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Original article

Mortality in children with severe acute malnutrition

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SUMMARY

Background: Malnutrition is a major contributor to the global disease burden, accounting for more than one-third of child deaths worldwide. Severe Acute Malnutrition is a disease that is an underlying condition in many under five admissions in the study area of Hiwot Fana Specialized University Hospital, Harare and in Ethiopia as a whole.

Objective: The main objective of the study is to identify the prevalent cause of mortality in Severe Acute Malnutrition, among children aged 6–59 months, admitted to Hiwot Fana Specialized University Hospital, Pediatric ward, Nutrition Rehabilitation Unit from 2013 to 2015. Which will be key to help improve the management protocol so as to see better outcomes in the patients in the study area, or at the very least to be a stepping stone to and point out the need for further analytical studies on the topic.

Methodology: The study was a retrospective, descriptive cross-sectional study which was conducted to identify the prevalent causes of mortality in patients aged 6–59 months admitted to Hiwot Fana Specialized University Hospital, Nutrition Rehabilitation Unit over the period of 2013–2015.

Results: The study reveals that the case recovery rate of the study area is 36% with the rate of patients who have disappeared or had left against physician's advice being a whapping 61.9%. The mortality rate weez was found to be 2.1% with the mortality sex ratio of Male: Female 1.6:1. The commonest complication that appears to related with mortality in Severe Acute Malnutrition was diarrheal disease (Acute Gastroenteritis) being present in 14 of the 15 deaths in the study period.

Conclusion: The study concludes that the Case Fatality Rate of the study area, even though very low, the high rate of disappearance and yet a comparatively low rate of recovery brings to question the general quality of care in the facility. More to this the commonest complication associated with mortality being a preventable and manageable one i.e. AGE calls for Vigilance in the management of such patients.

1. Introduction

1.1. Background

Malnutrition is a major contributor to the global disease burden, accounting for more than one-third of child deaths worldwide. Acute malnutrition arises as a consequence of a sudden/sharp period of food shortage and is associated with loss of body fat and wasting of skeletal muscle. Malnutrition can be classified as mild, moderate or severe based on anthropometry measurements, biochemistry and clinical assessment. Severe acute malnutrition (SAM) is defined by a very low weight for height (WHZs) below −3 z scores of the median WHO growth standards or weight for height <70%, by visible severe wasting, or by the presence of nutritional edema. In children aged 6–59 months, an arm circumference less than 115 mm is also indicative of severe acute malnutrition.

SAM inpatient management guidelines have been published by the World Health Organization (WHO) in 2000 recommend that children who are severely malnourished and have medical complications, such as severe edema, should be treated in an appropriate health facility. Treating children according to the WHO Protocol was thought result in a 48% reduction in deaths. However, despite global improvements, malnutrition still underlies half of the inpatient morbidity and mortality rates among children in rural Africa.

Abbreviations: SAM, Sever acute malnutrition; WFH, Wight for Height; WFA, Wight for Age; HFA, Height for Age; CFR, Case fatality rate; CR, Cure rate; WHO, World Health Organization; NRU, Nutritional Rehabilitation Unit.

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Protocol for management of severe malnutrition was endorsed by Federal Democratic Republic of Ethiopia Ministry of Health in 2013 and was last updated in 2016. One of the reasons for update of the guideline was high mortality rate of more than 20% from complicated severe acute malnutrition in many health facilities with the goal of reducing mortality from SAM to less than 5%.

1.2. Statement of the problem

Malnutrition is a preventable cause of mortality and morbidity among children. It is thought that about two third of all child death are the result of malnutrition. In developing countries, some 19 million children <5 years old are severely wasted which is defining feature of SAM. Estimates suggest that nearly 20 million children suffer from severe malnutrition, with 1 million dying annually. Also, it is likely to have been a contributing factor in approximately about half of 10 million deaths. Therefore, malnutrition continues to be a major public health problem throughout the developing world, particularly in southern Asia and sub-Saharan Africa. Despite global improvements, malnutrition still underlies half of the inpatient morbidity and mortality rates among children in rural Africa. Evidence showed treating severely malnourished child children according to the WHO Protocol would result in a 48% reduction in deaths. Experts also estimate inpatient treatment of complicated SAM according to the WHO protocol may result to attain SAM case fatality rate (CFR) of 14% (range: 5–30%) and recovery rate of 71% (25–95%) and even this is far above the 5% WHO cutoff point.

