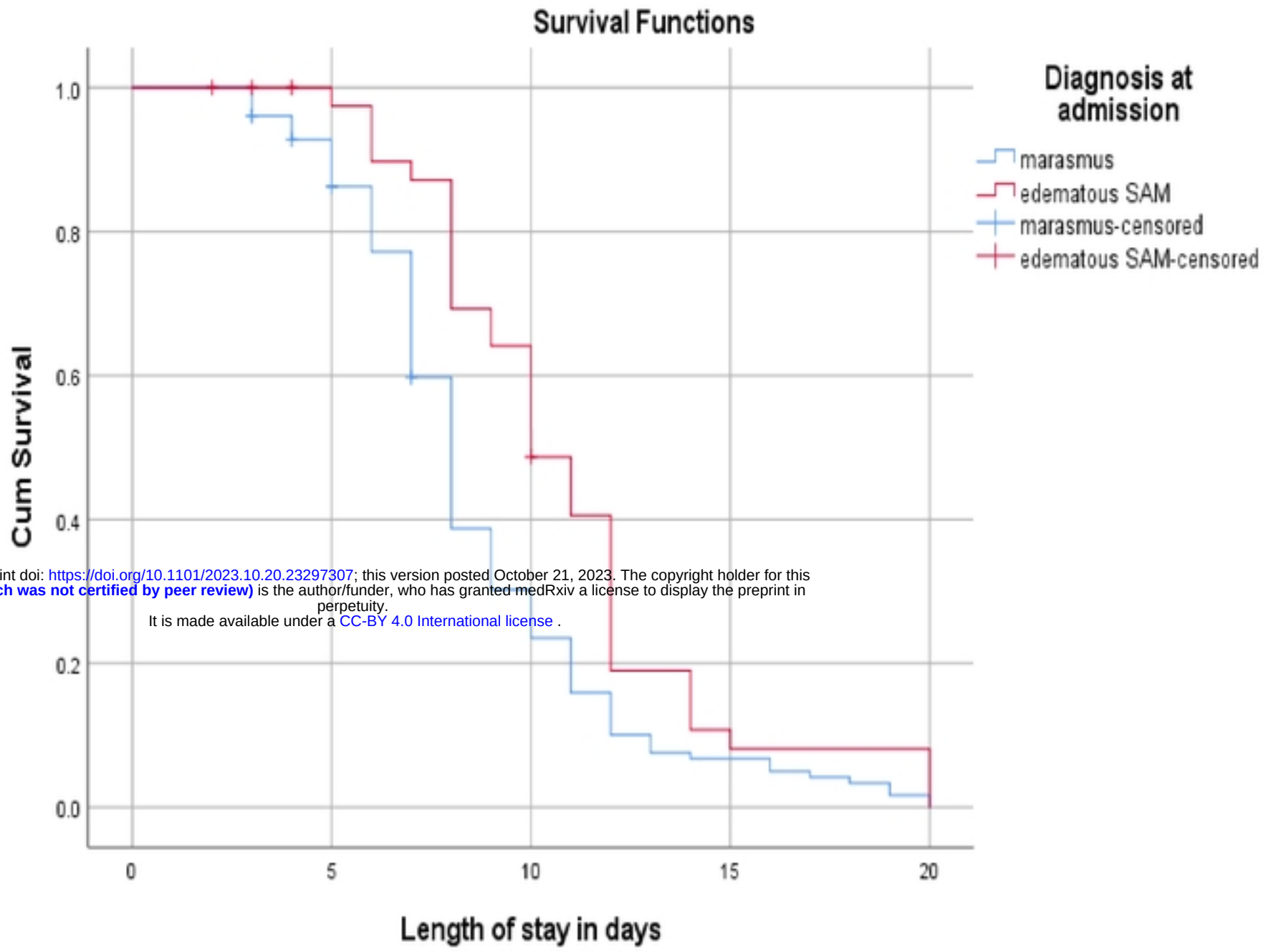

Figure 2: Kaplan Meier Survival curves of recovery time among 6-59 months old children by their diagnosis at admission, Suhul general hospital, 2023

