Predictors of In-Patient Mortality of Severe Acute Malnutrition of Hospitalised Children in a Tertiary Facility in Southern Nigeria

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Abstract

Introduction

Severe acute malnutrition (SAM) remains a public health concern in developing countries. Children with SAM are nine times more likely to die compared with those that are well-nourished. Most studies on SAM in Nigeria focus on disease burden without evaluating risk factors that may be useful as interventions in reducing mortality. This study evaluated predictors of mortality and outcome among hospitalised children with SAM in Southern Nigeria.

Methods

Children with SAM admitted into the paediatric medical ward of the University of Calabar Teaching Hospital between September 2017 and November 2019 were studied prospectively. A multivariable logistic regression was used to identify factors that independently predicted mortality with a p-value <0.05 considered significant.

Results

One hundred children were studied. The mean age was 14.28 ± 14.04 months, of which 89% were less than two years of age. Oedematous and non-oedematous SAM were found in 18.5% and 81.5%, respectively. Co-morbidities included tuberculosis (TB) (13.0%), HIV (12.0%), and HIV/TB co-infection (3.0%). Clinical presentation included fever (21.7%), anaemia (19.9%), diarrhoea (19.1%), skin changes (8.7%), and shock (1.8%). The mean duration of hospital stay was 11.48 ± 6.87 days. Nine of the children were discharged against medical advice and were excluded from further analysis. About 92.3% were discharged for follow-up and 7.7% died. After multivariable regression, the predictors of mortality were shock (p=0.037, adjusted odds ratio (aOR): 17.51, 95% confidence interval (95% CI): 1.19-258.77) and skin changes (p=0.035, aOR: 9.81, 95% CI: 1.18-81.46).

Conclusion

The presence of shock and skin changes are independently associated with mortality in hospitalised children with SAM. Prompt referral of children with SAM and more so with complications of shock and skin changes is hereby advocated to reduce mortality.
accounted for 11% of the mortality [4].

The Nigerian Demographic and Health Survey (NDHS) of 2018 showed that 37% of children under five years of age are stunted and 7% are wasted [5]. Most studies on SAM in Nigeria focussed on disease burden without evaluating risk factors, which may be useful in reducing mortality in hospitalised children with SAM. This study assessed the predictors of mortality and duration of hospital stay of children with SAM admitted into the paediatric medical ward of a tertiary hospital in Southern Nigeria.

**Materials And Methods**

**Study setting**

The study was conducted in the Department of Paediatrics at the University of Calabar Teaching Hospital (UCTH), Calabar, Cross River State, South-South Nigeria. Cross River State has a population of 3.86 million people [6]. Calabar is the capital city of the state, with its inhabitants mainly Efiks, Ibibios, Igahams, and other ethnic groups. Occupation of the dwellers commonly includes civil service, farming, fishing, trading, artisans, and other works of life. This is the only tertiary hospital in the state and serves as a referral centre for general hospitals and private hospitals across the state and beyond. Patients were admitted into the paediatric nutrition unit, which is in the paediatric medical ward, and were managed by medical personnel trained in paediatric nutrition. The WHO protocol for the management of SAM in children was used for treatment.

**Study design**

This was a two-year prospective cohort quantitative study of children admitted with severe acute malnutrition.

**Study participants**

Children admitted for SAM between September 2017 and November 2019 whose parents or caregivers gave informed consent were recruited into the study. A total of 100 children who presented with severe acute malnutrition during the study period were enrolled in the study. Children with SAM who are also diagnosed with other medical conditions such as sickle cell disease, malignancies, congenital malformations, chronic liver disease, chronic kidney disease, and neurological impairments were excluded from the study.

**Data collection**

Information on socioeconomic and demographic factors of patient and family, feeding practice-related variables including breastfeeding history, time of introduction of solid, semi-solid, or soft foods, types of foods given, clinical symptoms patient presented with were obtained from caregivers using a semi-structured questionnaire. Patients’ hospital notes were also reviewed, and relevant data were extracted on medical complications, co-morbidities, duration of hospital stay, type of malnutrition, and treatment outcome. The WHO criteria for the management of SAM were used in this study as criteria for admission, diagnosis, and discharge. The outcome measured was mortality during admission. Family socioeconomic status determination was based on Ogunsanya’s classification [7].