Effective implementation of WHO's guidance is thought to provide the opportunity to reduce mortality and it is estimated that with appropriate treatment, CFR for children with severe malnutrition could be as low as 5% both in community and outpatient treatment of health facilities [10]. However, the case fatality of children with severe malnutrition treated as inpatients have remained largely unchanged at 20%–30% for marasmus and up to 50–60% for kwashiorkor in poor resource setting. This has raised concerns as to the effectiveness of the WHO guidance, whether considering the overall approach, each of its 10 steps, the ease of implementation of the guidance with in different populations, settings and situations.

Ethiopia is among the 20 countries of the worlds which constitute 80% of malnourished children, ranking at number 7. The introduction of the new protocol for management of severe acute malnutrition has saved the lives of many children and adults by achieving high cure rate and reducing death rate in Ethiopia. It improved the treatment outcome of malnourished children compared to the minimum international standard set for management of severe acute malnutrition which is cure rate of at least 75% and death rate less than 5%, average length of stay of less than 30 days and average weight gain of 8 g/kg/day. However, still high mortality rate of more than 20% from severe malnutrition was reported in many health facilities in Ethiopia.

There are no studies undertaken in inpatient facilities in Eastern Ethiopia to evaluate the outcome and what the prevalent cause of mortality of children with admitted with complicated SAM. Therefore, the aim of this study is to determine the case fatality rate and what the major cause of mortality is in children 6–59 months admitted to Hiwot Fana University Hospital with severe malnutrition.

1.3. Significance of study

Even though SAM is a major cause of morbidity and mortality in Harrari regional state, as it is elsewhere in our country and other third world countries; there is an immensely worrying lack of studies on SAM in our setup. The lack of such researches creates a gap in understanding what the outcome of our currently practiced management is and therefor hinders any improvement, change or update of the management from a physician decision making stand point or even policy making point of view. Thus, this study aims to reveal what the prevalent cause of mortality and what the common complications are that are associated to SAM mortality; giving us basis to truly appreciate what the treatment outcome of SAM is in our setup and points to what our management needs to emphasize on to improve our mortality rate.

Hiwot Fana specialized university hospital as a tertiary health care facility needs such in-hospital studies on diseases such as Sam, which have grate contribution in the morbidly to the community it provides service too; so that appropriate and timely adjustments to its management protocols for it would shine light toward what its care provides would know what to be vigilant toward. More to this the research also aims to be a benchmark for further in hospital studies to help the hospital develop its own SAM management protocol tailored to prevent and manage the prevent complications and causes of mortality in its patients.

1.4. Literature review

Evidence from nutritional experts from a WHO report in 2007 showed the lower boundary of the recovery rate in low and middle-income countries of 25% results from a large proportion of admissions defaulting before recovery is reached and that case fatality rates ranged from 3.4% to 35%. According to the studies from Lusaka, Zambia in 2011 and Kenya in 2012 40.5% and 16% of children admitted to hospital with severe malnutrition died respectively [7,8]. A 4.4% in hospital child death was also reported from rural Kenya. Severe wasting (WHZ <−3) was present in 9.2% and kwashiorkor in 9.5%; 15.6% had one or both of these features [4].

A retrospective study from south Ethiopia in 2010 indicate 87% of children admitted TFC with severe malnutrition (47% cases of severe malnutrition had severe wasting and 53% had edematous malnutrition) were cured while 3.6% had died. A Historical cohort study in South-West Ethiopia Jimma University Hospital in 2010 also reported a mortality of as low as 2.6% and recovery rate of 87% [6].

