

Treatment Outcomes of Children with Severe Acute Malnutrition admitted in a Tertiary Hospital in Northeast Nigeria: An Observational Retrospective Cohort Study

Bukar LM,¹ Monguno HFK,² Garba AM,¹ Imam RA,¹ Musa HY,¹ Mele AM¹

ABSTRACT

Background: The number of children admitted with severe acute malnutrition (SAM) in Maiduguri is increasing largely because of insurgency. There is the urgent need to understand the factors and trends of mortality and default in SAM children under inpatient care to improve treatment outcomes. **Objectives:** This study aimed to estimate mortality and default rates and identify factors that were associated with mortality and default among children with SAM after admission at inpatient therapeutic feeding centre (ITFC), Maiduguri, Nigeria between 2017 and 2022. **Methods:** Cohort study data were extracted from the ITFC database, which has standard guidelines for core treatment and outcome indicators based on WHO criteria. A total of 5072 SAM children who were admitted in the centre were included in the study. The study collected the following data: age, gender, type of SAM, admission criteria, source and time of admission, intravenous fluid use during admission, and medical complications at admission such as shock, sepsis, hypothermia, hypoglycaemia, pneumonia, tuberculosis, acute diarrhoea, dehydration and severe anaemia. **Results:** Admitted SAM children had a mortality rate of 7.6% [95% Confidence Interval (CI) 5.8–9.1], and default rate of 1.6% (95% CI 2.57–3.47). The odds of not dying increased with the age of the child up to 35 months and decreased afterward [Adjusted Odd Ratio (AOR) 1.75, 95% CI 1.00–3.05, $p = 0.049$]. Similarly, mortality rate was 15.8% in the first 24 hours of admission (95% CI 7.1–26.3), and it decreased thereafter. Acute diarrhoea, dehydration, shock, malaria, severe anaemia, and late referral from other SAM programmes were found to be significant predictors of mortality at admission among SAM children (p value < 0.05). Default was lower among children with non-oedematous SAM (AOR 0.62; CI 0.41–0.95, $p = 0.030$) and those with Mid-upper arm circumference ≥ 12 cm (AOR 0.05, CI 0.01–0.33, $p = 0.002$). **Conclusion:** Integrated comprehensive care reduced mortality and default in SAM; shock, other medical complications and late referral increased deaths, while improvement increased default, informing interventions for linkage retention.

Keywords: Severe Acute Malnutrition, Treatment outcomes, mortality, default, Risk factors

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Introduction

Despite intensive efforts for the prevention of malnutrition in humanitarian setting, severe acute malnutrition [SAM] consistently impacts on children.¹ Of estimated 555 million global children under five years of age, nearly, 19 million are severely wasted.² Children with SAM disproportionately impacted middle- and low-income countries where the malnutrition burden is high and resources are limited.^{2,3} More than 90% of them live in the developing countries, specifically in sub-Saharan Africa and South East Asia.² Nigeria's nutrition prevention programs have improved in the last decades evident by the slow but sustained decline in prevalence rates of malnutrition.^{4,5} According to the



recent Nigerian Demographic and Health survey (NDHS) 2023-24 report, wasting and severe wasting is estimated to be 7 and 2% among under five children respectively.⁵ Likewise, in North-eastern region, 6.9 % of children were wasted and 2.6% were severely wasted.⁶ However, the under-five mortality rate is still unacceptably high in Nigeria (132 deaths per 1,000 live births) with the northwest and northeast regions having the highest figures. Moreover, acute malnutrition, or wasting, exclusively is an attributable cause of 12.6% of the 6.9 million deaths among children under 5-year-old.³

Without timely intervention and appropriate treatment, the World Health Organization (WHO) estimated that between 10% and 20% of children with SAM generally die within 2-3 months without treatment, without discriminating between children with and without medical complications.^{7,8} On the other hand, early diagnosis and initiation of treatment for medical complications in SAM substantially reduced mortality by about 80%.⁹ Inpatient care at stabilization centre where feasible was recommended by community management of acute malnutrition (CMAM) guideline of Nigeria for children with SAM with any medical complications.^{9,10} However, accessibility to stabilization centre (SC) remained low worldwide, and in humanitarian setting like Maiduguri may be quite challenging. In 2016, more than 475,000 children¹¹ were expected to have suffered from SAM in the conflict-affected areas of lake Chad, up from 175,000 at the beginning of the year.

