Treatment Outcome and Associated Factors among Under-Five Children with Severe Acute Malnutrition Admitted to Therapeutic Feeding Unit in Woldia Hospital, North Ethiopia

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Abstract

**Background:** Severe acute malnutrition is a major challenge to achieve the millennium development goals. It is also the least preventable causes of child deaths. Limited information is found on the factors that influence improvement of treatment outcome in the admitted children. So the study tries to identify associated factors that compromise outcome.

**Objectives:** Assessment of treatment outcome and associated factors among under-five children with severe acute malnutrition admitted to therapeutic feeding unit at Woldia general Hospital.

**Method:** A Hospital record based retrospective cohort study supplemented with qualitative inquiry was conducted. The study period was from January 01 to 06, 2014. Records of 324 children with severe acute under-nutrition were taken as the study sample. In-depth interview was conducted with six Health professionals in the ward. Multivariate analyses were done by using logistic regression to identify predictors.

**Result:** Among 324 admitted children, 85% with 95% CI (81%-88.7%), 6% with CI (3.8%-9.2%), 5% and 4% of the cases were cured, died, defaulters and transferred out respectively. Children with edema AOR: 0.12(0.032-0.42), HIV positive children AOR: 0.12(0.032-0.42), Children who gained Plumpy'nut AOR: 3.70( CI: 1.22- 11.23) were significant predictors for cure rate of severe acute malnutrition.

**Conclusion:** Even though recovery and death rates were found above and below the minimum acceptable cut-off points of the sphere standards respectively, better achievement should be expected to reduce mortality rate and increase cure rate. The burden of co morbidities plus lack of training and supportive supervision in the Hospital compromise the rate of recovery. There should be a strong linkage between the Health sector and other stakeholders to minimize the level of child under-nutrition via nutrition education.

**Keywords:** Treatment outcome; Sever acute malnutrition; Woldia hospital; North Ethiopia

**Abbreviation:** AOR: Adjusted Odd Ratio; SAM: Sever Acute Malnutrition; MUAC: Mid-Upper –Arm Circumference; CI: confidence interval; SD: Standard Deviation, TFU: Tarapatuc Feeding Unit

**Introduction**

Childhood under-nutrition encompasses overabundance of nutritional disorders that include stunting, underweight, wasting, severe acute malnutrition (SAM), and micronutrient deficiency disorders. Under-nutrition is often a consequence of low dietary intake of various nutrients and diseases. In this study the term malnutrition refers to under-nutrition and malnourished is synonym of under-nourished [1].

SAM is defined by an extremely low weight for height, by visible severe wasting (marasmus), and/or by the presence of nutritional edema (kwashiorkor). SAM or wasting is predominantly measured by one or more of the following criteria: Weight-for –height (WFH) < -3 Z-scores; Weight-for –height less than 70% of the median; Mid-upper – arm circumference (MUAC) less than 110 mm and Presence of bilateral pitting edema [2-4].

Worldwide nearly 24 million children (younger than 5 years) experience SAM and 19 million severely wasted children are living in developing countries. It is common in sub-Saharan Africa, with approximately 3% of children under –five affected at any one time. It is also associated with several hundred thousand child deaths each year [5,6]. Ethiopia is one of the countries with highest under-five child mortality rate, with malnutrition underlying to 57% of all children deaths [7].

Under-nutrition is a serious and major challenge for achievement of the Millennium Development Goals. Malnutrition interacts with other major causes of mortality and underlies anywhere from 35% to over 50% of all under-5 child deaths; impairs school performance and increase the risk of maternity-related problems [4,8,9].

The effects of under nutrition are not just short term and confined to the affected individual but may have important long term and intergenerational consequences. It has many effects ranged from morbidity to constrain the economic growth and development of a
nation. Effectively tackling malnutrition is therefore a global Health priority with potential for far reaching impact [10].

The potential public Health impact of treating SAM is therefore great, but access to appropriate care is severely limited. It is currently estimated that only 5% of SAM cases have access to treatment [11].