Figure 2

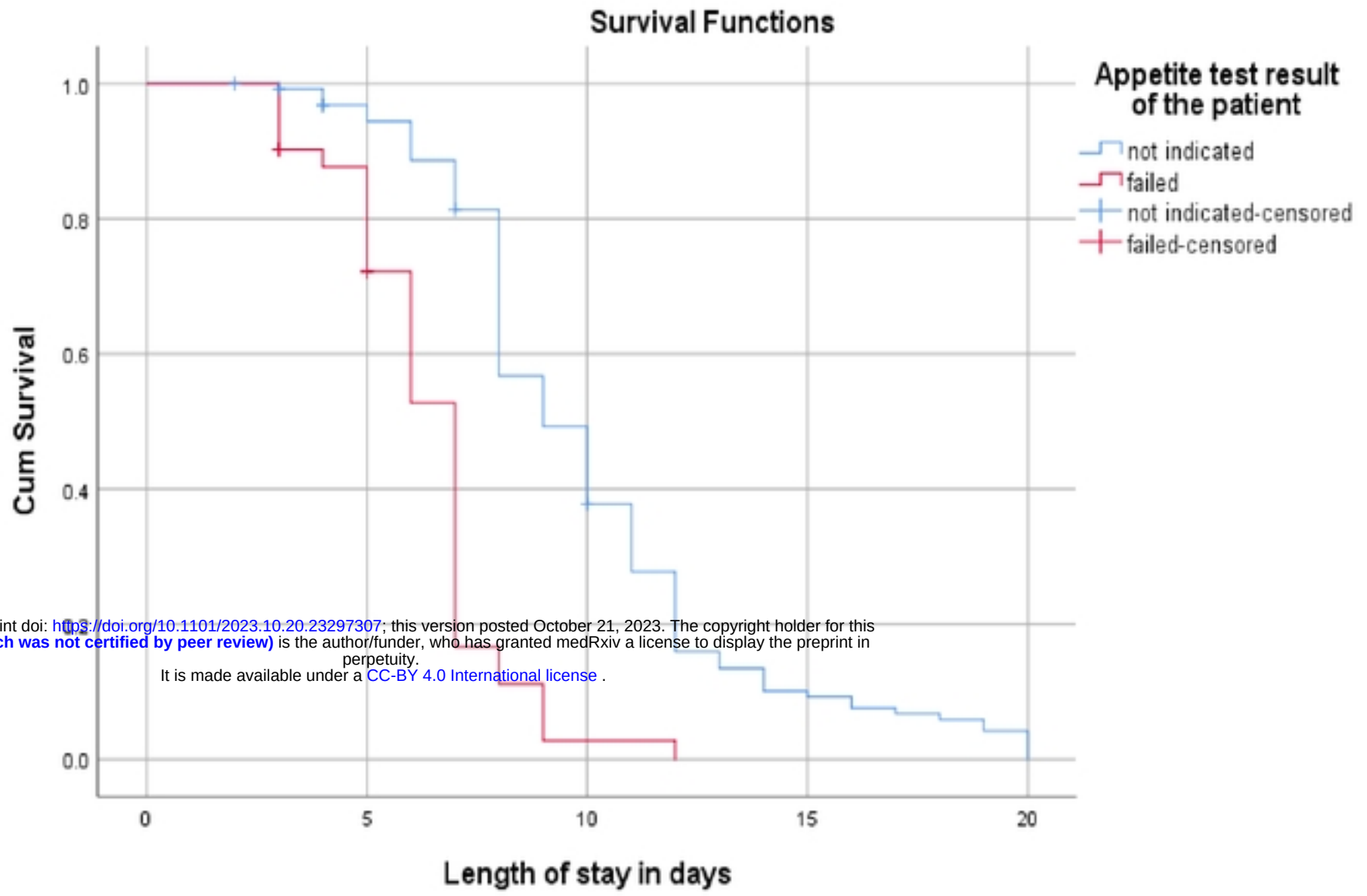

Figure 3: Kaplan Meier Survival estimates of recovery time among 6-59 months old children by their appetite test result at admission, Suhul general hospital, 2023