**Diagnostic criteria for severe acute malnutrition**

The WHO diagnostic criteria for SAM weight for length/height (WFH) less than −3 z-score, mid-upper arm circumference (MUAC) less than 11.5 cm and/or the presence of oedema were used [8]. Children without oedema were classified as having non-oedematous SAM and those with oedema as having oedematous SAM [8]. Weight was measured using an infant Waymaster weighing scale and stadiometer (health scale) depending on the child’s age.

**Admission criteria for severe acute malnutrition**

Admission criteria for children with SAM were based on the WHO criteria. Children with weight for length/height < −3 z-score, mid-upper arm circumference (MUAC) < 11.5 cm, presence of bilateral oedema, presence of medical complications, and children who failed the appetite test, that is, failed to eat a pre-specified amount of food relative to their weight [9]. Children with SAM aged less than six months were also admitted.

**Discharge criteria**

This was based on the WHO criteria for discharge of children with SAM [8].

**Ethical consideration**

Ethical clearance for the conduct of this study was obtained from the University of Calabar Teaching Hospital, Health Research Ethics Committee (UCTH/HREC/35/714). Informed consent was obtained from mothers of participating children verbally after addressing each mother about the study.
Statistical analysis

Data were analysed using Statistical Package for Social Sciences (SPSS) for Windows, Software Version 22.1 (SPSS Inc., Chicago, IL, USA). Variables that follow a normal distribution were described with means and standard deviations. The Chi-square and Fisher’s exact tests were used to test for differences in proportion or mean between groups. Multivariable logistic regression was used to identify factors that independently predicted mortality and odds ratios (OR) with a 95% confidence interval (CI) were reported. A p-value <0.05 was considered significant.

Results

Sociodemographic characteristics

A total of 100 children were admitted for SAM during the study period. The mean age was 14.28 ± 14.04 months with a median of 11.0 months and interquartile range of 6-17 months. Most of the children (65.0%) were infants aged 1.5 to 12 months of age, followed by children aged 13-24 months (24.0%). There were more females (54.0%) than males (46.0%). None of the children came from a high social class family background but from the low (88.0%) and middle (12.0%) social class. Mean maternal and paternal ages were 28.09 ± 6.39 and 35.60 ± 8.6 years, respectively. This is shown in Table 1.

| Variables                  | Mean ± SD | Frequency | Percentage (%) |
|----------------------------|-----------|-----------|----------------|
| Age group (months)         |           |           |                |
| 1–12                       | 14.28 ± 14.04 | 65        | 65.0           |
| 13–24                      | 24        |           | 24.0           |
| 25–36                      | 4         |           | 4.0            |
| 37–48                      | 2         |           | 2.0            |
| 49–60                      | 5         |           | 5.0            |
| Sex                        |           |           |                |
| Male                       | 46        |           | 46.0           |
| Female                     | 54        |           | 54.0           |
| Social class               |           |           |                |
| High                       | 0         |           | 0.0            |
| Middle                     | 12        |           | 12.0           |
| Low                        | 88        |           | 88.0           |
| Parent’s marital status    |           |           |                |
| Married living together    | 69        |           | 69.0           |
| Married not living together| 2         |           | 2.0            |
| Co-habiting                | 14        |           | 14.0           |
| Single parenting           | 15        |           | 15.0           |
| Number of siblings         |           |           |                |
| 0–3                        | 62        |           | 62.0           |
| >3                         | 38        |           | 38.0           |

TABLE 1: Sociodemographic characteristics of children with SAM (n = 100).
SAM: severe acute malnutrition.