In north-east Nigeria's Borno state alone, an estimated 49,000 children out of 244,000 children¹² suffering from severe acute malnutrition will die if they do not receive treatment. Furthermore, SAM children in humanitarian setting might encounter challenges such as parental death, school dropout, and stigma which in turn results in negative consequences.¹³ Humanitarian programs have been scaled up in Nigeria and contributed to a significant decrease in undernutrition and death in recent years.¹³ Although early inpatient care has been proven to be effective and beneficial for SAM children with medical complication, limited studies examined factors associated with death and default among SAM children who were receiving care at SC in Nigeria.

Furthermore, since the establishment of ITFC, in UMTH, Maiduguri in 2017, data from the centre has not been analysed or interpreted. Undoubtedly, comprehensive data analysis would help to evaluate

the effectiveness of the centre and identify determinant factors that affect treatment outcomes. This retrospective study from 2017 to 2022, aimed to estimate mortality and default rates and identify factors that were related to death and default among a cohort of SAM children who were admitted at ITFC, in Maiduguri. These findings, might be different from what had been reported by other researchers from other centres which differ from Maiduguri. And the results from this study could be used to design programs with the goals to improve treatment outcomes and maximize the benefits of CMAM in the ITFC and other similar settings in Nigeria.

Methods

Study Design and Setting: This was a hospital-based observational retrospective cohort study conducted at ITFC of UMTH, Maiduguri, the first and largest tertiary referral hospital in north-eastern Nigeria with a catchment population of over 10 million. The ITFC admits all children aged less than 5 years of age with SAM who fulfilled the inclusion admission criteria as per National guideline/WHO reference of SAM.^{10,14}

The ITFC is the first nutritional rehabilitation centre in a tertiary hospital in Nigeria that has the mandate of providing clinical services, research and teaching with the view to serve as a model. It is being supported by UNICEF and Alliance for International Medical Aids [ALIMA] to provide comprehensive and integrated care to children affected by the Boko Haram insurgency as part of humanitarian response to the crisis.

All services are being rendered at no cost to the patients including cost of transport at discharge. The centre has full complement of acute, transition and rehabilitation wards for various phases of the management after passing through a triage point. There is also an Intensive Care Unit (ICU) for critical ill patients who met the criteria for critical-care based on Paediatric Early Warning System (PEWS).¹⁵ Mothers were specifically kept at the centres so that they could be integrated into the effective care of the children, taught on preparation of local therapeutic diets, screening children for SAM using

MUAC tape and received counselling sessions on key household best practices.¹⁶ Admitted children in the centre were further diagnosed and treated by paediatricians, medical registers, nurses, dieticians and other sub-specialties as dictated by the child's presentation. For all management purposes the



Nigerian treatment protocol for SAM with medical complications was used.¹⁰

Study Participants: There were 5211 under five children with SAM admitted in ITFC from 2017 to 2022 based on the Protocol for the Management of SAM in Nigeria.¹⁰ The admission criteria for participants (age > 6 months to 59 months) were Weight-for-Length/Height value < -3 Z scores or Mid Upper Arm Circumference (MUAC) < 115 mm and/or children having bilateral pitting oedema and failed appetite test or with a medical complication. Similarly, participants less than 6 months were admitted if they are at risk of developing SAM, too weak to suckle breast milk or Weight-for-length < -3 Z scores or presence of bilateral oedema.^{10,14} All parents or guardians provided informed consent to the ITFC at admission. This ITFC informed consent also included incorporating their information in the ITFC database.

Ethics Statement: Ethical clearance was obtained from the Ethical Review Committee of Maiduguri Teaching Hospital (UMTH/REC/19/373). Permission was also obtained from Inpatient Therapeutic Feeding Centre. Confidentiality and privacy of the information were assured and maintained by preventing disclosure of the information to third parties. Written informed consent from the participants' legal guardian/next of kin was obtained at admission.

Data Collection and quality assurance: Cohort study data was extracted from the ITFC database using a form designed for this specific study from inpatient therapeutic feeding registration book, multi-charts and medical records. The following baseline data of study participants were collected: age, gender, type of SAM, admission criteria, source and time of admission and intravenous fluid use during admission. Medical complications at admission such as shock, hypothermia, hypoglycaemia, pneumonia, diarrhoea, and severe anaemia etc was based on definition in the relevant protocols.^{10,14}

The date of death was based on death certificate information. Default was defined as absent for two consecutive days while on admission in the ITFC database.