Figure 3

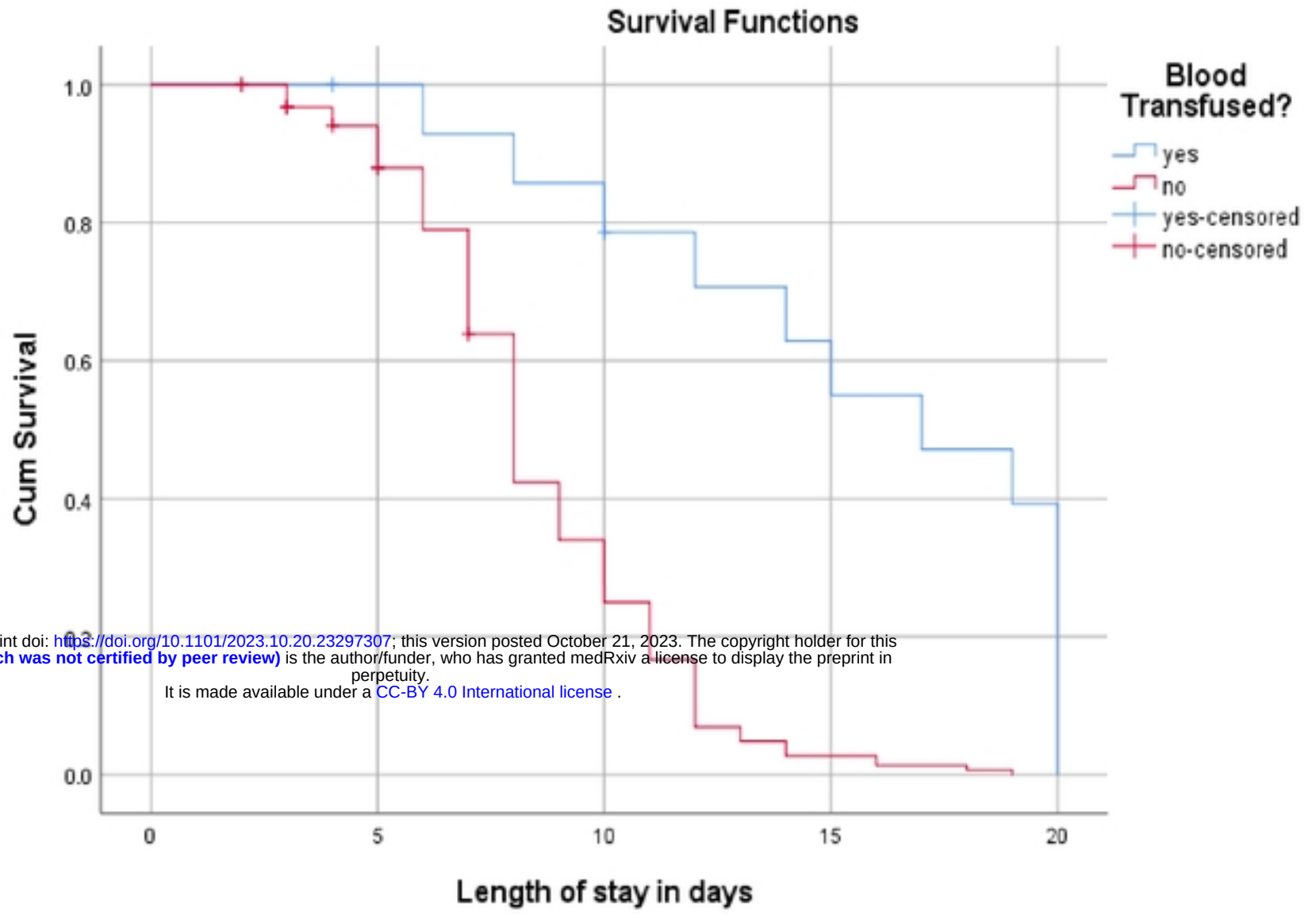

Figure 4: Kaplan Meier Survival curves of recovery time among 6-59 months old children based on blood transfusion after admission, Suhul general hospital, 2023