A study from rural Kenya from 2013 showed low MUAC measurement, visible severe wasting, and kwashiorkor are independently associated with inpatient death of severely malnourished children. Of the children with visible severe wasting, 22.5% died, compared with 2.5% without this sign. The positive and negative likelihood ratios for death of WHZ less than or equal to −3 and kwashiorkor were 4.36 and 0.47 respectively; those for MUAC less than or equal to 11.5 cm and/or kwashiorkor were 5.12 and 0.59; and those for visible severe wasting and/or kwashiorkor were 5.31 and 0.46 respectively [2,3]. The study also indicates the mortality rate was significantly higher in children with edema. Another prospective hospital based study from Kenya in 2012 showed sex, age, and admission fever had no effect on survival (adjusted $P > 0.2$) of children with severe malnutrition. However, a study conducted from Lusaka 2011 to evaluate mortality in severely malnourished children with diarrhea showed younger age was risk factors for death on among severely malnourished children [7].

According to a retrospective study from South Ethiopia in 2010 showed with increasing age, the death rate decreased and cure rate increased while severe wasting in admitted children was more common among boys than girls (10.1% vs. 8.2%), respectively, while kwashiorkor was less common among boys (8.4% vs. 10.8%, *P* 0.001. Diarrhea was also a major cause of complication in children with severe acute malnutrition admitted to the inpatient unit. Children

with diarrhea had a significantly reduced survival rate. Those with diarrhea on admission had a two and half times the odds of death, adjusted OR = 2.5 (95% CI 1.50–4.09, P < 0.001) [5]. A study from Kenya in 2011 also revealed children with severe malnutrition [7] complicated by diarrhea had a higher risk of death than those who did not have diarrhea during their hospital stay. Any diarrhea during admission resulted in a significantly higher mortality 19% than those uncomplicated by diarrhea 9% (X2 = 16.6 p=0.001). About 21% of the children admitted with diarrhea died compared to 12% without diarrhea on admission [7].

According a study from Kenya in 2012 poorer nutritional status, increased frequency of hypoglycemia and septicemia on admission (p < 0·0001), Bacteremia (p = 0·001), and greater volume of intravenous fluids infused (p = 0·004) are indicated to be risk factors for death among severely malnourished children admitted to hospital [1]. A study also indicates Severe dehydration was associated with a higher risk of death (crude 0odds ratio 1.7; 95% CI 1.1, 2.6; p = 0.012) [8].

Children who died on standardized-protocol management died mostly within the first 48 h of hospital admission. According to the study from Zambia Lusaka in 2011 of the children who died, 30.6% died within 48 h of admission, and 65.3% died within 1 week of admission. The study from south west Ethiopia in 2010 also showed platelet count less than 150000 cells/mm^3 is associated with increased risk of death from severe malnutrition [6]. The study from south Ethiopia was based on routine record so that the question for the precision of the measurement needs to be verified through prospective design. Furthermore, the study from South west Ethiopia also based history of the child rather than managing the patient. The aim of the study was also to compare the severe malnutrition outcome among HIV positive and negative children so that it might not represent the whole children admitted to hospital with severe malnutrition [6].

Almost all studies found in Africa and in our country on SAM is more on the risk factors, association with HIV and care take care awareness not on the causes of mortality so this study aims to start to fill the gap of this lacking statistics.

2. Objectives

2.1. General objective

- To identify the prevalent cause of mortality among children aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU with SAM, from 2013 to 2015

2.2. Specific objectives

- To determine the case fatality rate of among children with SAM aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015
- To determine the recovery rate of among children with SAM aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015
- To determine the defaulter/disappearance rate among children with SAM aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015
- To identify the prevalent complications among children with SAM aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015
- To determine prevalent immediate cause of death in among children with SAM aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015

3. Research methodology

3.1. Study setting

Hiwot Fana University Teaching Hospital is located in Harar town, a capital city of Harari regional State, Ethiopia. The Hospital has inpatient unit for children with SAM in the pediatric ward. According to the Hospital routine activity record report, close to 280 children with SAM receive treatment in the inpatient unit annually.

3.2. Source population

All children 6–59 months of age admitted to the inpatient unit from 2013 to 2015 E.C. will be eligible for the study. Over the study period there has been 876 children admitted to the NRU.

3.3. Study population

All children 6–59 months of age admitted to the inpatient unit with diagnosis of SAM without any other diagnosis i.e. HIV, DM, Congenital or previously diagnosed heart failure, Congenital anomalies, chromosomal abnormalities will be eligible for the study.