A structured data extraction form was designed to collect data from relevant clinical records. Data was collected by medical record officers who had been working in the ITFC after training on the techniques of data collection. Prior to actual data collection, a pre-test was carried out to check the reliability and validity

of the data extraction form. The completeness of data was checked by LM Bukar & HF Kachalla so as to provide feedback in the data collection process and to provide appropriate measures when necessary. Furthermore, data collectors, supervisors and principal investigator discussed on quality of data to increase the validity and consistency of the data.

Statistical Analysis: A time-to-event cohort analysis was performed. The primary study endpoints were death and default. Mortality and default rates were calculated based on Poisson distributions and their 95% confidence intervals (CI) were assessed. Death and default rates and other performance indicator values were compared with the SPHERE project reference standards as described in the 2017 inpatient SAM management protocol.¹⁰ The SPHERE standards for performance indicator were the minimum standards for food security, nutrition and food aid that follow the principles and rights of humanitarian charter.¹⁷ Data were censored on August 30, 2025. Cox proportional hazard models were performed to evaluate the treatment effect on death and default from ITFC. Competing risks for cause-specific hazard models were censored accordingly. The Odd ratios (OR) were generated through univariate regression models. Multivariate regression models were used to generate adjusted hazard ratios (AHR) with mortality and default, respectively. The following variables were included in the adjusted models: age, gender, type of SAM, admission criteria, source and time of admission, intravenous fluid use during admission, and medical complications at admission such as shock, hypothermia, hypoglycaemia, pneumonia, diarrhoea, and severe anaemia. A two-sided p-value of ≤ 0.05 was regarded as statistically significant. Statistical Package for Social Sciences (SPSS 24™ for Windows; IBM Inc., USA) was used for all data analyses.

Results

Baseline Characteristics of Study Participants

Of 5211 SAM children admitted from 2017 to 2022 in ITFC, Maiduguri, 55 participants had secondary causes of malnutrition at admission and medical records of 84 were incomplete. After exclusion of these subjects a total of 5072 study participants were included in the final cohort study analyses with a retrieval rate of 97.3%. The mean (SD) age of the recruited subjects was 1.27 (0.84) years with majority n (76.8%) being less than the age of two years with



slight male preponderance n (50.8%). Most of children (39.5%), outpatient therapeutic programme n (36.2%) were either referred from other stabilisation centres n or were readmitted to the program n (14.3%) (Table 1).

Table 1. Baseline characteristics of study participants (N = 5072)

Characteristic	Frequency (n)	Percentage (%)
Age < 1 year	2106	41.6
Age 1-2 years	1720	33.9
Age 2-3 years	851	16.8
Age 3-4 years	203	4.0
Age 4-5 years	197	3.7
<2 years (combined)	3896	76.8
Male	2578	50.8
Referral from SCs	2005	39.5
Referral from OTP	1837	36.2
Readmission	726	14.3

OTP: Outpatient Therapeutic Feeding Programme, SCs: Stabilization Centres

Medical condition/complications

Non-oedematous acute malnutrition (severe wasting) was the topmost cause of admission n (85.6%), followed by oedematous acute malnutrition.

Concerning medical complications, almost all, n (98.9%) of the admitted children had at least one medical condition; with pneumonia, acute diarrhoea and sepsis contributing about a quarter each (Table 2)

Table 2. Medical conditions and complications among admitted SAM children

Condition	Frequency (n)	Percentage (%)
Severe wasting (non-oedematous SAM)	4342	85.6
Oedematous SAM	730	14.4
≥1 complication	5016	98.9
Pneumonia	1268	≈25
Acute diarrhoea	1268	≈25
Sepsis	1268	≈25