Figure 4

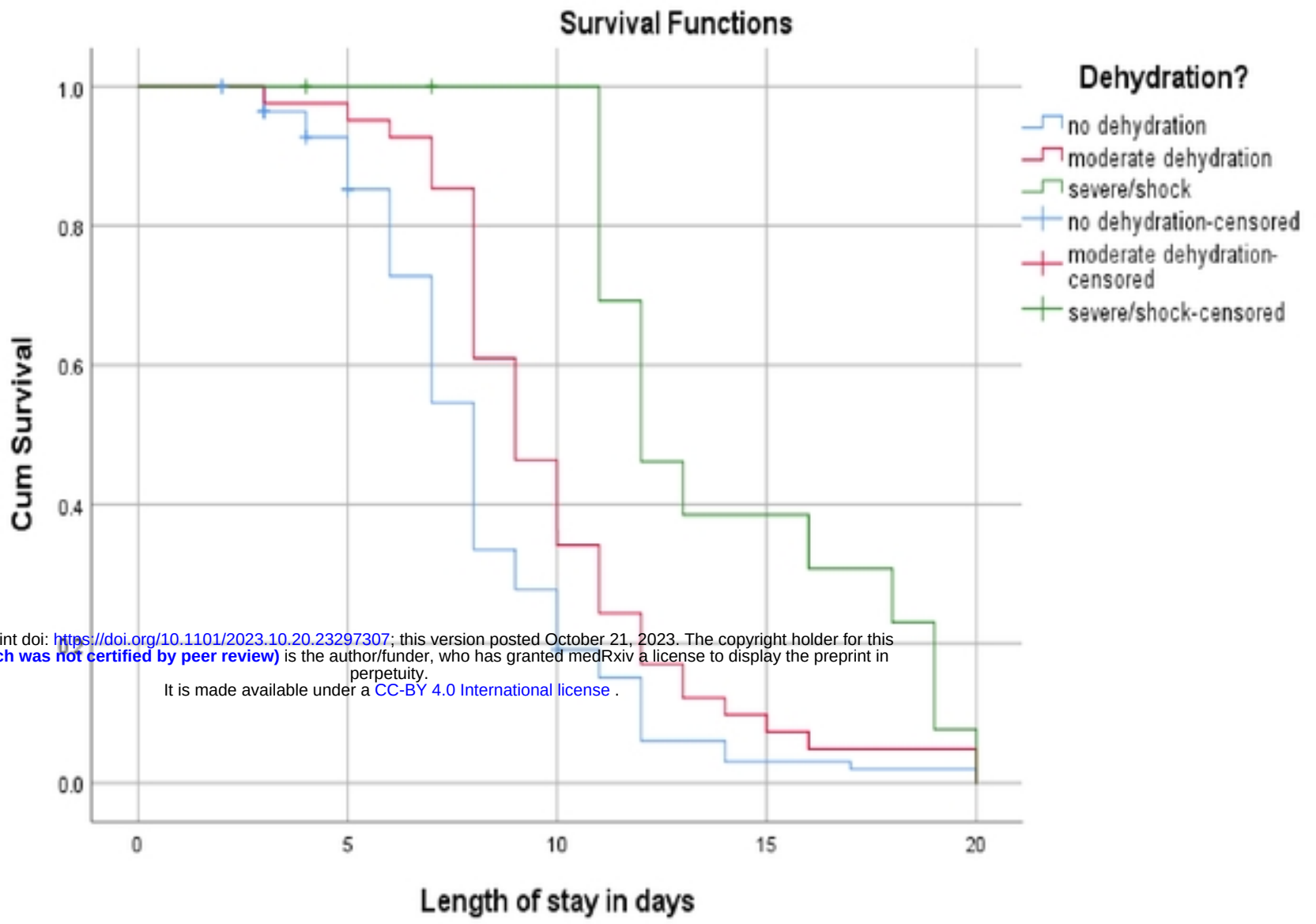

Figure 5: Kaplan Meier Survival curves of recovery time among 6-59 months old children by their level of at dehydration during admission, Suhul general hospital, 2023

Figure 5

Table 1: Log Rank (Mantel-Cox) test of equality of survival distributions for sociodemographic characteristics, clinical conditions at admission, routine medications and feeding in chidren with severe undernutrition treated in suhul hospital, 2023