3.4. Study design

A retrospective, descriptive cross-sectional study will be conducted to identify the prevalent cause of mortality in study population over the study period.

3.5. Sampling technique and size

No such sampling will be used and all children who fulfill the inclusion criteria will be included in the study.

3.6. Inclusion and exclusion criteria

From the source population all patients who don't fulfill the exclusion criteria will be included in the study.

3.6.1. Inclusion criteria

- Both sexes
- Age b/n 6–59 months
- Patients with any of the SAM complications
- Patients who have no previously diagnosed comorbidities

3.6.2. Exclusion criteria

- Children aged <6 months and older than 59 months
- Children who have a previously Diagnosed comorbidity i.e.
  - o HIV
  - o DM
  - o Congenital anomalies
  - o Chromosomal abnormalities'

3.7. Variables

3.7.1. Independent variables

- Age
- Sex
- SAM diagnosis criteria
- Definition of complications

3.7.2. Dependent variables

- Case fatality rate
- Recovery rate
- Defaulter rate
- Cause of death

4. Data collection

4.1. Data collection technique

Data will be collected from the nutritional rehabilitation unit log book and from individual patient cards, where admission diagnosis of SAM and any SAM resulted complications will be noted and subsequent management, new complications and finally cause of death will be recorded.

4.2. Data collection materials

Data will be collected using a format prepared from the nutritional rehabilitation unit log book and from individual patient cards.

4.3. Data analysis and quality control

The collected data will be cleaned, coded and analyzed by SPSS version 17 statistical package. For all statistical tests, the cut-off point will be 0.05 and $P < 0.05$ will be used as measure of statistical significance. Results will be expressed in tables and percentage after analysis.

For each patient involved in the study all presenting complications, the most life-threatening complications and immediate cause of death reported on the death summary will be analyzed and cause of mortality will be established.

5. Ethical consideration

Before beginning data collection, Official letter was submitted to medical director of HFSUH and Permission was asked. The purpose of the study will be explained to each worker to precede the data collection from patient registration.

Data collectors will be strictly oriented about patient confidentiality and the patients' name or card number will never be used by any means throughout the research.

6. Definition of terms

SAM: Severe wasting will be defined by an MUAC, 115 mm and/or a weight-for-height z score (WHZ) less than 3 of the median WHZ in WHO Child Growth Standards. All children 6–59 month with bilateral pitting edema, and/or MUAC, 115 mm will be admitted to the NRU.

Hypoglycemia: Blood glucose <3 mmol/L (<54 mg/dl).

Severe Anemia: Hgb < 4 gm/dl or Hct <12%.

Hypothermia: Rectal temp < 35.5dc or axillary < 35dc.

Diarrhea: more than 3 episodes of loose stool.

Pneumonia: age appropriate definition of tachypnea with or without fever.

Sepsis: children fulfilling the criteria for SIRS (even w/o bacteremia in study set up).

7. Results

During the study period of two years, there had been a total of 826 admissions to the pediatric ward at Hiwot Fana specialized university hospital with an assessment of severe acute malnutrition.

Of the afore mentioned admissions 74 where aged above 59 moths and another 41 where under 6 months of age, making these groups not fitting of the inclusion criteria thus excluded from the study. This brings the study population to be 711. The most prevalent age group in the study was the one between 6 months and 12 months accounting for about 45.5% of the study population a more detailed depiction of the soci demographic characteristics of the study population is provided below in Table 1.

The data, that has been collected from the HMIS log book at the NRU ward apart from the socio demographic data shows outcome of the patients following there stay at the wards and shows that only 256 out of the 711 in the study have been said to be recovered up on discharge making the institution's recovery rate 36%.

A staggering statistics creeps up here revealing that the remaining 440 about 61.9% of patients admitted during the study period have either disappeared or had left against physician's advice i.e. defaulted.

Coming to the main result the study was after, the data available showed only 15 deaths in the study period from the total 711 patients included in the study. Giving us an astoundingly low care fatality rate of 2.1%.