Antenatal and nutritional history of children admitted for SAM

As shown in Table 2, 76 (76.0%) mothers attended antenatal care (ANC) and 36.3% delivered in non-tertiary
hospitals, 24.2% had home delivery, 19.8% delivered in tertiary hospitals, 17.6% were at the traditional birth attendant (TBA) home, and 2.2% took place in the church. Exclusive breastfeeding (EBF) for six months was noted in 15.1% of infants. About 40.9% breastfed for less than six months, 26.9% practiced mixed feeding, and 17.2% did not breastfeed. Most children (61.0%) were fed with homemade complementary food. The consistency of the feeds was reported to be watery by 55.0% of the caregivers. A majority of the caregivers (72.7%) did not add a protein source to the complementary food.

| Variables                      | Frequency | Percentage (%) |
|-------------------------------|-----------|----------------|
| Antenatal care                |           |                |
| Yes                           | 76        | 76.0           |
| No                            | 24        | 24.0           |
| Place of delivery             |           |                |
| Tertiary hospitals            | 18        | 18.0           |
| Other hospitals               | 33        | 33.0           |
| Traditional birth attendant   | 16        | 16.0           |
| Home delivery                 | 22        | 22.0           |
| Church delivery               | 2         | 2.0            |
| Missing                       | 9         | 9.0            |
| Breastfeeding history         |           |                |
| Exclusively breastfed for six months | 14  | 14.0          |
| Breastfed for less than six months | 38   | 38.0          |
| Not breastfed at all          | 18        | 18.0           |
| Mixed feeding                 | 25        | 25.0           |
| Type of complementary food    |           |                |
| Commercial                    | 9         | 9.0            |
| Homemade                      | 61        | 61.0           |
| Mixed                         | 30        | 30.0           |
| Consistency of feed           |           |                |
| Watery                        | 55        | 55.0           |
| Thick                         | 44        | 44.0           |
| Who feeds the child?          |           |                |
| Mother                        | 69        | 69.0           |
| Family members                | 5         | 5.0            |
| Nanny                         | 1         | 1.0            |
| Mixed                         | 3         | 3.0            |

**TABLE 2: Antenatal and nutritional characteristics of children with SAM (n = 100).**

SAM: severe acute malnutrition.

Type of SAM and clinical characteristics of admitted children

Oedematous SAM occurred in 18.5% of the children, and 81.5% had non-oedematous SAM. Co-morbidity included tuberculosis (13.0%), HIV/HIV exposed status (12.0%), and HIV/TB co-infection (5.0%), respectively. Clinical presentation among the admitted children was fever (21.7%), anaemia (19.9%),...
diarrhoea (19.1%), skin changes (8.7%), oedema (6.1%), and shock (1.8%), as shown in Figure 1.

**FIGURE 1**: Clinical presentation of children admitted for SAM.

SAM: severe acute malnutrition.

**Outcome of management of children admitted for SAM**

The mean duration of hospital stay on admission was 11.48 ± 6.87 days, with a range of 1 to 35 days. Nine of the children were discharged against medical advice (DAMA). Out of the 91 children left, 92.3% survived and were discharged for follow-up in the outpatient clinic, and 7.7% died.