Mortality

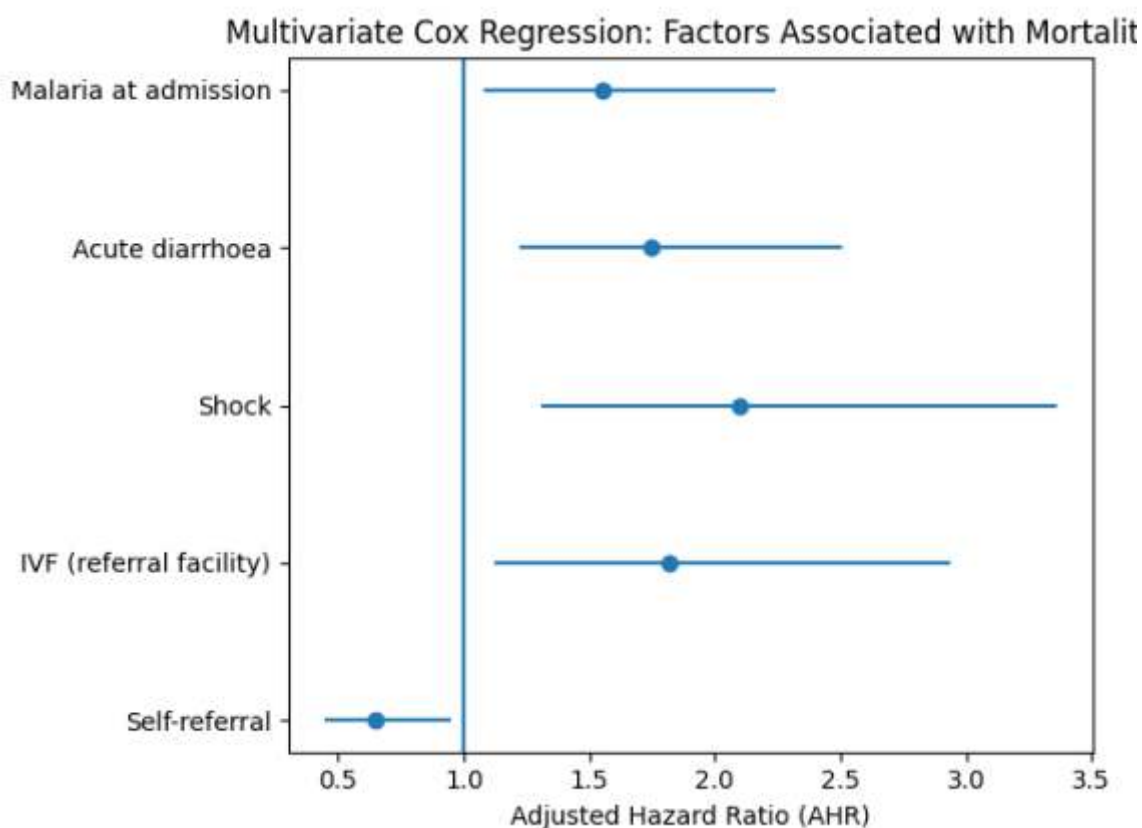
Among 5072 SAM children admitted between 2017 and 2022, 385 of them died, giving an average mortality rate of 7.6% (95% CI 5.8-9.1). The mortality rate was 15.8% in the first 24 hours of admission (95% CI 7.1-26.3), and it decreased thereafter (Figure 1). The odds of not dying increased with the age of the child up to 35 months and decreased afterward (AOR 1.75, CI 1.00-3.05, p = 0.049). Univariate Cox regression analyses indicated that several factors were

significantly associated with mortality, including referral from other stabilization centres, use of intravenous fluid, shock, dehydration, acute diarrhoea, sepsis, severe anaemia and malaria. In the multivariate model, self-referral was associated with reduced risks of mortality (Figure 1). Furthermore, receiving intravenous fluid (IVF) from the referral facility, diagnosis of shock, acute diarrhoea, malaria at admission were associated with increased risks of mortality.



Figure I: Multivariate Cox Regression

Forest plot showing adjusted hazard ratios (AHR) and 95% confidence intervals for factors associated with mortality.



Default

Among 5072 SAM children admitted between 2017 and 2022, 81 defaulters were reported, and the average default rate was 1.6% (95% CI 0.9-2.4). The default rate was 1.1% in the first one week of admission (95% CI 0.03-1.67) and increased after then (Table 3). We identified the following factors that were significantly associated with default using the univariate Cox regression model: age, gender type SAM and MUAC

at admission and referral from other SCs. In the multivariate model, non-oedematous SAM cases at admission were associated with a reduced risk of default rate (AHR 0.62; CI 0.41-0.95, p=0.030). On the other hand, children with MUAC \geq 12 cm at the time of admission were 20 times less likely to default compared to those with MUAC, <11.5cm (AHR 0.05, CI 0.01-0.33, p=0.002)