From these cases the prevalent age group accounting for the mortality is the age group 36–59 months ,this data can be furthter seen in Table 2 and Fig. 1 below.

The cards of these 15 patients were extracted and information pertaining to the complications mortalities most were one's diagnosed with edematous malnutrition or Kwashiorkor accounting to 9 out of the 15 deaths and the remaining 6 where of the non-edematous type. Most of the mortalities where male (9 out of 15) bringing the SAM mortality sex ratio to M:F 1:1.6.

The diagnosis of SAM was made with grade 3 edema in 8 out of the 15 cases and the remaining 6 was with severe wasting as was evidenced with a weight for height less than 70%. The commonest presenting symptoms were cough and generalized body swelling both accounting for 7 out of 15 cases each, with the remaining one patient presenting with diarrhea and vomiting which even though most of the cases had complaints of diarrhea it seems to be considered not a concerning complaint by the care takers thus not usually motioned as the chef complaint .The prevalent conditions associated with mortality in the study population can be seen below in Fig. 2.

The study has shown that AGE was the commonest complication preset in children with malnutrition that died, being present in 14 out of 15 cases. The second commonest complication said to be

Table 1
Age group and sex distribution among children aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015..

Age group	Male	Female
6–12 months	201	123
12-36 moths	120	40
36–59 months	67	160

Table 2
Mortality age and sex distribution,among children aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015.

Age group	Male	Female
6–12 months	4	1
12–36 months	1	3
36–59 months	3	3

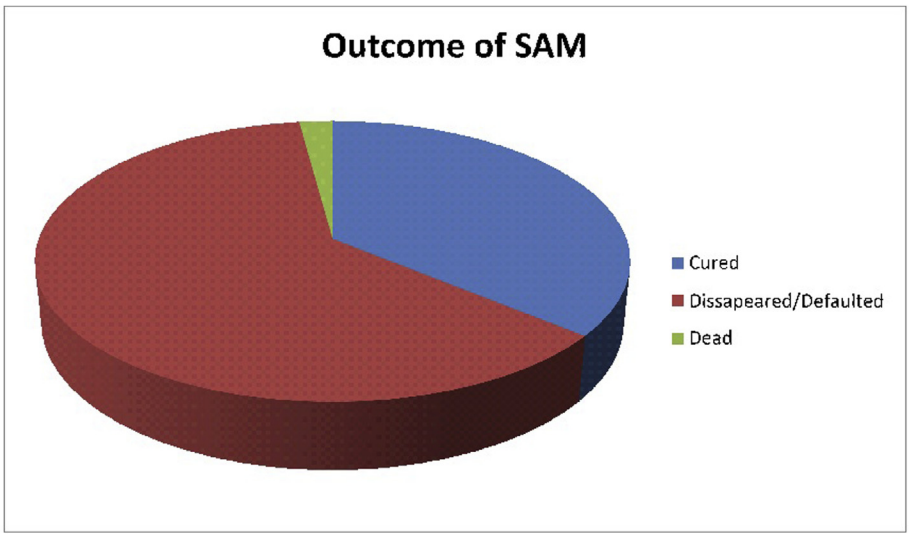

Fig. 1. Pie chart of SAM outcomes among children aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015.

pneumonia present in these patients who have perished being associated with nearly half all the 15 deaths (6 out of 15).

Other complications that where present in descending frequency are Anemia in 4 out 15 deaths, Disseminated TB 3 out 15 cases and vitamin A deficiency in 2 of the 15 deaths.

All of these Patients have been started on nutritional supplementation with F 75 and second line Anti-biotics of IV Ampicillin and gentamycin. 14 out of 15 of them have been started on Resomal fluid replacement.

Even though these patients had varying clinical courses during their stay at the hospital most are said to befall the same immediate cause of death in their last hour which was multi organ failure secondary to septic shock which accounts for 12 out of the 15 deaths. Two others were said to have died secondary to respiratory failure and the remaining one had no cause of death has been stated.

8. Discussion

The results of the study are cross referenced with studies done by the WHO globally and three African studies, two in Kenya and one in Zambia, plus two additional national studies conducted in south Ethiopia and Jimma in 2011 on the outcomes of children with severe acute malnutrition, are discussed here and do reveal mostly expected comparable results and some peculiar disparities.