**Predictors of mortality among children admitted for SAM**

Table 3 and Table 4 show significant associations were found between the presence of HIV infection (p=0.036), presence of skin changes (p=0.044), anaemia (p=0.020), and shock (p=0.048) and mortality among children admitted for SAM. However, age group, sex, social class of caregivers, breastfeeding history, type of SAM, presence of tuberculosis, fever, diarrhoea, and vomiting were not significantly associated with mortality.
| Sociodemographic factors | Management outcome | Chi-square value ($X^2$) | p-value |
|--------------------------|--------------------|--------------------------|---------|
|                          | Survived (%)       | Died (%)                 |         |
| Age group (months)       |                    |                          |         |
| 1-23                     | 74 (93.7)          | 5 (6.3)                  | 1.57    | 0.220** |
| ≥24                      | 10 (83.3)          | 2 (16.7)                 |         |         |
| Sex                      |                    |                          |         |
| Male                     | 37 (88.1)          | 5 (11.9)                 | 1.06    | 0.243** |
| Female                   | 47 (95.9)          | 2 (4.1)                  |         |         |
| Social class             |                    |                          |         |
| Middle                   | 11 (100.0)         | 0 (0.0)                  | 1.04    | 0.562** |
| Low                      | 73 (91.2)          | 7 (8.8)                  |         |         |
| HIV infection            |                    |                          |         |
| Yes                      | 76 (95.0)          | 5 (5.0)                  | 6.76    | 0.036*  |
| No                       | 8 (72.7)           | 3 (27.3)                 |         |         |
| Tuberculosis             |                    |                          |         |
| Yes                      | 72 (91.1)          | 7 (8.9)                  | 1.15    | 0.568** |
| No                       | 12 (100.0)         | 0 (0.0)                  |         |         |
| TB/HIV co-infection      |                    |                          |         |
| Yes                      | 83 (93.3)          | 6 (7.7)                  | 5.16    | 0.149** |
| No                       | 1 (50.0)           | 1 (50.0)                 |         |         |
| Fever                    |                    |                          |         |
| Yes                      | 48 (88.9)          | 6 (11.1)                 | 1.00    | 0.241** |
| No                       | 33 (97.1)          | 1 (2.9)                  |         |         |
| Diarrhoea                |                    |                          |         |
| Yes                      | 42 (89.4)          | 5 (10.6)                 | 0.03    | 0.445** |
| No                       | 38 (95.0)          | 2 (5.0)                  |         |         |
| Vomiting                 |                    |                          |         |
| Yes                      | 29 (85.3)          | 5 (14.7)                 | 3.35    | 0.100** |
| No                       | 51 (96.2)          | 2 (3.8)                  |         |         |

**TABLE 3:** Relationship between sociodemographic, nutritional, and clinical factors management outcome among children admitted for SAM.

SAM: severe acute malnutrition, TB: tuberculosis. *Significant p-value and **Fisher's exact test.
### TABLE 4: Relationship between sociodemographic, nutritional, and clinical factors management outcome among children admitted for SAM.

SAM: severe acute malnutrition. *Significant p-value and **Fisher’s exact test.

As shown in Table 5, only two of the independent variables (presence of skin changes and shock) made unique contributions to the model out of the five independent variables. It was shown that the odds of dying following management for SAM among children who presented with skin changes were 9.8 times the odds of dying among children who did not present with skin changes, while the odds of dying among those that presented with shock were 17.5 times the odds of those that did not.
### Table 5: Multivariable analysis of predictors of management outcome of SAM.

| Predictors                      | Number | P-value | aOR  | 95% CI      |
|---------------------------------|--------|---------|------|-------------|
| HIV infection                   |        |         |      |             |
| Infection                       | 11     | 1       |      |             |
| No infection                    | 77     | 0.053   | 0.11 | 0.01–1.02   |
| TB/HIV co-infection             |        |         |      |             |
| Co-infection                    | 2      | 1       |      |             |
| No co-infection                 | 86     | 0.121   | 0.06 | 0.00–2.12   |
| Presence of skin infection      |        |         |      |             |
| No                              | 68     | 1       |      |             |
| Yes                             | 20     | 0.020*  | 9.81 | 1.18–81.46  |
| Presence of anaemia             |        |         |      |             |
| No                              | 51     | 1       |      |             |
| Yes                             | 37     | 0.040   |      |             |
| Presence of shock               |        |         |      |             |
| No                              | 83     | 1       |      |             |
| Yes                             | 5      | 0.027*  | 17.51| 1.19–208.77|

aOR: adjusted odds ratio, SAM: severe acute malnutrition, and TB: tuberculosis.

### Discussion

The number of children hospitalised with severe acute malnutrition continues to rise in Sub-Saharan Africa. Over the study period, 8.4% of the total children admitted had SAM. In this study, there was no significant difference in the gender of the children with SAM. This is in keeping with the study by Ubesie et al. [3] in Enugu and Cartmell et al. [9] in Maputo. A total of 79% of the study population were less than two years of age. Studies have shown that undernutrition is more common within this age bracket [3,10]. This emphasises the importance of the first 1000 days of life where exposure to poor nutrition increases the odds of stunting, morbidity, and mortality [11].