There are some studies conducted in Ethiopia that deal with determining the magnitude of treatment outcomes of severely malnourished cases admitted to different Health facilities [7,12]. Both of the studies are concentrated on making comparison of their findings with other findings and minimum international standard set for management SAM. Unfortunately, adequate information is not available in identifying what factors hinder the appropriate care provision to improve treatment outcomes. To the present, there are no researches done concerning about malnutrition, particularly on treatment outcomes of children with SAM in Woldia general Hospital. This study, therefore, aims at measuring treatment outcomes of under-five children with SAM, and identifying factors associated with treatment outcomes in the Hospital and also aims at exploring some problems faced in the management of SAM by interviewing Health professionals.

Identifying the challenges or factors which hamper provision of appropriate care at Health facility level is a vital step to alleviate child death and to have Healthier generation. Furthermore, it has paramount importance for planners and policy makers to adopt proper design, implementation and monitoring strategies at national level to reduce the huge burden of SAM.

Methodology

Study setting and source population

The study was conducted at Woldia Hospital Woldia (also spelled Woldemasia or Woldiya) is a hillside market town, capital of the Semien Wollo Zone in Northern Ethiopia. It is situated at a distance of 321 km from Addis Ababa the capital city of Ethiopia. Based on the 2007 national census conducted by the Central Statistical Agency of Ethiopia (CSA), the town has a total population of 46,139, of whom 23,000 are men and 23,139 women [CSA, 2007]. The total Health services distribution in the zone are one Hospital, 61 Health centers and 248 Health posts. The Health coverage of the town is 98% in 2005E.C (Daniel G. Yirgaw, 2011). The study was conducted from January 01 to 06, 2014. All children under-five years of age who have been registered at TFU and patients enrolled from September 2011 to December 2013 were included in the study. All cases of SAM were selected from TFC register book in paediatric ward and whose cards were found in the card store diagnosed as having SAM in Woldia Hospital from September 2011 to December 2013 and fulfilled the inclusion criteria.

Inclusion and exclusion criteria

All under-five children with SAM that have been admitted to TFU program from September 2011 to December 2013 were included in the study. Those children with SAM who did not have proper records on anthropometric measurements (weight, height, MUAC), age, gender and discharge outcomes were excluded from the study to make clear comparisons and proper interpretation of the result. Similarly, children with documented secondary under-nutrition due to other pathological disorders and with other causes of oedema were also excluded from the study as this could distort the outcome.

Sample size determination and sampling procedure

For the first specific objective, the sample size was determined using single proportion population formula with the following assumptions: an average cure rate in admitted under-five children with SAM to be 75% (Efrem Teferi, 2010), 5% level of significance, and 5% as margin of error, then it was calculated as follows:

\[ N = \frac{Z^2 \cdot P \cdot (1-P)}{D^2} + z \times z \times P \times (1-P) = 288 \]

By adding 10% for compensation of missing (incomplete) data the final sample size is 317. But the total admitted under-five children with SAM from September 1, 2011 to December 30, 2013 in the Hospital were 324. Since the difference between the calculated sample size and total admitted SAM cases was small, all SAM cases were considered in this study. All cases of SAM were selected from TFC register book and patients cards enrolled from September 2011 to December 2013. First the patient cards were collected from the card store by using card number and were cross checked with TFC register book, the necessary information were recorded by using checklist format. The cases were selected if and only if they were eligible for inclusion criteria. In-depth interview was conducted with six purposively selected Health professionals. First the list of staffs with their duration of service year in the ward was obtained from the head of the ward. Then based on their service year, two medical practitioners, two male BSc in nursing and two female diploma certificates were included in the interview.

Data collection methods

Data were collected by using both quantitative and qualitative method. The data were gathered using checklist for the management of Hospitalized cases of severe acute malnutrition by six individuals certified with diploma in nursing. All the necessary data were recorded from TFC patient monitoring card and register book. Additionally, the data were collected qualitatively by using a guide for in-depth interview to Health professionals of TFC staffs to explore problems related management of SAM in the Hospital like knowledge on admission and discharge criteria, Health professionals to patient ratio, training, availability of feeding material, medications and presence of supervision.