Table 3: Factors associated with default in multivariate Cox regression

Factor	AHR	95% CI	p-value	
Non-oedematous SAM	0.62	0.41-0.95	0.030	Reduced risk
MUAC \geq 12 cm	0.05	0.01-0.33	0.002	Reduced risk



Discussion

The study reported a mortality rate of 7.6 % in ITFC at UMTH among admitted SAM children with medical complications. This high death rate could be a result of delay at presentation to the centre, the referral of severe cases from other stabilization centres, occurrence of infections, and presence of comorbidities. The presence of shock, use of IVF before admission, malaria, acute diarrhoea and dehydration were identified as significant predictors of death. This result was comparable to reports from other Africa regions (7.6 – 8%)¹⁸⁻²⁰ for admitted SAM children aged less than 59 months. The finding was higher than the cohort study by Asres *et al.* (n =401) that revealed 4.2% death rate.²¹ Our result was much lower than previous studies which have shown that mortality among hospitalized children with SAM is as high as 10% to 40% in Nigeria and other countries in sub-Saharan Africa.²²⁻²⁵

Moreover, mortality reached the peak of 15.8 within the first 24 hours of admission, dramatically reduced from the 48 hours of admissions, and reached nearly 0 at the second week of admission. The trends were consistent with previous studies that reported generally higher mortalities in the first 24 to 36 hours of admissions and decreased over time.²² It could be explained that shock and other complications related to severity of SAM and late referral were the possible major causes of death within the first 24 hours of admission.

In this study children admitted spontaneously had significantly reduced mortality, as these children were treated using of strict protocol which contributed to the lowest mortality rate among the study cohort. This is similar what was reported by WHO-ELENA, 2023 in studies on use of antibiotics in outpatient management of SAM and treatment of persistent diarrhoea in SAM cases. On the other hand, the use of IVF before admission and late referrals resulted in increased mortality in this study. It also reflects what other studies²⁻⁶ have shown. And at the time of admission, many children had other medical conditions/complications, such as acute diarrhoea, dehydration, shock, malaria and severe anaemia which also increased the mortality in these group of children as reported in earlier studies among children with SAM and medical complications in Katsina state,¹¹ and among Ethiopian children with SAM,^{18,23,24}

The overall default rate was 1.6% in this study. This (1.6%) was considerably below the national and international minimum standards of cut-off point (< 15%).^{10,14} Studies conducted in other African settings,^{18,19,22} had found default rates ranging between 5.3 to 12.9%, this is slightly higher but within the acceptable SPHERE standard.^{1,26} By contrast, this finding was much lower than findings from other centres in Nigeria^{23,25} (children either absconded or discharge against medical advice). Similar higher attrition rates were reported from Ethiopia (35.6% & 43.6%)^{21,27} and India (47.2%).²⁸ The observed variation might be due to study period and provision of quality of care, or efficient use of resources including manpower. In our centre, we are operating an integrated service which provides retention support such free medical care, food, psychosocial support to the caregivers. High attrition rates can result in suboptimal treatment outcomes, increased mortality, increased cost of care, and severe infections.

One strength of the study was the utilization of a database that included approximately all SAM children from all part of the region. The study provided a profile of this group of children and assessed factors associated with mortality and default. The study also confirmed the effectiveness of inpatient care for SAM. Therefore, the findings have important real-world implications to reduce mortality and default in admitted SAM children. The study has limitations. First, the study included SAM children who were in ITFC between 2017 and 2021 in Maiduguri, some groups were not covered such as SAM children who were in outpatient care. However, significant proportion of the children admitted were from OTP. Second, this number of events especially the defaults were relatively small (32 defaulters), which possibly could cause the overfitting of the Cox model to predict risk factors. Third, the retrospective study was limited by the existing information in the database. Some information that might be helpful to explain the study results was lacking, such as children's details on referral intervention/treatment or families' attitudes or sociodemographic characteristics.

Conclusions

Integrated and comprehensive care have significantly reduced mortality and default among children admitted with SAM. Although first-24 hours shock



and late referral were associated with increased mortality. Children with perceived improved nutrition status were more likely to default. The findings have implications to design interventions and programs that support linkage to care, early recognition of danger sign, and retention in care.

Data Availability Statement

The data analysed in this study is subject to the following licenses/restrictions. Data was extracted from the ITFC database. The original database was not available to the public due to institutional regulations. Requests to access these datasets should be directed to: dr.lb.umth@gmail.com

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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