Children from the low socio-economic class accounted for 88% of the study population. This conforms to SAM’s being a nutritional disorder of poverty and ignorance as underlining causes of SAM [12]. Alongside poverty is the illiteracy of mothers. Low socioeconomic status has been shown as both a basic cause of SAM at the national or regional level and an immediate cause at individual levels according to the conceptual framework of the determinants of undernutrition by the United Nations Children’s Fund (UNICEF) [12]. This adversely affects the ability of families to purchase adequate, nutritious foods. Nahar et al. found that children severely underweight are more likely to have undernourished, poorly educated young mothers and poorly educated, unskilled fathers [13].

Exclusive breastfeeding and the introduction of solids, semi-solid, or soft foods at the appropriate time are part of the population-based indicators for assessing infant and young child feeding (IYCF) practices established by WHO [12]. IYCF contributes significantly to reducing childhood undernutrition when practiced effectively [12]. In this study, 16% of mothers never breastfed, making use of breastmilk substitute (BMS), which could lead to diarrhoea and undernutrition, especially when inappropriately prepared. Exclusive breastfeeding (EBF) is seen as the single largest preventive intervention outcome against childhood mortality, with a 15% reduction in under-five mortality compared to other interventions [14]. Optimal breastfeeding alongside complementary feeding could prevent malnutrition and save about a million children’s lives [15]. Breastfeeding has been shown to reduce mortality in infants from diseases such as diarrhoea and provides immunoglobulins that aid in faster recovery during illness [15]. In this study, diarrhoea accounted for 19.1% of the children who presented with medical complications. Diarrhoea in the setting of inadequate nutritional intake could lead to SAM, and SAM could give rise to diarrhoea following an increased risk of infection or due to carbohydrate intolerance [8]. In addition, Meremiku et al. showed that failure to breastfeed was associated with 36.4% of underweight and 1.2% of persistent diarrhoea in a
Evidence-based guidelines for the treatment of shock in children with SAM are urgently needed. Skin changes have been demonstrated to be independently associated with mortality in children with SAM.[28] The presence of shock and skin changes, which have been shown to have a significantly poor outcome,[29] were more likely to die compared to those without these medical complications. Wagnew et al.[27] in Ethiopia showed that children with shock had 17.5 times higher odds of death compared to those without shock. The mean duration of stay on admission was shorter than in other studies.[3,25,20]. The low rate may be attributed to starting our patients on 50 kcal/kg/day of feeds in place of the recommended F75 by WHO, thereby reducing the risk of refeeding syndrome.

On univariate analysis, the presence of HIV infection, anaemia, skin changes, and shock were significantly associated with mortality in children with SAM. Following multivariable regression, children with skin changes and shock had a significant independent association with mortality. Those with shock had 17.5 times higher odds of death compared to those without shock. Wagnew et al.[27] in Ethiopia showed that children with shock were more likely to die compared to those without these medical complications. This finding was also upheld by Gebremichael et al.[28] and Guesh et al.[29]. Skin changes such as hypopigmentation, hyperpigmentation lesions, bullae formation, and desquamations were noted amongst the study population. In SAM, skin involvement varies, involving severe forms such as lichenoid skin changes such as hypopigmentation, hyperpigmentation lesions, bullae formation, and desquamations which have been shown to have a significantly poor outcome.[50] The strength of this study included the prospective design where data were collected at admission without bias to the outcome. One limitation of our study was that, as a tertiary hospital-based study, the findings may not completely reflect the situation at the lower tiers of the health system or in the communities.

Conclusions
The overall mortality rate was 7.7%, with a mean duration of hospital stay of 11.48 days. The mortality rate was lower than the WHO estimated case fatality rate for in-patients with SAM. The presence of shock and skin changes has been demonstrated to be independently associated with mortality in children with SAM. Evidence-based guidelines for the treatment of shock in children with SAM are urgently needed.

Additional Information

Disclosures

Human subjects: Consent was obtained or waived by all participants in this study. University of Calabar Teaching Hospital, Health Research Ethics Committee issued approval UCTH/HREC/35/714. Animal subjects: All authors have confirmed that this study did not involve animal subjects or tissue. Conflicts of interest: In compliance with the ICMJE uniform disclosure form, all authors declare the following:

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organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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