Interview was conducted by one individual with BSc qualification in nursing and by a supervisor qualified with BSc in public Health. The interview was conducted in face to face manner. Repeated ideas were raised with the sixth interviewee and saturation was reached at this conversation. The interview was stopped after interviewing six Health professionals. The investigator was in close contact with them and was involved when it is necessary.

Data quality assurance

The data collection checklists were adopted from pre-established known sources ((UNHCR/WFP 1999); (Federal Ministry of Health 2007); (Habulembe 2010)) to address the study variables. Prior to data collection, training was given for four days for data collectors on how to fill the recording format by taking sample of 12 patient cards from card store, and for interviewer and supervisor on how to interview the staffs and clear descriptions on the interview guidelines was given.

To ensure the completeness and consistency of information during data collection, the principal investigator and supervisor made a thorough check before receiving the filled format from each data collector and in the meantime the patients’ cards were randomly selected and cross checked for completeness and errors on spot. There were also meetings at the end of data collection time for discussion.

For the qualitative part, the interview was held by the one who had previous experiences in qualitative data collection in collaboration with the principal investigator.
Data management and statistical analysis

Data were entered into Epi-Data version 3.02 and exported to SPSS version 20 for analysis. Exploratory data analysis was carried out to check the levels of missing values, presence of influential outliers and normality. The anthropometric index (WHZ-score) was computed by entering data to ENA for SMART.

The proportion of discharge outcomes were reported as ‘recovered,’ ‘died,’ ‘defaulted’ and ‘transfer out’ cases using numbers and percentage. The average length of stay was computed for both recovered wasted and oedematous children. As to the international sphere standard, the length of stay under the TFU and rate of weight gain were computed separately for marasmic and kwashiorkor children recovered from SAM.

For binary logistic regression, treatment outcome was dichotomized into cured and died; and coded as (died=0, cured=1). Even though the final fate of defaulters and transferred out cases were not known, sensitivity analysis was done to see the change in effect of these case on the relationship between the outcome variable with each independent variable. Three analyses were done. The first analysis was done for extreme case scenario; and assumption was defaulters and transferred out cases were either cured or died. The second analysis was conducted for possible case scenario; the assumption was defaulters and transferred out cases were proportionally allocated as cured and died. And the third analysis was done for those cured and died cases only. Eventually, adding or removing of these cases had nearly similar effect on the strength of association and statistical significance. Therefore the final analysis was done by taking cases that are cured and died. Then Defaulters and transferred out cases were considered as non-responses.

The strength of association was expressed in odds ratio (OR). Hosmer-Lemeshow goodness-of-fit and CI for OR were used in the binary and multivariable logistic regression analyses. Eventually, results from binary analysis of p<0.3 were moved to multivariable analysis and done through backward logistic regression method to control the effects of confounding. In this study the outcome of interest was contextualized for recovery rate in the logistic regression model. Any statistical test was considered significant at P< 0.05.

The qualitative data analysis was done by using thematic framework analysis technique. The interview guideline first was prepared in section based on the point to be addressed. The idea obtained from each interviewee was indexed into correspondence sections. Then it was easily done manually because the ideas were put theme by theme and were interpreted. Further refinements of the data were done to make it well structured and organized write up. Responses obtained from in-depth interview participants were synthesized accordingly and repeated ideas were removed.

Ethical consideration

Ethical clearance was secured from Haramaya University, college of Health and medical sciences, institutional Health research ethics review committee. Before conducting the survey, letter from Haramaya University was given to the Hospital manager and followed by information sheet and informed consent was given. Confidentiality of the information and privacy of the center (both the staff and cases from card) were secured.