Variable	Category	Percentage of outcome			Median	95% CI		Log rank (Mantel-Cox)	
		Recovered no. (%)	Censored no. (%)	Total no. (%)	survival (days)	LB	UB	Chi-square	*p-value*
Age in months	6-24	108 (64.3)	7 (4.2)	115 (68.5)	8	7.6	8.4	3.804	0.051
	25-59	50 (29.7)	3 (1.8)	53 (31.5)	10	8.8	11.2		
Sex	Female	85 (50.6)	6 (3.6)	91 (54.2)	8	7.4	8.6	0.404	0.525
	Male	73 (43.4)	4 (2.4)	77 (45.8)	8	6.9	9.1		
Residence	Host-urban	29 (17.3)	1 (0.6)	30 (17.8)	9	8	10	0.728	0.695
	Host-rural	80 (47.6)	9 (5.4)	89 (52.9)	8	7.6	8.4		
	IDP	49 (29.1)	0 (0)	49 (29.1)	9	7.9	10.1		
Type of Admission	New	154 (91.6)	9 (5.4)	163 (97)	8	7.4	8.6	0.05	0.945
	Re-admission	4 (2.4)	1 (0.6)	5 (3)	8	7.4	8.6		
Breastfeeding	Yes	90 (53.5)	6 (3.6)	96 (57.1)	8	7.5	8.5	3.265	0.195
Status	No	25 (14.9)	3 (1.8)	28 (16.7)	8	7.4	8.6		
	Not indicated	43 (25.6)	1 (0.6)	44 (26.2)	10	8.1	11.9		
Appetite Test	Not indicated	121 (72)	6 (3.6)	127 (75.6)	9	8	10	58.082	< 0.001
	Failed	37 (22)	4 (2.4)	41 (24.4)	7	6.6	7.4		
Pneumonia	Yes	39 (23.2)	2 (1.2)	41 (24.4)	8	7.5	8.5	1.366	0.242
	No	119 (70.8)	8 (4.8)	127 (75.6)	8	7.2	8.8		
Persistent Diarrhea	Yes	39 (23.2)	0 (0)	39 (23.2)	10	8.5	11.5	2.077	0.150
	No	119 (70.8)	10 (6)	129 (76.8)	8	7.6	8.4		
Vomiting	Yes	5 (2.9)	1 (0.6)	6 (3.6)	9	7.9	10.1	1.488	0.223
	No	153 (91.1)	9 (5.4)	162 (96.4)	8	7.4	8.6		
Hyperthermia	Yes	23 (13.7)	2 (1.2)	25 (14.9)	8	6.5	9.5	5.997	0.014
	No	135 (80.3)	8 (4.8)	143 (85.1)	8	7.4	8.6		
	Overall	158 (94)	10 (6)	168 (100)	8	7.4	8.6		

Table 1: Log Rank (Mantel-Cox) test of equality of survival distributions (Continued)

Variable	Category	Percentage of outcome			Median survival (days)	95% CI		Log rank (Mantel-Cox)	
		Recovered no. (%)	Censored no. (%)	Total no. (%)		LB	UB	Chi-square	*p-value*
Malaria Test	Not indicated	108 (64.3)	4 (2.4)	112 (66.7)	8	7.5	8.5	17.529	< 0.001
	Negative	30 (17.8)	5 (3)	35 (20.8)	8	6.5	9.5		
	Positive	20 (11.9)	1 (0.6)	21 (12.5)	12	7.7	16.3		
Lethargic or Unconscious	Yes	6 (3.6)	3 (1.8)	9 (5.4)	17	8.6	25.4	11.946	0.001
	No	152 (90.4)	7 (4.2)	159 (94.6)	8	7.6	8.4		
Anemia	Yes	12 (7.1)	4 (2.4)	16 (9.5)	17	12.1	21.9	23.878	< 0.001
	No	146 (86.9)	6 (3.6)	152 (90.5)	8	7.6	8.4		
Skin Lesions	Yes	19 (11.3)	3 (1.8)	22 (13.1)	12	10.1	13.9	8.738	0.003
	No	139 (82.7)	7 (4.2)	146 (86.9)	8	7.6	8.4		
Dehydration Status	No Dehydration	104 (61.9)	8 (4.8)	112 (66.7)	8	7.5	8.5	21.825	< 0.001
	Moderate/Some	41 (24.4)	0 (0)	41 (24.4)	9	7.9	10.1		
	Severe/Shock	13 (7.7)	2 (1.2)	15 (8.9)	12	10.2	13.8		
Diagnosis at Admission	Marasmus	120 (71.4)	6 (3.6)	126 (75)	8	7.6	8.4	10.207	0.001
	Edematous SAM	38 (22.6)	4 (2.4)	42 (25)	10	8.7	11.3		
Blood Transfusion	Yes	13 (7.7)	2 (1.2)	15 (8.9)	17	10.1	23.9	30.141	< 0.001
	No	145 (86.3)	8 (4.8)	153 (91.1)	8	7.6	8.4		
IV Fluid Given	Yes	13 (7.7)	2 (1.2)	15 (8.9)	12	9.7	14.3	8.272	0.004
	No	145 (86.3)	8 (4.8)	153 (91.1)	8	7.6	8.4		
Antibiotics	Oral	15 (8.9)	1 (0.6)	16 (9.5)	6	5.3	6.7	52.786	< 0.001
	Intravenous	143 (85.1)	9 (5.4)	152 (90.5)	9	8.5	9.5		
NG Tube Feeding	Not indicated	94 (55.9)	3 (1.8)	97 (57.7)	8	7.5	8.5	22.890	< 0.001
	Yes	64 (38.1)	7 (4.2)	71 (42.3)	11	10.1	11.9		
Measles Vaccination	Not indicated	7 (4.2)	5 (3)	12 (7.1)	8	6.8	9.2	4.553	0.103
	No	62 (36.9)	5 (3)	67 (39.9)	9	8.1	9.9		
	Yes	89 (52.9)	0 (0)	89 (53)	8	7.2	8.8		
Deworming	Not indicated	89 (53)	10 (6)	99 (59)	8	7.6	8.4	6.604	0.010
	Yes	69 (41)	0 (0)	69 (41)	10	7.7	12.3		
	Overall	158 (94)	10 (6)	168 (100)	8	7.4	8.6		