Starting from the recovery rate, the study populations rate of 36% is substantially lower compared to two national studies done in Jimma and southern Ethiopia which both reported a rate of 87% [6,8]. One would assume this may indicate a high mortality rate in the study area but in actuality the lower recovery rate appears to be more linked to the institutions alarmingly high rate of patients who have defaulted; which is about 61.9%.

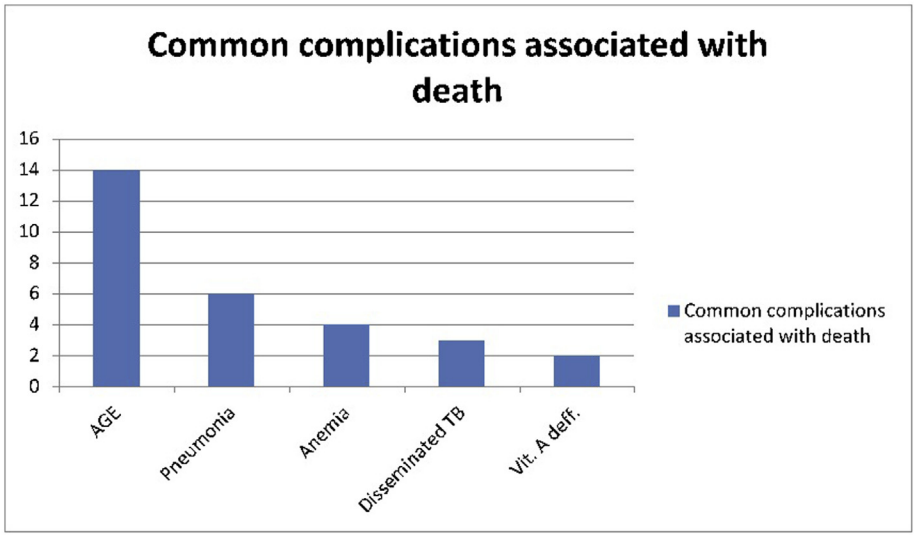

Fig. 2. Common complications associated with SAM mortality among children aged 6–59 months, admitted to HFSUH, Pediatric ward, NRU from 2013 to 2015.

This high number of defaulters is also comparably much higher, 4 times higher than the 15% defaulter rate outlined by the SPHERE Project in 2011 [11].

This peculiar disparity brings to question the facilities quality of care and overall patient satisfaction. One can justifiably postulate the high disappearance rate may steam from a general lack of awareness from the care takers of these children or an overall lack of a health seeking behavior, not appreciating the medical care and nutrition support benefits. One can also hypothesis a communication gaps between the health care providers in the facility and the care givers have fostered this misconception and lack of awareness resulting in the high disappearance rate and low reportable recovery rate.

Moving to the mortality rate of severe acute malnutrition in the study population; the study reveals a CFR of 2.1%. This number is comparatively sustainably lower than almost all the literature that has been reviewed for this discussion. It is closer but lower than the mortality rate reported in the 2011 Jimma study which stands at 2.6% and yet lower compared to the south Ethiopia study of the same year with the mortality rate of 3.6% [6,8].

The mortality rate of the study is more peculiar when compared to the reported rates of other researches done in Africa on SAM outcome, which report rates of 4.4% in a study done in Kenya [4] and 16% from another rural Kenyan study from 2008 [3,9]. It is also lower than the global data provided by the WHO's 2007 report which puts the acceptable SAM mortality rates in low and middle-income countries between 3.4% and 35%.

Such a mortality rate, even though pleasing, compared to a low recovery rate and a high defaulter rate in the same setup raises the questions of appropriate and accurate mortality recording and even more the unknown statues of defaulters in the hours leading up to their disappearance and their outcome after doing so, as possible contributors to such a low in hospital mortality rate.

The mortality sex ratio of the study population which is M: F 1.6: 1 is higher than the Southern Ethiopia research's reported mortality sex ratio of 10.1% boys to 8.2% girls [8].