Results

Characteristics of the study participants

A total of 324 under five children with severe acute under-nutrition were admitted to therapeutic feeding unit from September 2011 to December 2013. Defaulters and transferred cases were excluded in the logistic regression analysis due to their final fate were not known. From all admitted children 36(11.1%) were children younger than six months, 205 (63.3%) were children in 6 to 23 months of age group. The mean (±SD) of the age of the admitted children was 18 (±14) months while the median age was 13 months. There were 154(47.5) males and 170(52.5%) females admitted with SAM. Out of these admitted children, 195(60.2%) of them had history of breastfeeding. Two-third or 216 (66.7%) of the admitted children were from rural part of north Wollo. Majority (80.8%) of children was identified as newly admitted children followed by readmission (12.7%) and the rest were transferred from other Health facilities (6.5%). From those admitted patients, marasmus was the predominant cause of admission followed by Kwashiorkor and mixed one. Despite of the variations in the grade of oedema, all oedematous children had a complete resolution from oedema with average days of 4.9.

The mean (± SD) weight of severely malnourished children at admission was 6.8(±2.88) kilograms while at discharge was 7.41(± 2.89) kilograms respectively. After completing the intervention, children showed 8% and 5% weight and MUAC increase during discharge as compared with their admission Weight and MUAC respectively. The mean (± SD) of WHZ-score for recovered children was -0.97(±1.23).

Co-morbidities

The most common sign of infection at admission was fever (16%), followed by hypothermia (1.9%) and hypoglycaemia was also common complication as it was indicated from the interview. Severe acute malnutrition compromised the capacity of individual immunity to combat infection. The most common co-morbidities accompanied with SAM at admission were diarrhea (43.2%) and pneumonia (29%), HIV infection (6.2%) and TB (4%). Diarrhoea (73.6%) was found with a significant higher frequency in children with marasmus (wasted children). Among dehydrated children (42.9%), 72.9% was attributed due to diarrhoea. Dysentery accounts 4.3% of all admitted cases. Children with prolonged duration of diarrhoea (>2wks) were accounted 6.2% of all admitted children and 14.3% of children with diarrhoea (Table 1).

Provision of medications and therapeutic feeding

Management of admitted cases with severe acute malnutrition to TFU were managed in accordance with its national guidelines for treatment of SAM. Out of 324 children whose medication records were available for review, 91% received amoxicillin, 83.3% received vitamin A supplementation and 71.3% received folic acid. Zinc was not commonly prescribed but three cases (9%) with diarrhoea were taking it as indicated from the record. The most commonly used therapeutic products in the management process were F-75(formula 75 that contains 75 kilocalories in 100 milliliters, minerals and proteins), F-100 (formula 100 that contains 100 kilocalories in 100 milliliters) and RUTF particularly Plumpy'nut (Table 2).

Treatment outcomes

Among 324 admitted children with SAM, 275(85%), 21(6%), 15(5%) and 13(4%) cases were cured, died, defaulters and transferred out respectively. The proportions of exit indicators with 95% of confidence interval were 81.0%- 88.7% for recovery rate, 3.8%-9.2% for death rate, 2.3%- 7.0% for default rate and 1.8%-6.2% for transfer out rate.

The mean (± SD) weight gain for recovered wasted children
was 12.03 (± 8.62) g/kg/day while for those recovered oedematous children was 8.33 (± 5.26) g/kg/day. The average length of stay among recovered wasted children was 13 (±7.12) days and among recovered oedematous children was 14.4 (±7.7) days.

Factors associated with treatment outcome

Among variables entered to multivariable logistic regression, admission category of the child, HIV status and provision of Plumpy’nut were significant predictors of recovery and death rate. Admission category didn’t show statistical significance in binary logistic analyses but showed an association and statistical significance in the final model. Oedematous children were less likely (or the probability of recovery was reduced by 73% among oedematous children as compared to wasted children) to be cured than wasted children (AOR: 0.27; 95% CI: 0.10-0.79). The adjusted odds of recovered children who had given Plumpy’nut were 3.7 times the odds of recovered children who were not taking Plumpy’nut (AOR: 3.70; 95% CI: 1.22-11.23). Severely malnourished children co-morbid with HIV/AIDS were less likely to be cured as compared to not co-morbid with HIV/AIDS (AOR: 0.1; 95% CI: 0.03-0.423). HIV infection was a predominant factor that compromised recovery rate and increased mortality rate. Nevertheless, age of the child, pneumonia, anemia, heart failure, TB infection and provision of F-100 were showed association with recovery and death rate but the rest exit indicators were within the minimum standard set of the guideline for management of severe acute malnutrition (Table 3) [3]. Better achievements were observed in increasing cure rate and in reducing mortality rate as compared with similar studies in 20 TFCs of African countries (cure rate of 65% and death rate of 12%) [13].