Table 1: Predictors of recovery time among children treated for SAM in Suhul general hospital from January 01, 2023 to July 31, 2023

Variable	Category	Percentage of outcome			CHR (95% CI)	AHR (95% CI)	*P-value*
		Recovered	Censored	Total			
Age in months	6-24	108	7	115	1	1	0.591
	25-59	50	3	53	0.745 (0.531-1.045)	0.900 (0.612-1.322)	
Appetite test	Not indicated	121	6	127	1	1	**0.008**
	Failed	37	4	41	3.934 (2.619-5.911)	1.874 (1.180-2.978)	
Hyperthermia	Yes	23	2	25	1	1	0.948
	No	135	8	143	1.670 (1.040-2.681)	1.020 (0.565-1.839)	
Malaria Test	Not indicated	108	4	112	1	1	0.263
	Negative	30	5	35	0.790 (0.526-1.186)	1.045 (0.651-1.677)	
	Positive	20	1	21	0.358 (0.204-0.629)	0.430 (0.140-1.323)	
Lethargy/unconsciousness	Yes	6	3	9	1	1	0.512
	No	152	7	159	3.271 (1.419-7.542)	1.429 (0.429-4.149)	
Anemia	Yes	12	4	16	1	1	0.545
	No	146	6	152	3.775 (1.992-7.153)	0.546 (0.077-3.876)	
Skin lesions	Yes	19	3	22	1	1	0.370
	No	139	7	146	1.862 (1.146-3.024)	1.340 (0.707-2.540)	
Level of dehydration	No dehydration	104	8	112	1	1	**< 0.001**
	Moderate/Some	41	0	41	0.650 (0.452-0.935)	0.538 (0.361-0.800)	
	Severe/shock	13	2	15	0.339 (0.188-0.611)	0.250 (0.128-0.489)	
Diagnosis at admission	Marasmus	120	6	126	1	1	**< 0.001**
	Edematous SAM	38	4	42	0.594 (0.411-0.860)	0.452 (0.294-0.694)	
Blood transfusion	Yes	13	2	15	1	1	**< 0.001**
	No	145	8	153	5.667 (2.652-12.110)	5.559 (2.419-12.773)	
IV fluid	Yes	13	2	15	1	1	0.204
	No	145	8	153	2.050 (1.154-3.643)	1.785 (0.731-4.363)	
Antibiotics	Oral	15	1	16	1	1	**0.002**
	Intravenous (IV)	143	9	152	0.162 (0.090-0.291)	0.365 (0.192-0.692)	
NG tube feeding	Not indicated	94	3	97	1	1	**0.001**
	Yes	64	7	71	0.503 (0.364-0.697)	0.531 (0.372-0.758)	
Deworming	Not indicated	89	10	99	1	1	0.805
	Yes	69	0	69	0.691 (0.500-0.954)	1.076 (0.601-1.925)	

Table 2