The study reveals the most common complication related to mortality in severe acute malnutrition patients in the study population is Acute gastroenteritis present in almost all (14 out of 15) cases; which can be said to be comparable but still higher than an odds ratio notes from the south Ethiopian study of 2011 which reported children with diarrheal disease had 2.5 times higher mortality than ones that didn't making it the most highly associated complication linked to SAM mortality [8].

9. Conclusions and recommendation

From the results one can surmise that even though the case fatality rate of 2.1% is said to be low, the case recovery rate of 36% is still unsatisfactory at best. More to this, the institution's rate of patients who disappear and leave without physicians advise and defaulted from treatment (61.9%) is unacceptably high which raises question in the quality of care, health promotion education, patient and health care provider communication and patient satisfaction in general.

Highest mortality was seen in patients with edematous malnutrition (9 out of 15) compared to non-edematous malnutrition (6 out of 15); plus, the age group inflicted with the highest mortality is the age group between 36 and 59 months (6 out of 15), which calls for to attention the need for vigilance in the management of such patients.

The greatest relation that is seen between a complication from severe acute malnutrition and SAM mortality is with Acute gastroenteritis (14 out of 15) and the main cause of immediate cause of death is multi organ failure flowing septic shock (12 out of 15). From which one come to a conclusion that the commonly associated complication leading to SAM mortality is a preventable and manageable one, especially in the institute the study was conducted in.

9.1. Recommendations

Following the results and conclusions one draws from the study important four recommendations can be put forth.

The main and most pertinent recommendation being the need for vigilance and unrelenting follow up in the management of severe acute malnutrition patients with AGE. So as to prevent the subsequent development of dehydration, shock and eventually death. Vigilance in the sense that either staff administration of RESOMAL per fluid loss; since negligence on the care takers side could be the reason these patients develop dehydration, or proper and adequate education in the dangers of fluid loss and the importance of RESOMAL replacement to the care takers.

The second recommendation is pertaining to the alarming number of patients who are reported to either have disappeared or have left against physicians' advice. This could point to a general lack of health seeking behavior in the care takers, a poor quality of care or rather poor communication between the health care providers in the institute and the care takers, resulting in a low patient satisfaction.

For which the study's recommendation is a general improvement in the communication of health care providers and the care givers accomplished in the provision of a communal morning health education sessions given to all care takers that are present in the NRU ward, scheduled every other morning. Not only were information is given but care taker's concerns and questions are heard and addressed.

This could potentially improve disappearance rate and even more can be used as a platform to promote health seeking behavior, communicate other information pertaining to the management of patients with severe acute malnutrition or health in general.

The third recommendation concerns the main challenge faced in the data collection of the study, especially in the data collected in the log books. It was found that about 187 patients included in the study had no outcome recorded on discharge which was then corrected by extracting the patient cards to find out respective outcomes.

This problem points to a lack of accountable recording and chart keeping which could result in difficulty in monthly and annual audits that should be conducted to reveal short comings and appropriate solutions in a timely manner to improve outcome in the patients admitted to the NRU ward. The recommendation is that accountable and responsible personnel be appointed to this crucial task and adequate and frequent oversight and audits by the administration to the adequacy of recordings at the wards.

Final recommendation is about the need for further in hospital studies conducted in the mortality and general outcome of SAM patients. It is highly recommended that a prospective analytical study be performed that aims to establish a dependable quality data that revels and prevalent cause of mortality in children with severe acute malnutrition.

9.2. Limitations

In conducting this study there have been two main limitations have been faced that have been tried to ameliorate the best of one's abilities within the scope of the study.

The first the main limitation is the presence of incomplete data found especially in the NRU log books that showed that 187 patients from the 711 included in the data had no outcome recorded which has been attempted to correct by extracting the cards and referring to the outcomes. But further problems where faced with poor chart keeping and a lack of discharge summaries in a few of the cards.

The second limitation of the study is, since the study is a retrospective, one has to take the admission diagnosis and death reports written by a medical inter to infer complications associated with death and the immediate cause of death. These assessments, especially pertaining to the causes of death, have not been confirmed by a certified physician and if they were there is no record of that being done.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.clnesp.2019.07.001.

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