Discussion

The review showed that the proportion of recovery and death rates in admitted under-five children were 85% and 6% respectively. Not only recovery rate and death rate but also the rest exit indicators were within the minimum standard set of the guideline for management of severe acute malnutrition (Table 3) [3]. Better achievements were observed in increasing cure rate and in reducing mortality rate as compared to similar studies in 20 TFCs of African countries (cure rate of 65% and death rate of 12%) [13].

However, cure rate was substantially smaller as compared to findings from southern part of Ethiopia (Wolaita (92%), kembata tembaro (92%) and Awassa (95%), West Hararge (88%) and Maradi-Niger (87.7%) and also the mortality rate was much higher in this study as compared to findings from southern part of Ethiopia (3.6%), west Hararge (88%) and Maradi-Niger (87.7%). This is may be due to the presence of high proportion of

| Treatments and feedings given | Frequency (n=324) | Percent |
|-------------------------------|------------------|---------|
| Amoxicillin                   |                  |         |
| Yes                           | 295              | 91.0    |
| No                            | 29               | 9.0     |
| Vitamin A                     |                  |         |
| Yes                           | 270              | 83.3    |
| No                            | 54               | 16.7    |
| Measles immunization          |                  |         |
| Yes                           | 133              | 41.1    |
| No                            | 86               | 26.5    |
| Not indicated                 | 105              | 32.4    |
| Antimalarial                  |                  |         |
| Yes                           | 11               | 3.4     |
| No                            | 271              | 83.6    |
| Not indicated                 | 105              | 32.4    |
| Folic acid                    |                  |         |
| Yes                           | 231              | 71.3    |
| No                            | 93               | 28.7    |
| Mebendazole                   |                  |         |
| Yes                           | 66               | 20.4    |
| No                            | 258              | 79.6    |
| Iron                          |                  |         |
| Yes                           | 153              | 47.2    |
| No                            | 171              | 52.8    |
| ORS/Resomal                   |                  |         |
| Yes                           | 143              | 44.1    |
| No                            | 181              | 55.9    |
| F-75                          |                  |         |
| Yes                           | 292              | 90.1    |
| No                            | 32               | 9.9     |
| F-100                         |                  |         |
| Yes                           | 315              | 97.2    |
| No                            | 9                | 2.8     |
| Plumpy’nut                    |                  |         |
| Yes                           | 161              | 49.7    |
| No                            | 163              | 50.3    |

Table 1: The percentage distribution of treatments and feedings given to <5 children with SAM admitted to TFU at Woldia general referral Hospital from September 2011 to December 2013.
chronic diseases like HIV, TB, heart failure and anemia compromised the rate of recovery and increased rate of death in the setting.

Another reason for reduced cure rate and increased death rate from the interview were having co-morbidities prior to the admission, development of cross infection during the stay, being critical at arrival, lack of regular and supportive supervision, lack of training for TFU staffs concerning on the guideline for the management of SAM and high staff workload during night affect the treatment outcome. These are the potential contributors that lead to inappropriate management and increased death rate.

One general practitioner strongly suggests that "deaths occurred due to the presence of HIV infection, heart failure, anemia and being critical at admission. One female BSc in nursing said that "Readmitted cases and critically ill cases at admission have less chance of recovery."

The finding were similar with qualitative studies in seven less developed countries, South Africa and Malawi found that inappropriate treatment due to inadequate knowledge and training, inadequate monitoring, high workload and combined with high prevalence of medical complication will compromised the quality of care [5,14-16].

As majority of the staffs said “there are gaps in handling of severely under-nourished cases appropriately due to lack of capacity building by providing adequate knowledge and lack of on-going training on the guideline for the management of SAM, and lack of supportive and regular supervision.”

In this study, wasted children are more likely to be cured as compared to children with oedema. The finding is in line with studies conducted in Malawi and Botswana which indicates that being oedematous is predictor for death [17,18]. But studies from Kenya, Pakistan and sub-Saharan Africa contradict the above finding and found that wasted (Marasmic) children are more likely to be died than oedematous (kwashiorkor) children [19,20]. The reasons for the current study probably, this is due to children with oedema are more prone to develop metabolic complication, fluid overload (heart failure) and will be died.

Among tested factors, being kwashiorkor, known HIV infection and provision of RUTF (Plumpy’nut) were negatively or positively affect treatment outcomes. Children with kwashiorkor and HIV infection were less likely to be cured and increase death rate where as children that were gained Plumpy’nut during their stay were almost four times more likely to be recovered. This was similar with study conducted in Pakistan; high prevalence of HIV infection leads to a persistent increased case mortality rate and provision of RUTF for non-oedematous cases improves rate of recovery [17,20].

In this study effort was made to find out the effect of adding or removing of defaulters and transferred out cases on the relationship between independent variables and the outcome variable through sensitivity analysis. Use of records could not allow including other factors such as education of parents, economic status of parents, distance from the Hospital and complete data on breast feeding. Therefore, readers are recommended to take this into account during interpretation of these findings.

There are few factors with a wide confidence interval observed in this study. In addition, there are also some variables that were not significantly associated with the outcome of interest which might affect the precision. Therefore, any interpretation of this finding should take into account the degree of precision.

Conclusion and Recommendation

The review revealed that recovery rate is remaining low as compared to similar studies in Ethiopia and death rate is also higher in the study. However, both recovery and death rates in the Hospital are above the cut of points of the minimum standard sets in humanitarian and disaster prevention (or the sphere standards), there should be a great effort to have a better achievement in increasing cure rate and in reducing death rate.

In this study being oedematous, HIV infection and provision of Plumpy’nut for non-oedematous children are the independent predictors of both recovery and death rate. Oedematous children were more likely to die as compared to wasted children. However provision of Plumpy’nut for non-oedematous children had a rapid recovery of children from severe under-nutrition. HIV infection highly affects the recovery rate among children with severe under-nutrition in the Hospital and responsible for 30% of child deaths. Essential nutrition action approach to address under-nutrition among HIV positive children should be applied effectively to reduce child mortality.

Moreover, effective implementation of the national guideline for the management of SAM through provision of adequate training, strong monitoring and evaluation, ensuring sustained resource follow and timely provision of routine medications will have crucial roles in reducing the high burden of comorbidities and establishing an appropriate management system in the Hospital. Thus , the aforementioned one alone could not ensure a sustained reduction in mortality rate and better enhancement of recovery rate, there should be integrated management of SAM via intersectoral collaboration beyond Health sector and awareness creation at the community level to prevent child under-nutrition through nutrition awareness creation at the community level to prevent child under-nutrition through nutrition education,

Recommendations Forwarded:

For woreda, Zone Health offices and education office

- Strongly monitor and uninterrupted follow of therapeutic foods particularly Plumpy’nut for non-oedematous children and F-75 for oedematous children since oedema was a predominant factor for child death.
- Programmed, on-going staff training, and regular and
supportive supervision should be needed for better improvement of recovery and death rates.

For regional Health bureau, federal ministry of Health and non-governmental sectors

- Especial attention from the Hospital, zone Health office and other organizations who are working on HIV and nutrition should be given for effective management of severely undernourished children comorbid with HIV/AIDS to reduce child mortality rate.
- Essential nutrition action approach for HIV positive children should be properly and effectively implemented for better achievement in recovery rate

For researchers

- Further qualitative studies should be conducted that includes both Health professionals and care givers so as to generate more and deep information.

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Computing Interest

The authors declare that they have no computing interest

Authors' Contributions

TC: Initiated the research, wrote the research proposal, conducted the research, did data entry and analysis and wrote the manuscript. LO: Involved in the write up of methodology of proposal and research work. EG: Contributed in the designing of methodology and write up of proposal. EA contributed in the designing of methods, write up and analysis of result.

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